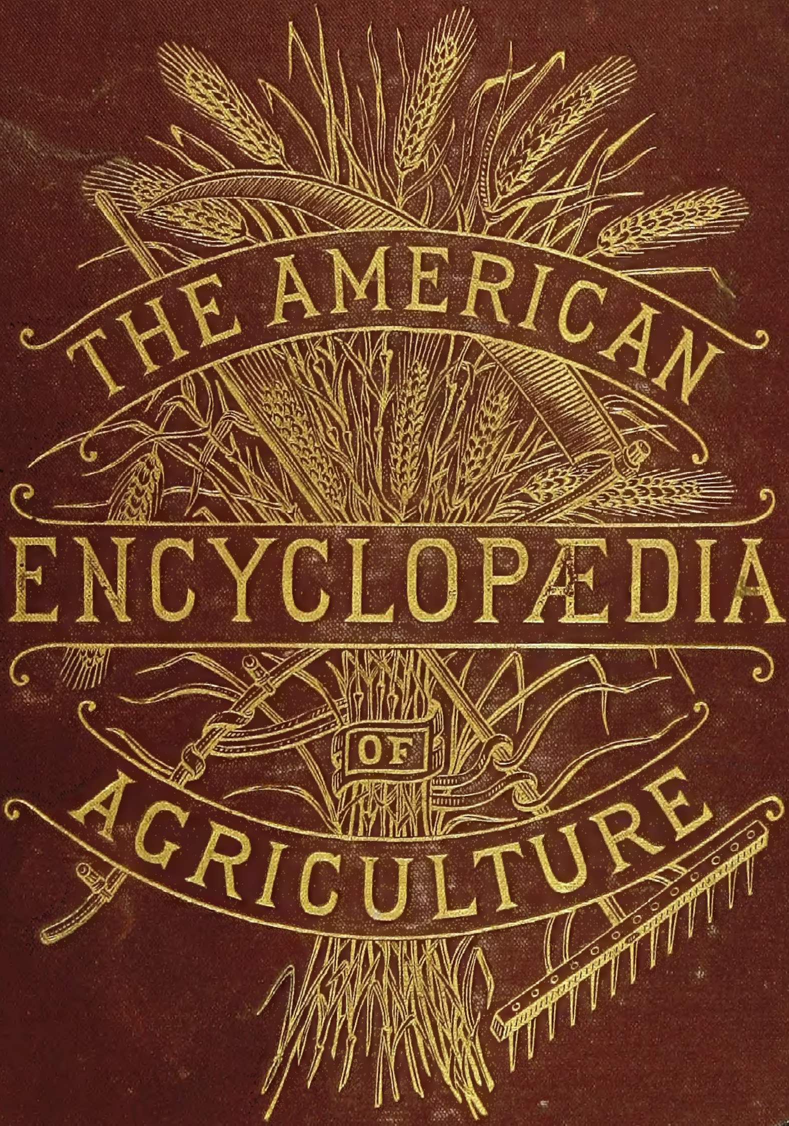

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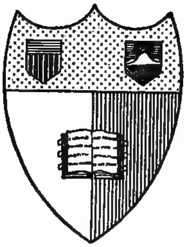

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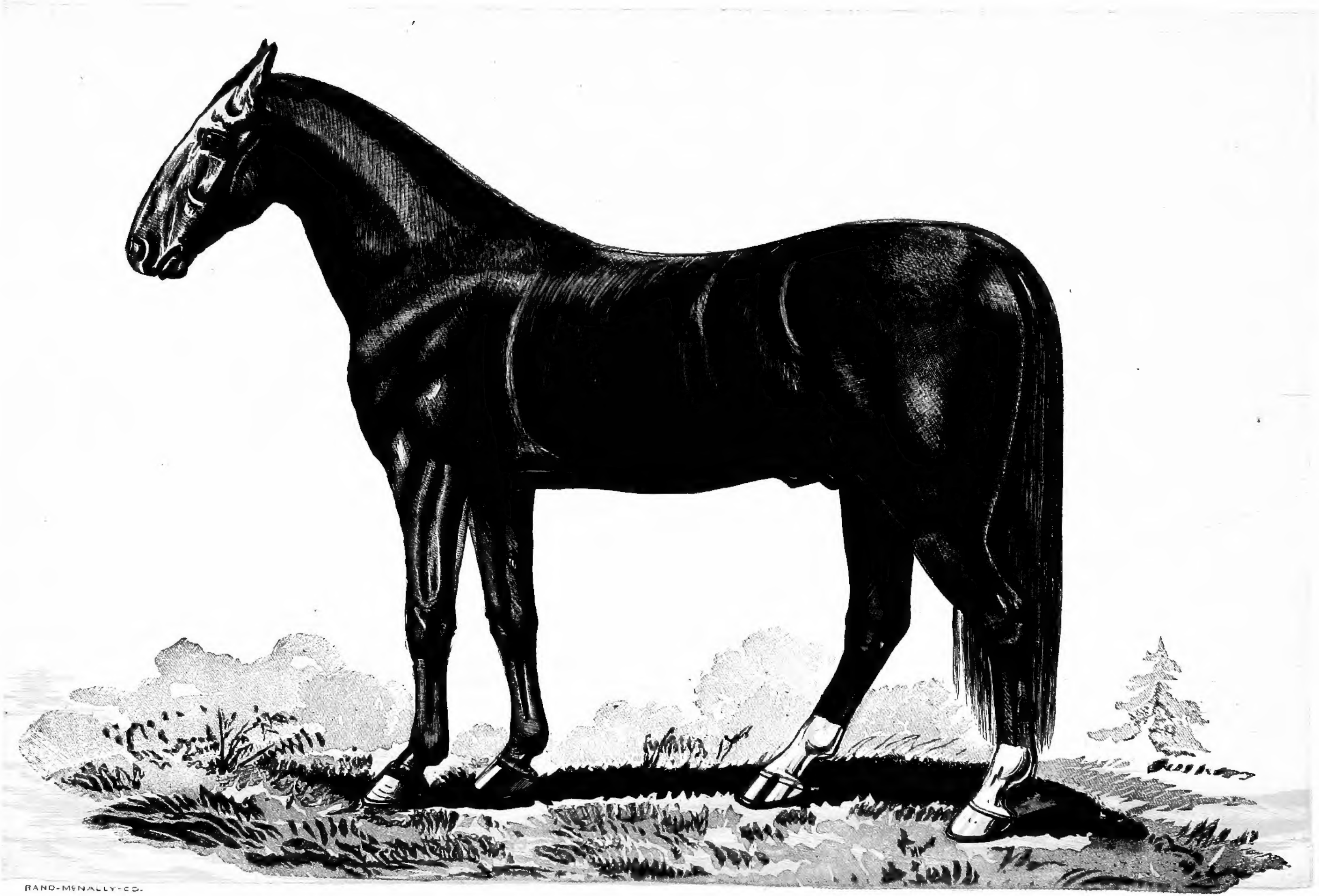

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THE AMERICAN

Encyclopædia of Agriculture:

A TREASURY OF USEFUL INFORMATION

FOR THE

FARM AND HOUSEHOLD.

EDITED BY HON. JONATHAN PERIAM,

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ENCYCLOPÆDIA OF AGRICULTURE:

A

TREASURY OF USEFUL INFORMATION.

ABATTOIR. A building erected especially for slaughtering animals intended for human food. Really a French term for a slaughter house, but understood in the United States, for those intended for slaughtering animals near large cities, to supply the daily consumption.

ABDOMEN. That region of the body of animals which contains the stomach, intestines, liver, spleen, pancreas, kidneys and bladder. In spiders it is the second division of the body; in insects the third division. In some species of insects the abdomen is covered with wings and, also, wing cases. The abdomen is divided into segments or rings, on the side of which are spiracles, by which the respiration of insects is carried on. In animals the abdomen is separated from the breast, internally by the diaphragm, and externally by the extremity of the ribs. In ichthyology, the abdominals are a class, or order of fishes, the ventral fins of which are placed behind the pectoral. These embrace the division of bony fishes. This class contains among others the flying fish, herring, mullet, pike and salmon.

ABNORMAL. Irregular or unusual; applied to deviations from the ordinary development of parts of animals or plants.

ABORTION. The casting of young before the natural time. In veterinary practice, aborting is the slipping, slinking, miscarriage or expulsion of the fœtus at so early a period as to render continued life impossible. The causes are numerous, principal among which are want of proper sustenance, undue feeding, sudden frights, accidents from falls and bruises, over exertion, and particularly, in large stables, the odor and diseased condition of animals which abort, so that often in stables where many cows are kept it will infect the entire herd. Of late years it has become one of the most serious disabilities in large dairy stables. The signs of approaching abortion are uneasiness, languor, restlessness, sudden filling of the udder, and often a bloody discharge. At the first symptoms the animals so affected should be immediately removed, and the whole stable completely disinfected. The preventives are regular care and feeding, and absolute cleanliness. One peculiarity of this disability is that animals, aborting once, are liable to a recurrence at about the same period, when again gravid. Great care is therefore necessary with such animals during the period when it may again be looked for. One superinducing cause of abortion in large dairies is thought to be degeneration from over service of the bull. Instances are recorded when abortion has ceased, upon a change to a mature, vigorous bull, who was restricted to one service a day during the coupling season; and it is a notable fact that in small dairies of not over a dozen cows, abortion is rare. Another prolific cause is, confined, hot stables where many cows are kept. The remedy here would be, as we have said, perfect cleanliness, and perfect ventilation as well. Many of the causes of abortion seem obscure, yet the following may be taken as being pretty well settled: The prevalence of abortion is not proportionate to the relative extent of butter and cheese production in the afflicted districts. It is not more prevalent among good milkers than among ordinary milkers. It is not more common in first pregnancies than in subsequent ones. It happens most frequently in the sixth, the seventh, or the eighth month of pregnancy, and in the month of December, January or February. In all probability it is not due to exposure to cold, or to insufficient stabling of any kind. It is not more prevalent among cows impregnated at the age of one year or eighteen months than among those impregnated at a later period. It is more frequent among cows which have been impregnated by two or three year old bulls than among those impregnated by yearling bulls. It is not due to inflammation of the uterus, nor to any marked change in the generative organs except a stoppage of the circulation and an arrest of development. It is probably not owing to any defect in the original form of the fœtus. Aborting cows are more liable to miscarry the following year than those which have never been affected. The early separation of the calf from the cow does not seem to have any injurious influence in producing subsequent abortions. Abortion is a disease which is extremely local in character, and confined for the most part to particular farms. The large majority of farms, even in the affected districts, are free from the disease, while upon a few farms the percentage of abortion is high, and the disease destructive in its effects. Farms affected, and those unaffected, often lie in close proximity, with no marked difference in physical situation, or in the treatment which the cattle receive, to account for the difference in the prevalence of abortion. It is probable that abortion is, in many instances, imported into the affected farm by cows, purchased while with calf, coming from infected districts, or even from localities where the disease is not known to exist. Abortion is caused by a number of natural causes: pampering with high feed in hot stables; smutty grain and hay is especially a predisposing cause; violent usage, as blows on the belly, slipping in the stall or on frozen ground; teasing by the bull; purging, or condiments, are also predisposing causes. It is, of late years, epidemic, or more probably endemic as confined generally to large stables, and, probably also generated there; and, once a cow is attacked, sympathy may cause it to spread; also if the animal be not removed, and the stable thoroughly fumigated, it may spread by means of the minute germs always given off in all cases of disorganization, and thus in extreme cases it may be carried to other stables; hence the necessity once it is found, that the greatest care be taken in isolating affected animals. Indeed it is better that a cow that has once aborted, be fattened and killed, since at the recurrence of the same period of carrying the young, the cow will again be liable to abort. To one who has inhaled the peculiar odor of a stable where there are aborting cows, it will at once be apparent that the utmost pains should be taken to thoroughly fumigate the stable, and also, where gravid cows are stabled, that the building be kept free from foul odors of every kind, since cattle are apparently more annoyed by these than any other of our farm animals. Thus, also, every person in buying cows, should receive a guarantee, if possible, that she has never aborted; even then she should be carefully watched for symptoms up to the seventh month of carrying the fœtus. The first symptoms are: The animal will lose appetite; the cow will partially or altogether cease to chew the cud; her milk will diminish; she will be listless and dull, inclined to lie down, and, upon being moved about, will show weakness, and perhaps will stagger. If she seems restless, refuses her food, or if she paws the ground, rests her head on the manger, and especially if there be a discharge of whitish glairy fluid from the vagina; if the belly seem less round, somewhat enlarged, or in any way altered in shape, remove her to other and distant quarters at once. As the symptoms progress, the animal shows more and more distress, she moans, and at length the pains of labor relieve her of the load, often in a putrid and even decomposed condition. Once certain that the fœtus is dead, delivery should be accomplished as quickly as possible. The water bag (the pouch in which the fœtus is contained), if not broken, should be so; then proceed to remove the afterbirth as directed in the article After-birth, using plenty of time and operating in the most gentle manner. Sprinkle the fœtus and all that comes away from the cow with carbolic acid or chloride of lime, or bury it deeply, covering it with quicklime, or sprinkle it with carbolic acid. The vagina of the cow should be cleansed, by being syringed with chloride of lime as directed in the article After-birth, the stable thoroughly cleansed, the animal carefully littered and tended, and when all foul odor has ceased from the vagina, the stable must be effectually fumigated. (See article Fumigation.) The cow having recovered, she should not be allowed to take the bull the same season, or at least for several months; and, in no case, with any cow, should a bull be allowed to serve, who is not in full vigor. There is no doubt the service of exhausted male animals is among the potent causes of abortion: hence the necessity that such males be vigorous. The treatment of the cow during recovery may be identical with that described in the article After-birth.

ABORTIVE. Deficient. A common term in botany, and signifying the absence of stamens or pistils, whereby fruit can not be produced; but also used to designate the partial or complete obliteration of any other organ, as the leaf, petals, carpels, etc.

ABSORBENTS. In veterinary practice medicines given internally to neutralize the action of acids found in the stomach or bowels. Prepared chalk, carbonate of soda, etc., are absorbents. Externally absorbents are agents applied for absorbing the moisture of galls, or to prevent friction between folds of the skin. Calamine, flour, starch and other agents of a drying nature, or those for drying up sores, blisters or grease, are absorbents. They are useful in all mild cases where the system has not become imbued with virus. In physiology absorbents are a class of vessels whose office it is to convey the product of digestion, the nutrition, into the circulation, to be deposited as flesh, fat, bone, and other necessary portions of the animal body, to build up the system and repair waste. They are divided into lacteals and lymphatics. The lacteals are situated in the cavity of the abdomen; their minute mouths, opening on the inner surface of the stomach and intestines, suck up the nutritious portion of the food eaten, and carry it to a canal emptying into the left jugular vein. The lymphatics, on the other hand, are distributed over every portion of the animal frame. They remove the residue of nutrition. When the supply of food is deficient, the lymphatics remove from those portions of the body such material as can be spared, to be converted into blood. They empty their contents into the same vein as the lacteals, and in their distribution through the body follow the course of the veins. In plant life the leaves are absorbents to a slight degree, but the true absorbents are the minute, sponge-like extremities of the roots (*Spongioles*), whose office it is to suck up the fluid nutrition of plants from the soil in which they are rooted.

ABSORBENT SOILS. Such soils in so fine a state of tilth or division that they will absorb moisture readily from the air. The sandy soils and loams are, in a natural state, good absorbent soils. (See Soils.)

ABSORPTION. The taking in or sucking up of fluids. The roots of a plant absorb the liquid food. In certain damp states of the atmosphere the leaves and green parts of plants absorb moisture to a certain degree. In animals absorption is carried on by the lacteals and lymphatics. The earth absorbs rain and dew. Charcoal, plaster, etc., absorb ammonia and other gases.

ABSTERGENTS. Medicines used for resolving tumors. They are usually stimulating.

ABUTMENT. The solid part of a pier from which an arch springs.

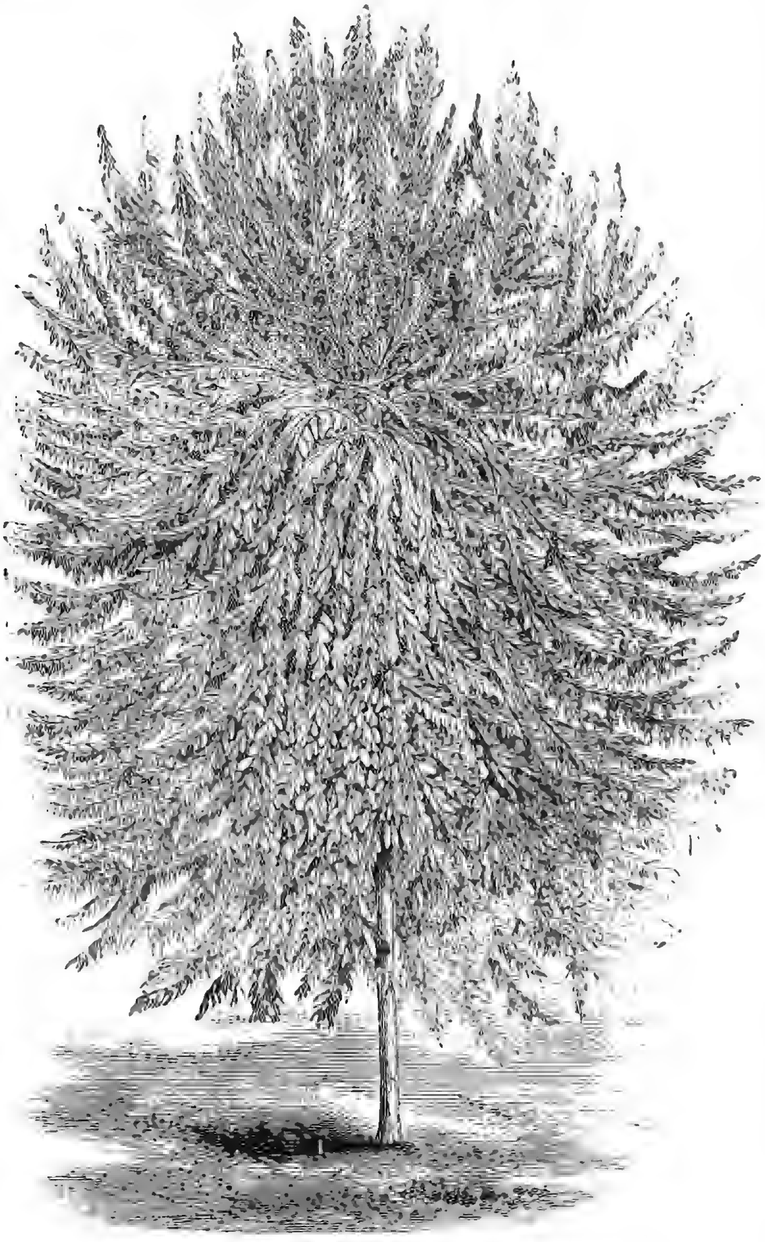
ACACIA. A class of spinous, leguminous trees, with small flowers collected in spikes and heads, many of them highly ornamental from the delicacy of their foliage. They are mostly natives of hot climates. The United States contains but few species, and these are insignificant. The locust, sometimes called acacia, is not so, but a robinia; one variety (*R. pseudacacia*) being well known as one of our most valuable timber-trees, where it escapes the ravages of the borer. The honey locust, sometimes called three-thorned acacia, *Gleditschia-triacanthos*, is somewhat closely allied to the true acacia, is very ornamental as a tree and useful for hedging. (See Locust, and Honey Locust.)

ACARI. The family of mites, to which belong the scab, the mange, the itch, and other insects infesting the skin of animals. These will be treated of under the appropriate names as they occur, as in itch, mange, etc.

ACCIPITRES. The order of birds to which belong eagles, hawks, and similar birds of prey.

ACCLIMATE. To cause an animal or plant to remain healthy and in sound condition in a climate different from its natural one. Plants can not be acclimated in climates essentially different from their native ones.

ACCLIMATION OF PLANTS. It is a generally received opinion that a plant removed from a warmer to a colder climate gradually becomes changed so that it will stand a lower temperature than in its native habitat. Such, however, is not the fact. Its zero, that is, the temperature at which it is killed, remains the same. The temperature at which a plant is destroyed, varies with each species. Indian corn, for instance, is certainly killed when the thermometer sinks to 32° Fahrenheit. The cucumber is killed at 40°; the egg-plant at 45°. Celery, on the other hand, will withstand a temperature of 20°, and cabbage 15° or less. Plants, however, are essentially modified by being removed to a climate more severe than is natural to them. They gradually become earlier in ripening. Thus we see corn and potatoes, two of the plants most widely distributed as to latitude, broken up into a great number of varieties, some of them remarkably early in ripening. A contributor in an extended article on the geography of plants, originally published in a report of the Department of Agriculture, holds the following language: We are apt to suppose that plants which grow in tropical countries must necessarily be tender, and adapted only to hot-house culture, not reflecting that they may have grown in very elevated and cold regions in those countries. Such is the case with many species introduced from Japan, Chili and Nepal, which appear to be hardy in England. Of the dahlia, the heliotrope, the potato, and Lima bean, it may be said long culture has done nothing to increase their hardiness. Sound views respecting the geography of plants would correct the prevailing errors regarding acclimation. The acclimatizing of plants, or, as it is supposed to be, inuring them to lower temperatures than those they have been accustomed to or have required in their native habitats, does not appear to be a possibility. It has been satisfactorily determined that a plant must receive the same amount of heat for the proper performance of certain processes necessary to the production of leaves, flowers and fruit, whether in places to which it is indigenous, or far removed therefrom in more northern latitudes. The definite degree which it has demanded during certain epochs of growth is still required wherever it may grow; but the aggregate of heat may be received during a shorter term in high latitudes because of the greatly increased length of the day, and the processes be hastened and maturity attained at an earlier date. This is well illustrated in the growth of maize or Indian corn, which is said to be remarkably accommodating, though it must have a semi-tropical heat wherever grown, if only for a few weeks, and this heat it obtains even beyond the northern limits of the United States. It is well known that the varieties of maize grown near the northern limit of its cultivation ripen earlier than those which are esteemed valuable further south. Man has applied to his purposes the property possessed by many plants of adapting themselves to the new conditions, and the many varieties of maize, wheat, etc., attest the possibility of change within certain limits. The principle above enunciated is, however, subject to some modifications as regards its application to certain physiological changes which have been observed to result from long-continued efforts to cultivate plants under unnatural conditions. Plants are, without doubt, capable of modification within certain limits. Witness the numberless varieties of grains and fruits, some of which appear to be more hardy than their progenitors. Many of these which appear to, or really do, thrive in more northern districts than those from which they were derived, have merely acquired a greater susceptibility to the influences of light and heat, and are thence aroused into earlier action, quickened in their vital functions, and mature under a lesser aggregate of heat as measured by the thermometer, though for the critical periods of their existence they demand the same mean temperature as the original from which they were derived. It is in the power of man to fix these peculiarities when observed, and in a measure to produce them by the selection of those which promise well, and continuing the selection with adequate care through several generations. Vilmorin, by skillfully applying the principles which influence plants in their tendencies to sport into new varieties and directing them into the desired channel, has almost created a new race of beets containing twice as much sugar as their ancestors, and promising to be readily perpetuated. Acclimating the tender plants of the tropics, and inuring them to the cold seasons of the north or temperate latitudes, is, therefore, impossible, though some minor modifications upon those of short growth during the periods of fervid heat of the northern summer have been made. The olive and the orange have not been rendered more hardy, and the peach appears to be still endowed with the same tenderness of bud it has always shown. The difficulties of acclimation may be illustrated by the fact that certain vegetable products can be grown in particular latitudes, while others, though they may attain considerable size, can not be grown with any useful result. For instance, in England the vine will never yield grapes capable of making wine even of a quality equal to champagne; nor will tobacco ever acquire that peculiar principle which gives it, in the estimation of many, so great a value when grown in some other countries, and yet both the vine and the tobacco plant flourish in the soil of England. The botanist and the meteorologist can explain why this is so, and thus prevent the commencement of speculations which must end in loss and disappointment. It is of great importance to be able to define accurately when a plant may be said to suit a particular climate. It is not enough that it live and send out leaves; it must be able to produce flowers and seeds and to elaborate the peculiar secretions and products on which its qualities depend. Indian hemp has grown in England, even, to the height of ten feet, with thick stems, vigorous leaves, and abundance of flowers, but it did not produce the resinous matter upon which its supposed value as a medicinal agent depends. The rhubarb of Turkey, which, as regards size and vigor of the plant, thrives well in England, does not produce a root of any medicinal value, or of the same quality as that grown in Chinese Tartary, from which, though known as Turkey rhubarb, it is derived. The leaves of the tea plant are harmless, or but slightly stimulating in certain latitudes, while they become narcotic and unwholesome in others. This fact can be explained by the study of the connection which exists between climate and vegetation — a question to be solved by the botanist and meteorologist. It is science only that can explain the failure of attempts to cultivate the tea plant in Madeira and in the Indian Archipelago, while a variety of the Chinese plant is now cultivated in the upper districts of India with great success. In the United States we have so wide a range of latitude and so fervent a summer sun that many tropical plants, which mature in a single season, may be most successfully raised by means of some forcing in the spring. Witness the cultivation of the tomato

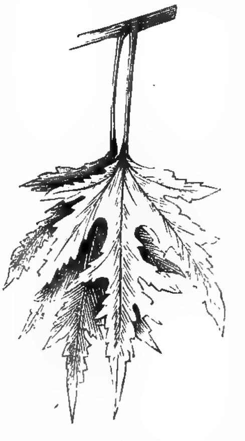


WIER'S CUT-LEAVED SILVER MAPLE.

and egg plant in high latitudes. These have been broken up into many varieties, some of which ripen earlier than others, yet they are certainly killed with the same degree of cold in one situation as they are in another, and there is no reason to suppose that these or other plants will ever become acclimated so as to resist a greater degree of cold than would suffice to kill them in their native country.

ACCOUNTS, FARM. (See Farm Accounts.)

ACER. The generic name of the maple family of trees. The flowers are polygamous, calyx colored, five lobed or parted — rarely four to twelve lobed; petals either none or as many as the lobes of the calyx; stamens four to twelve; ovary two celled, with a pair of ovules in each; styles two, long and slender; at the back of each ovary a wing is formed, the fruit being in pairs, and one-seeded, but which at length separates each keyed fruit by itself. The family contains both trees and shrubs, with apparently palmated-lobed leaves and small flowers. The species of value for planting are: The sugar or rock maple, *Acer saccharinum;* the black sugar maple, *A. nigrum;* the white or silver maple, *A. dasycarpum*, and the red or swamp maple, *A. rubrum*, of the American species, and the Norway maple, *A. platanoides*, a European species. There are now a number of ornamental species, some of which are beautiful. We give an illustration of one of the best, originated in Illinois and now widely planted east and west. It will serve as a type of the ornamental weeping species. The illustration of the leaves reduced will show the peculiar toothed notches of the leaves. The shrubs or small trees belonging to the maple family are the striped maple, or moosewood, *Acer Pennsylvanicum*, and the mountain maple, *A. spicatum. Negundo aceroides*, or the ash-leaved maple, or box elder as it is called in the west, is closely allied. It is a fast-growing and handsome tree when young, and attains a height of sixty feet. It will live fifty or sixty years, and soon forms a pleasant and dense shade; hence is much planted in the west. Its sap makes an excellent syrup, but no sugar. The flowers are diœcious, calyx minute, four to five cleft; petals, none; stamens, four to five. The leaflets are smoothish when old, very veiny, ovate, pointed, toothed; the seed smooth, with large rather in-curved wings, and should be gathered and planted as soon as ripe, which occurs early in summer. (See articles on the various species.)



LEAVES OF WIER'S CUT-LEAVED MAPLE (REDUCED).

ACETATES. Salts containing acetic acid. Sugar of lead is a combination of acetic acid and lead, hence called acetate of lead.

ACIDS. Generally sharp, sour substances, which redden litmus paper, and combine with metallic oxides or bases to form salts. All acids, however, are not sour to the taste, since all oily bodies contain one or more acids, and corn starch sugar is made by means of sulphuric acid. The inorganic acids are mineral ones. Those of interest in agriculture are, sulphuric, muriatic, silicic and phosphoric acids. Sulphuric acid is a component of gypsum, forming with the base sulphate of lime. Muriatic acid occurs in salt, as chloride of hydrogen, forming chloride of soda (common salt). Silicic acid occurs in quartz, or rock crystal (which forms so considerable a portion of the earth's surface, and so large a portion of many sands), and is essentially silicic acid, being a compound of oxygen with a base, forming silicon. Phosphoric acid is contained in the bones of animals and man, in combination with lime, being a salt of phosphoric acid. Phosphites, again, are salts of phosphorous acid, containing less oxygen than phosphoric acid. The highest degree of oxygenation is marked in chemistry by the termination *ic*, and the salt thus formed terminates in *ate*. Thus we have carbonate of lime from carbonic acid and a base. The termination *ous*, signifies a lower degree of oxygenation, and its compound terminates in *ite*. A still lower degree of oxygenation is termed *hypo*. Thus, in compounds of nitrogen we have nitric acid, nitrous acid, and hypo-nitrous acid; the last containing the least oxygen, and the first the most. The important vegetable acids are, nitric, acetic, carbonic, tannic, gallic, prussic, humic, oxalic, tartaric, benzoic, citric and malic acid. Nitric acid in a pure state is unknown ; the strongest contains one atom of acid to two of water, and, in this state, is extremely caustic, dissolving most metals. The pure acid would consist of one atom of nitrogen with five of oxygen. Acetic acid is formed in vinegar by the second fermentation of wine, cider or beer; the first being the vinous fermentation. Acetic acid is also a product of the combustion of wood, containing no resin, as in making charcoal, combined with empyreumatic oils. When freed from these, it is called pyroligneous acid. Acetic acid, in its most concentrated state, is extremely sour, acrid and pungent. The combinations of acetic acid with various bases are termed acetates; thus we have the acetate of lead, copper, iron and alumina. Carbonic acid is formed of one atom of carbon and two of oxygen. The air contains from four to six parts in 10,000. Soils containing vegetable matter give it off during decay. From carbonic acid plants obtain their supply of carbon in the shape of starch, sugar, vegetable fiber, etc. Carbonic acids in plants is decomposed in the light, and a part of its oxygen is thrown out by the leaves, thus giving this important element back to the air from whence it came. Tannic or gallic acid is a white astringent powder, with acid reaction. Tannin is the astringent principle of galls, sumac, catechu, oak, hemlock, and other barks. Their value for tanning is reckoned according to the quantity of tannic acid they contain. The following table, from Davy, shows the amount of tannic acid contained in various substances·

	Pounds.		Pounds.
Oak bark	29	Lombardy poplar.	15
Spanish chestnut . .	21	Birch	8
Leicester willow (large)	33	Hazel.	14
Elm	13	Blackthorn	16
Common willow (large) .	11	Coppice oak.	32
Ash	16	Inner rind of oak bark	72
Beach	10	Oak cut in autumn . .	21
Horse chestnut.	9	Larch cut in autumn. .	8
Sycamore	11		

Sicilian sumac contains about 78 parts in 480 parts. Nut galls 127 parts, and catechu 261 parts in 480. Prussic acid is a pellucid fluid of strong odor, and is contained in numerous plants of the rosaceous family, especially in the almond and peach, from the seeds and blossoms of which it is distilled. It is composed of one equivalent of cyanogen and one of hydrogen. It is one of the most deadly poisons known. Cyanogen is a gas which burns with a blue flame. With oxygen it forms cyanic acid. The gas is poisonous, and forms cyanides by combining with various metals. Humic acid contains carbon 64, hydrogen 4, and oxygen 32 parts in 100. By treating the humus of the soil (black humus) with carbonate of soda, by boiling a dilute solution of carbonate of soda and humus together, a dark brown liquid is obtained, which owes its color to the ulmate of soda contained. By repeating the process with the humus, and with fresh quantities of the liquid carbonate, the fluid at last remains clear. Ulmic acid has passed into the solution, and ulmin remains undissolved in the residue mixed with earth, sand, and the other component parts of the humus or peat. Humic acid may also be obtained by the action of strong hydrochloric acid, of sulphuric acid, and of alkalies upon sugar and other substances containing cellulose. Oxalic acid is found in its free state in the hairs of the chick pea (*cicer arietinum*). In combination with potash it is found in rhubarb, sorrels and docks, and in combination with lime in lichens. When pure, it is a very soluble crystalline, colorless, solid, intensely sour, and fatally poisonous. Benzoic acid gives aroma to many balsams, and sweet-scented grasses and other plants. Citric acid is the sour principle of cherries, cranberries, gooseberries, lemons and other fruits. Malic acid is the acid principle of apples, pears, plums, etc. Tartaric acid, combined with potash, is contained in the juice of the grape, in tamarinds, bilberries, etc. As food the acids are not of value. They are, however, grateful to most palates. They are cooling, and are said to furnish carbon in some degree in respiration.

ACORN. The fruit of the oaks, in common with other nuts, is called mast, and is much relied on in timbered countries as food for swine in autumn. The fruit of the live oak is sweet and edible, and is used as food by savages. In all ages savage tribes have used some species of acorns as food. The ancient Greeks and other savage nations so used them before their civilized era, as do the Indians of California at this day. The Indians pound the dry acorns into meal, leach the acridity out by laying the meal on a sand bed and pouring on water, heated with red-hot stones in water-tight baskets. It is then formed into a mass by taking up on the palm of the hand and washing off as much of the sand as will readily drop, then rolled in leaves and grass and baked in a hole in the ground covered by hot embers. The taste is horrible, even to a hungry man, and the smell of the compound, filthily prepared, such as no civilized sense can bear. Yet the Indians consider it nice and fatten on this food. Acorns are the food of quite a number of herb-eating animals, including the deer. The ancient Britons certainly ate them, and the Druids taught that everything produced on the oak, even the mistletoe, was of Divine origin. In the seventh century Ina, the Saxon king, made a law in relation to the fattening of swine on them in the forests. This law was called a pawnage or pannage. Turner, the earliest English writer who has written on acorns as food, says: "Oke, whose fruit we call *acorn*, or an *eycorn* (that is, the corn or fruit of an eyke), is hard of digestion, and nourish very much, but they make raw humores. Wherefore we forbid the use of them for meates." In relation to the superstition of the Divine origin of the oak, the Greeks believed it was the first created tree. The Persians and other Oriental nations held it to be of Divine origin, and the Jews held it in great reverence. This unity of sentiment among savages is undoubtedly due to the fact that its mast furnished food and its wood strong clubs for primitive warfare, and later, as civilization advanced, the value of its timber kept the tradition alive. Above we give cut showing an acorn in the process of germination Unlike the bean, the two halves of the seed do not form the first seed leaves, but these, nevertheless, serve to nourish the plumule, as the young shoots and leaves of a plant are called, the radicle being the young root.

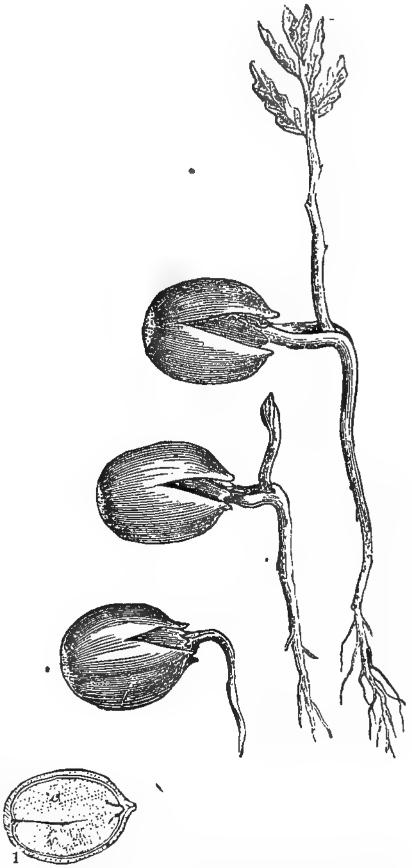


FIG 1. Acorn, seed of the oak, cut open, showing *c*, *c*, the cotyledons; *r*, the radicle, at the pointed end. Other figures show the progress of germination; *r*, radicle; *p*, plumule.

ACRE. A name common to all European languages, and derived from Oriental sources. We use it to designate a measure of land. The

English acre contains 160 square rods, 4,840 square yards, 43,560 square feet or 174,240 squares of six inches (thirty-six inches) each, or 6,272,640 square inches. The Irish acre is 7,840 square yards, and is equal to one acre, two roods and nineteen poles nearly, English measure. The Scotch acre contains 5,760 square Scotch ells, and is equal to one acre, one rood and two poles nearly, English measure. The French arpent or acre is equal to 51,690 square feet, English, or nearly one acre and three-quarters of a rood English. The Strasburg acre is about half an English acre. The word acre, agr, akora, and akkoran, respectively Hebrew, Syriac, and Arabic, denotes a field and a husbandman. The Saxon aecerman signifies a husbandman, and Wachter, in his Glossary, gives the word akerman as signifying a day laborer.

AERATION. That quality in soils which renders it porous and capable of taking up and holding air, is one of the indispensable qualities of all good soils, since such soils are readily aerated, or capable of receiving and holding air. Hence the quality of being aerated, or of imbibing air, also renders soils capable of readily taking and holding water and the gases, and if in parting with moisture they do not become too compact, they are called arable land—that is, capable of being plowed and cultivated in crops. (See Air and the Growth of Plants.)

AFTER-BIRTH, RETENTION OF. This distressing disability is not infrequent, and may be produced by a variety of causes—poor condition and hurried delivery being the most usual. It should never be left to putrefy, as too many indifferent masters allow. It is disgraceful, poisons the blood, and is a fertile means of abortion in other animals. If the after-birth does not come away during twelve hours after calving, hang a weight of about four pounds to the visible mass. If this do not bring relief in twenty-four hours more, introduce the hand carefully, and gradually peel it from the womb with the finger nail, having an assistant pulling constantly with a firm and steady but not strong pull. When brought away, syringe the vagina thoroughly with an ounce of chloride of lime in a quart of water. If there is considerable bleeding, give a full dose of ergot of rye—2 ounces—and if necessary, move the bowels with a light purgative—say 1 pound of glauber salts.

AFTERMATH. The second crop, or aftergrowth of grass and clover after being mowed for hay. The aftermath, in ordinary seasons, contains from one-third to two-thirds of the nutriment of the first crop, according to the variety of grass. It used to be the rule to carefully mow the aftermath, but of late years, and especially in the present, this has given place to pasturing the meadows at such times as they may not be punched by the hoofs of the stock. If properly cured, it makes the best of hay for calves and colts, and if the aftergrowth of grass is heavy it should be cut or fed off, since otherwise it will interfere with gathering the successive crops of hay.

AGAVE. The Mexican aloe. The juice yields pulque, and a good hemp is made from the leaves.

AGE OF ANIMALS. The age of domestic animals is most accurately known by their teeth, and by various indications that may assist proximately in determining age, as more or less gray hairs in horses, and the appearance of the eye. In all horned stock the eye and the rings or corrugations on the horns give some indication of age, and in swine the tusks also assist. The teeth, however, give the only true indication of the true age of animals. (See articles, Horse, Cattle, Sheep, Swine, etc.)

AGE OF PLANTS AND TREES. Plants are designated as, annual, those which die at the end of a season of growth; biennial, those which live two years, and perennial, those which live and grow from year to year. As a rule with plants as with animals, when young they are more succulent than when at full maturity. When in full vigor their vessels are filled with juices elaborated by the leaves, but as age increases their powers of assimilation grow less and less, until at length they die and decay. The age of trees may be determined with considerable certainty by cutting a cross section of the stem or trunk and counting the annular growths or rings. Yet in the case of very old trees much difficulty is experienced; so that here again, as with very old animals, the age can only be approximately ascertained. In animal life, the individual retains vigor for about three times the period required for it to attain maturity. Thus the sheep naturally lives about ten years, swine about the same, cattle fifteen years, and the horse eighteen to twenty years. Yet individuals, in exceptional cases, attain far greater ages, as we see in man, who should retain vigor until the age of sixty, and yet in some cases attains the age of more than 100 years. So horses sometimes attain the extreme age of forty years, but always lose vigor when beyond twenty years, and generally, through abuse, before the age of twelve years. To return to trees, the oak begins to lose extreme vigor of growth after about sixty years, the elm at fifty, the spruce at forty. Thus at these ages, or younger, it may be taken as being the most profitable time to cut such trees. Again, it has been said that the fastest growing trees are the shortest lived. This, however, is not true. The cottonwood, for instance, is an extremely fast-growing tree while young, and yet it is one of the monarchs of the western alluvial bottom lands, and lives to a great age. The locust, *pseud-acacia,* is a fast-growing tree, and its timber is one of the most lasting known. The age of historical trees is interesting. The oak at Langton Wood, England, was credited with being 1,000 years old. In England there are yew trees that are older than the time of King John, and the chestnut of Yarmouth is said to have been growing there in the time of William the Conqueror. There is a lime tree at Trons, in the Grisons, 600 years old. In the palace gardens in Grenada, Spain, were cypresses thought to be 900 years old. The deciduous at Chapultepec are over 5,000 years old. The Baobab trees of Africa are as old as this, and the giant red woods of California and some trees in Australia have been thought the oldest trees living, as they are the largest. Our American horticultural poet, Hempstead, thus chastely describes these sylvan monarchs of California:

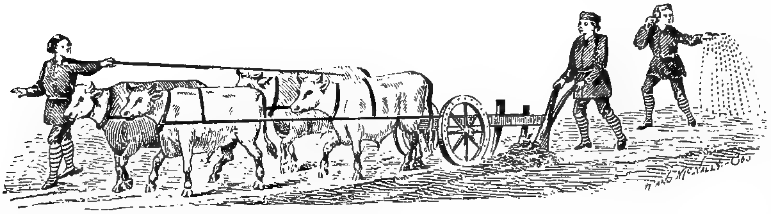
> They were green when in the rushes lay and moaned the Hebrew child;
> They were growing when the granite of the Pyramids were piled;
> Green when Punic hosts at Cannæ bound the victor's gory sheaves,
> And their grim and mangled bodies lay around like autumn leaves;

From their tops the crows were calling when the streets of Rome were grass,
And the brave Three Hundred with their bodies blocked the rocky pass;
In their boughs the owl was hooting when upon the Hill of Mars
Paul rung out the coming judgment, pointing upward to the stars;
Here, with loving hand transplanted, in the noonday breeze they wave,
And by night, in silent seas of silver, arrowed moonbeams lave.

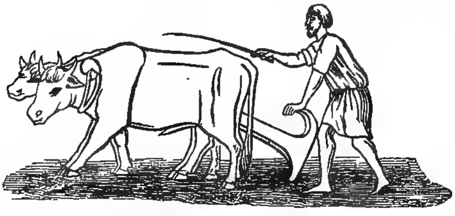
AGI, or AGY. Chilian pepper, *Capsicum baccatum.*

AGISTMENT. Payment for pasturage on another's lands.

AGRICULTURE. Agriculture, in some of its subdivisions, has engaged the attention of man from the earliest ages. Even the most savage tribes gather seeds and nuts for food, and soon learn to till the soil for the production of roots and grain in a crude way. Animals are at length caught and domesticated; from savageism man emerges into barbarism, and possesses flocks and herds. At length semi-civilization brings some of the crude arts, and civilization and enlightenment the higher arts and sciences. As showing the progress of agriculture in England in the fourteenth century, we give a cut reproduced from an old Saxon calendar, illustrating plowing and sowing between the centuries 1300 and 1400.

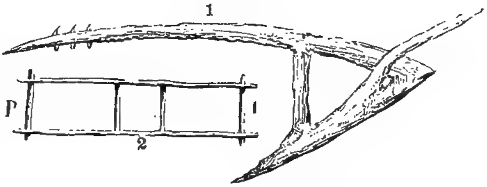


In its broad sense, agriculture embraces all that pertains to the working of the soil and obtaining sustenance and clothing therefrom, whether it be from the cereal grains, pasturage, hay, the herding, feeding and fattening of animals—all that relates to the making and applying of manures, the draining, and in fact to all which goes to increase the productive capacity of the soil. Agriculture is divided into two grand subdivisions: 1, That which relates to the farm proper; 2, that which relates to the forest, the orchard and garden. The first is called husbandry, the second horticulture.

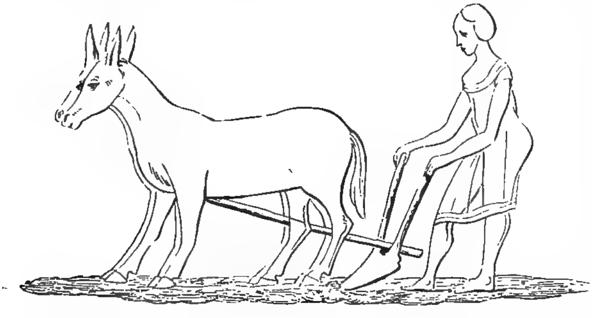


ANCIENT ROMAN PLOW AND PLOWMAN.

Husbandry, again, is divided into the cultivation of farm crops, as grain, grass, fiber and other useful special plants, stock breeding and feeding, and dairying. Of late years these subdivisions of husbandry have been more and more separated. Thus, large farms are used almost or quite exclusively for the cultivation of grain; great estates are devoted almost entirely to the grazing of cattle; other extensive farms are devoted to the breeding of animals; others, again, are employed exclusively in dairying; still another class have grown prominent within the last fifteen years, — feeders owning but little land, — who buy up cattle and hogs in the autumn, and buy corn in the field with which to fatten them. The grain farmer may not be a breeder or feeder of stock for market, except to a limited extent. He may employ his energies almost exclusively in grain, as is often done in the settlement of new countries. So the feeder will confine himself often almost entirely to pasturage and hay, depending upon buying much of his grain. The dairyman will also bend his best energies in the direction of pasturage and hay, raising perhaps comparatively little grain. The breeder, however, to be successful, must raise not only pasturage and hay, but also grain. This gives a succession of crops, and also enables an economical rotation to be carried out, thus not only keeping the fertility of the farm intact, but, under proper management, increasing its fertility from year to year. Thus, as a country becomes settled up, we see the more sagacious farmers combine all the arts of husbandry, to a greater or less extent, and with profit. Or, again, the principal industry to which the soil is adapted will be pursued to the fullest extent possible, and the other branches carried forward as far as practical experience shows them to be warranted. Horticulture, the second great division of agriculture, embraces pomology, or all that relates to the orchard; arboriculture, or that which pertains to the planting and care of trees, and the rearing and care of groves, forests and wind-breaks; vegetable gardening, or the cultivation of plants for culinary use; floriculture, or the cultivation and care of flowers in the garden, conservatory, green-house and hot-house; landscape gardening, or all that pertains to the ornamentation of the home, public and private parks and landed estates, in all enlightened countries, is one of the most important—the landscape gardener alone being obliged to deal with all the branches of horticulture. To return to ancient agriculture. Some years ago the editor, in preparing a work—The Groundswell—on agriculture and coöperative effort thereon, wrote upon ancient agriculture as follows: It is well known that, at some periods of ancient times, and in some countries, agriculture was held to be an honorable calling, and kings, princes and statesmen did not disdain to till the soil with their own hands. In ancient Egypt, where labored the men who reared the mighty pyramids, the priests and soldiers owned the lands—about six acres of the Delta of the Nile being allotted to each warrior. At war's alarm they sprang forth ready armed to fight for their estates and homes. In times of peace they grew and spun flax, and with the roots, herbs, wheat, and leguminous fruits which they raised, they supplied food for a large portion of the then known civilized earth. The Carthaginians considered agriculture to be of all callings the most aristocratic, and the kings, princes and nobles were among the most active cultivators of the soil. When the Romans finally subdued and laid waste the land, the only books which they deemed worthy of being carried away, it is said, were twenty-eight volumes of manuscripts relating to agriculture. The Chinese, who have bridges constructed 2,000 years ago, still consider agriculture so noble an art that a solemn ceremony is each year performed at which the emperor is required to turn the soil. This nation fed silk-worms before Solomon reared his temple. They built the great wall around the empire while Europe was yet wrapped in the gloom of the Dark Ages. They cultivated cotton centuries before the discovery of America. In many respects, their knowledge and practice concerning the careful tilling of the soil is to-day superior to ours, with all our boasted enlightenment. A tract of fifty square miles about Shanghai is called the Garden of China; and while we of the United States are lamenting our worn-out farms, and talking about emigrating to virgin lands, this people, for countless generations, have tilled the same soil, and under their management, it is to-day as productive as ever. Some of the States of ancient Greece esteemed agriculture as the mother of arts, and their agricultural products were exhibited at the Olympic games. With the Spartans, however, agriculture was contemned It was left to the Helots, their slaves, whom they thought fit only to cultivate the soil. It is not strange, therefore, that they should have been obliged to sup black broth (whatever that may have been). Nor is it strange that they took a distaste to their wretched fare, and finally rivaled even the Athenians in luxury, the laws of Lycurgus to the contrary notwithstanding. The earliest recorded history of agriculture is from inscriptions and hieroglyphics on the monuments and other works of stone that have come down to us. The following is a copy of one of the Egyptian plows, at a time very ancient but yet when civilization was very considerable. It is more than probable, however, that Egypt received the rudiments of her civilization from China, since the oldest of her inscriptions seem to point that way. An ancient monument in Asia Minor shows a plow and yoke, supposed to be the oldest known, made wholly of wood, the natural crooks of a tree. Fig. 1 shows the plow, and Fig. 2 the yoke, both the crudest imaginable. Yet at this day the Chinese, and indeed all the Oriental nations, where they have not come in direct contact with the civilization of Europe and America, still use the crudest forms imaginable. Of ancient agriculture one really knows but very little. From both sacred and profane history we know that Egypt was rich in grain. The paintings and inscriptions of ancient Egypt show that they had carried the cultivation of the soil to a high state of perfection. They understood the art of manuring, the value of rotation. Gardens, orchards, fish-ponds, and preserves of game were part and portion of ancient Egyptian villas. A steward directed the operations of the farm, superintending the laborers, and kept the accounts. Agriculture from the fall of Rome to the beginning of the present century has been summed up as follows: In the ages of anarchy and barbarism which succeeded the fall of the Roman empire, agriculture was almost wholly abandoned. Pasturage was preferred to tillage, because of the facility with which sheep, oxen, etc., could be driven away or concealed on the approach of an enemy. The conquest of England by the Normans contributed to the improvement of agriculture in Great Britain. Owing to that event, many thousands of husbandmen, from the fertile and well-cultivated plains of Flanders and Normandy, settled in Great Britain, obtained farms, and employed the same methods in cultivating them, which they had been accustomed to use in their native countries. Some of the Norman barons were great improvers of their lands, and were celebrated in history for their skill in agriculture The Norman clergy, and especially the monks, did still more in this way than the nobility. The monks of every monastery retained such of their lands as they could most conveniently take charge of, and these they cultivated with great care under their own inspection, and frequently with their own hands. The famous Thomas à Becket, after he was Archbishop of Canterbury, used to go out into the field with the monks of the monastery where he happened to reside, and join with them in reaping their corn and making their hay. The implements of agriculture at this period were similar to those in common use in more modern times. The various operations of husbandry, such as manuring, plowing, sowing, harrowing, reaping, threshing, winnowing, etc., are incidentally mentioned by the writers of those days, but it is impossible to collect from them a definite account of the manner in which those operations were performed. The first English treatise on husbandry was published in the reign of Henry VIII., by Sir A. Fitzherbert,



MOST ANCIENT PLOW AND YOKE (1,200 YEARS B. C.)



ANCIENT EGYPTIAN PLOWING.

Judge of the Common Pleas. It is entitled the Book of Husbandry, and contains directions for draining, clearing and inclosing a farm, for enriching the soil and rendering it fit for tillage. Lime, marl and fallowing are strongly recommended. The author of the Book of Husbandry, says Mr Loudon, writes from his own experience of more than forty years, and, if we except his biblical allusions, and some vestiges of the superstition of the Roman writers about the influences of the moon, there is very little of his work which should be omitted, and not a great deal that need be added, in so far as respects simple culture, in a manual of husbandry adapted to the present time. Agriculture attained some eminence during the reign of Elizabeth. The principal writers of that period were Tusser, Googe and Sir Hugh Platt. Tusser's Five Hundred Points of Husbandry was published in 1562, and conveys much useful instruction in metre. The treatise of Barnaby Googe, entitled Whole Art of Husbandry, was printed in 1558. Sir Hugh Platt's work was entitled Jewel Houses of Art and Nature, and was printed in 1594. In the former work, says Loudon, are many valuable hints on the progress of husbandry in the early part of the reign of Elizabeth. Among other curious things, he asserts that the Spanish or Merino sheep was originally derived from England From the Restoration down to the middle of the eighteenth century, agriculture remained almost stationary. Immediately after that period, considerable improvement in the process of culture was introduced by Jethro Tull, a gentleman of Berkshire, who began to drill wheat and other crops about the year 1701, and whose Horse-hoeing Husbandry was published in 1731. Though this writer's theories were in some respects erroneous, yet even his errors were of service, by exciting inquiry and calling the attention of husbandmen to important objects. His hostility to manures, and attempting in all cases to substitute additional tillage in their place, were prominent defects in his system. After the time of Tull's publication, no great alteration in British agriculture took place, till Robert Bakewell and others effected some important improvements in the breed of cattle, sheep and swine. By skillful selection at first, and constant care afterwards, to breed from the best animals, Bakewell at last obtained a variety of sheep, which, for early maturity and the property of returning a great quantity of mutton for the food which they consume, as well as for the small proportion which the weight of the offal bears to the four quarters, were without precedent. Culley, Cline, Lord Somerville, Sir J. S. Sebright, Darwin, Hunt, Hunter, Young; these have all contributed to the improvement of domestic animals, and have left little to be desired in that branch of rural economy. Among other works on agriculture, of distinguished merit, may be mentioned the Farmer's Letters, Tour in France, Annals of Agriculture, etc., by the celebrated Arthur Young; Marshall's numerous and excellent works, commencing with Minutes of Agriculture, published in 1787, and ending with his Review of the Agricultural Reports in 1816; Practical Agriculture, by Dr. R W. Dickson, and also the writings of Kames, Anderson and Sinclair exhibit a union of philosophical sagacity and patient experiment, which have produced results of great importance to the British nation and to the world. To these we need only add the name of John Loudon, F. L. S. H S., whose elaborate Encyclopædia of Gardening and Encyclopædia of Agriculture have probably never been surpassed by any similar works in any language. The establishment of a National Board of Agriculture was of very great service to British husbandry. Hartlib, a century before, and Lord Kames, in his Gentleman Farmer, had pointed out the utility of such an institution, but it was left to Sir John Sinclair to carry their ideas into execution. To the indefatigable exertions of that worthy and eminent man the British public are indebted for an institution whose services can not be too highly appreciated It made farmers, residing in different parts of the kingdom, acquainted with one another, and caused a rapid dissemination of knowledge amongst the whole profession. The art of agriculture was brought into fashion, old practices were amended, new ones introduced, and a degree of exertion called forth heretofore unexampled among the farmers of Great Britain. Of some of the more important ancient nations we find that the nomads of the patriarchal ages, like the Tartar, and perhaps some of the Moorish tribes of our own, whilst mainly dependent upon their flocks and herds, practised also agriculture proper. The vast tracts over which they roamed were in ordinary circumstances common to all shepherds alike. During the summer they frequented the mountainous districts, and retired to the valleys in the winter. Vast flocks of sheep and of goats constituted the chief wealth of the nomads, although they also possessed animals of the ox kind. When these last were possessed in abundance, it seems to be an indication that tillage was practised. We learn that Job, besides immense possessions in flocks and herds, had 500 yoke of oxen, which he employed in plowing, and a very great husbandry. Isaac, too, conjoined tillage with pastoral husbandry, and that with success, for we read that he sowed in the land Gerar, and reaped an hundred fold—a return which, it would appear, in some favored regions, occasionally rewarded the labor of the husbandman. Along with the Babylonians, Egyptians and Romans, the Israelites are classed as one of the great agricultural nations of antiquity. The sojourn of the Israelites in Egypt trained them for the more purely agricultural life that awaited them on their return to take possession of Canaan. Nearly the whole population were virtually husbandmen, and personally engaged in its pursuits. Upon their entrance into Canaan, they found the country occupied by a dense population possessed of walled cities and innumerable villages, masters of great accumulated wealth, and subsisting on the produce of their highly cultivated soil, which abounded with vineyards and olive-yards. It was so rich in grain that the invading army, numbering 601,730 able-bodied men, with their wives and children and a mixed multitude of camp-followers, found old corn in the land sufficient to maintain them from the day they passed the Jordan. The Mosaic Institute contained an agrarian law, based upon an equal division of the soil amongst adult males, a census of whom was taken just before their entrance into Canaan. This land, held in direct tenure from Jehovah, their Sovereign, was strictly inalienable. The accumulation of debt upon it was prevented by the prohibition of interest, the release of debts every seventh year, and the reversion of the land to the proprietor, or his heirs, at each return of the year of jubilee. The owners of these small farms cultivated them with much care, and rendered them highly productive. They were favored with a soil extremely fertile, and one which their skill and diligence kept in good condition. The stones were carefully cleared from the fields, which were also watered from canals and conduits communicating with the brooks and streams with which the country was well watered everywhere, and enriched by the application of manures. The seventh year's fallow prevented the exhaustion of the soil, which was further enriched by the burning of the mass of spontaneous growth of the Sabbatical year. The crops chiefly cultivated were wheat, millet, barley, beans and lentiles, to which it is supposed, on grounds not improbable, may be added rice and cotton. The ox and the ass were used for labor. The word "oxen," which occurs in our version of the Scriptures, as well as in the Septuagint and Vulgate, denotes the species rather than the sex. As the Hebrews did not mutilate any of their animals, bulls were in common use. The quantity of land plowed by a yoke of oxen in one day was called a yoke, or acre. The slopes of the hills were carefully terraced and irrigated wherever practicable, and on these slopes the vine and olive were cultivated with great success. At the same time the hill districts and neighboring deserts afforded pasturage for numerous flocks and herds, and thus admitted of the benefits of a mixed husbandry. With such political and social arrangements, and under the peculiar felicitous climate of Judea, the country as a whole, and at the more prosperous periods of the commonwealth, must have exhibited such an example of high cultivation, rich and varied produce, and wide-spread plenty and contentment as the world has seldom elsewhere produced on an equally extensive scale. The unrivaled literature of Greece affords us little information regarding the practical details of her husbandry. The people who, by what remains to us of their poetry, philosophy, history, and fine arts, still exert such an influence in guiding our intellectual efforts, in regulating taste, and in molding our institutions, were originally the invaders and conquerors of the territory which they have rendered so famous. Having reduced the aboriginal tribes to bondage, they imposed upon them the labor of cultivating the soil, and hence both the occupation and those engaged in it were regarded contemptuously by the dominant race, who addicted themselves to what they regarded as nobler pursuits. With the exceptions of certain districts, such as Bœotia, the country was naturally unfavorable to agriculture. When we find, however, that valleys were freed from lakes and morasses by drainage; that rocky surfaces were sometimes covered with transportable soil, and that they possessed excellent breeds of the domesticated animals, which were reared in vast numbers, we infer that agriculture was better understood and more carefully practised than the allusions to it in their literature would seem to warrant. Amongst the ancient Romans agriculture was highly esteemed, and pursued with earnest love and devoted attention. In all their foreign enterprises, even in earliest times, as Schlegel remarks, they were exceedingly covetous of gain, or rather of land; for it was in land, and in the produce of the soil, that their principal and almost only wealth consisted. They were a thoroughly agricultural people, and it was only at a later period that commerce, trades, and arts were introduced among them, and even then they occupied but a subordinate place. Their passion for agriculture survived very long; and when at length their boundless conquest introduced an unheard of luxury and corruption of morals, the noblest minds amongst them were strongly attracted towards the ancient virtues of the purer and simpler agricultural times. Several facts in Roman history afford convincing proof, if it were required, of the devotion of this ancient people to agriculture in their best and happiest times. Whilst their arts and sciences and general literature were borrowed from the Greeks, they created an original literature of their own, of which rural affairs formed the substance and inspiration. Schlegel and Mr. Hoskyn noticed, also, the striking fact that, whilst among the Greeks the names of their illustrious families are borrowed from the heroes and gods of their mythology, the most famous houses amongst the ancient Romans, such as the Pisones, Fabii, Lentuli, etc., have taken their names from their favorite crops and vegetables. Perhaps it is not much to assert that many of those qualities that fitted them for conquering the world and perfecting their so celebrated jurisprudence, were acquired, or at all events nourished and matured, by the skill, foresight, and persevering industry so needful for the intelligent and successful cultivation of the soil. The words which Cicero puts into the mouth of Cato give a fine picture of the ancient Roman enthusiasm in agriculture: I come now to the pleasures of husbandry in which I vastly delight. They are not interrupted by old age, and they seem to me to be pursuits in which a wise man's life should be spent. The earth does not rebel against authority; it never gives back but with usury what it receives. The gains of husbandry are not what exclusively commend it. I am charmed with the nature and productive virtues of the soil. Can those old men be called unhappy who delight in the cultivation of the soil? In my opinion there can be no happier life, not only because the tillage of the earth is salutary to all, but from the pleasures it yields. The whole establishment of a good and assiduous husbandman is stored with wealth; it abounds in pigs, in kids, in lambs, in poultry, in milk, in cheese, in honey. Nothing can be more profitable, nothing more beautiful, than a well-cultivated farm. In ancient Rome each citizen received, at first, an allotment of about two English acres. After the expulsion of the kings, this allotment was increased to about six acres. These small inheritances must, of course, have been cultivated by hard labor. On the increase of the Roman territory the allotment was increased to fifty, and afterwards even to 500 acres. Many glimpses into their methods of cultivation are found in those works of the Roman authors which have survived the ravages of time. Cato speaks of irrigation, frequent tillage and manuring, as means of fertilizing the soil. Mr. Hoskyn, and others from whose contribution to the History of Agriculture we have drawn freely in this historical summary, quotes the following interesting passage from Pliny, commenting on Virgil: Our poet is of opinion that alternate fallows should be made, and that the land should rest entirely every second year. And this is, indeed, both true and profitable, provided a man has land enough to give the soil this repose. But how, if his extent be not sufficient? Let him, in that case, help himself thus: Let him sow next year's wheat-crop on the field where he has just gathered his beans, vetches, or lupines, or such other crop as enriches the ground. For, indeed, it is worth notice that some crops are sown for no other purpose but as for good for others; a poor practice, in my estimation. In another place he tells us: Wheat, the later it is reaped, the better it casts; but the sooner it is reaped, the fairer the sample. The best rule is to cut it down before the grain is got hard, when the ear begins to have a reddish-brown appearance. Better two days too soon than as many too late, is a good old maxim, and might pass for an oracle. The following quotation from the same author is excellent· Cato would have this point especially to be considered, that the soil of a farm be good and fertile; also, that near it there be plenty of laborers, and that it be not far from a large town; moreover, that it have sufficient means for transporting its produce, either by water or land: and, also, that the house be well built, and the land about it as well managed. But I observe a great error and self-deception which many men commit, who hold opinion that the negligences and ill-husbandry of the former owner is good for his success or after-purchaser. Now, I say, there is nothing more dangerous and disadvantageous to the buyer than land so left waste and out of heart; and therefore Cato counsels well to purchase land of one who has managed it well, and not rashly and hand-over-head to despise and make light of the skill and knowledge of another. He says, too, that as well land as men, which are of great charge and expense, how gainful soever they may seem to be, yield little profit in the end, when all reckonings are made. The same Cato, being asked, what was the most assured profit rising out of land? made this answer: To feed stock well. Being asked again, what was the next? he answered: To feed with moderation. By which answer he would seem to conclude that the most certain and sure revenue was a low cost of production. To the same point is to be referred another speech of his· That a good husbandman ought to be a seller rather than a buyer; also, that a man should stock his ground early and well, but take long time and leisure before he be a builder; for it is the best thing in the world, according to the proverb, to make use, and derive profit, from other men's follies. Still when there is a good and convenient house on the farm, the master will be closer occupied, and take the more pleasure in it; and truly it is a good saying, that the master's eye is better than his heel. In relation to the improvement of agriculture in Great Britain during the last century, it is undoubtedly true that this country is more indebted to Lord Bacon than to any of his contemporaries for the impetus which agriculture received in his day. This great philosopher taught men, by the inductive method, to inquire into and to discover by experiment, step by step, through the great alphabet of nature — soils, gases, elements, etc. — the true relation which each bears to each. If all the votaries of agriculture had followed this great man's teachings we should have heard less of that myth—the Science of Agriculture. It might more truly be called the sum of all sciences, since, though it is made up of something of all sciences, nevertheless, it will never, in the nature of things, become in itself a true science. Early in the eighteenth century, Jethro Tull, one of the earliest and one of the best writers on agriculture that England ever had, did much, through the record of his experiments in new and improved modes of culture to advance the customary system of tillage, and to reduce it to rule. Tull was the father of drill husbandry, and the inventor of the horse-shoe. He also invented, but failed to perfect, the threshing-machine, leaving the final triumph in this direction for American genius to achieve, more than a century later Arthur Young is also justly celebrated for his labors in behalf of agriculture. He traveled extensively over Europe, to observe the various methods of tillage which prevailed, and is said to have edited nearly one hundred volumes relating to the profession. In Scotland, Lord Kames, and still more, Sir John Sinclair, were earnest and persevering patrons of agriculture. To the latter gentleman, Scotland is indebted for a complete agricultural survey of the country, with statistical accounts relating to it. The publication of the fruits of his labors had the important result, among others, of leading to the establishment of the Board of Agriculture, in 1793, by Mr. Pitt. Sir Humphrey Davy was another benefactor of husbandry, deserving prominent mention. It was the result of his experiments which led to the establishment of Agricultural Chemistry as a recognized branch of modern science; and this is truly the corner-stone of agriculture. Recognizing a plant as a living thing, he held that the laws of their existence must be studied in order to develop the most perfect growth. By experiments, and in his lectures, he demonstrated that plants derive their component parts either from the atmosphere by which they are surrounded, or from the soil in which they grow. These elements being principally carbon, nitrogen, oxygen and hydrogen; he showed by analysis of soils and plants the relative nature of each, and the conditions necessary to best furnish the elements for growth, and proved that the process of vegetation depends upon their constant assimilation by the organs of plants, by means of moisture, light and heat. Coming to American agriculture, what a change has been wrought in the last forty years. Indeed, from the dark ages until the beginning of the nineteenth century there was no great and general advance in agriculture. At the close of the seventeenth century, England, then just beginning to obtain the mastery of the seas, had but one-half the area of that country in arable and pasture lands, the remainder being moor, forest and fen. As late as the beginning of the nineteenth century much of the land in England either remained in forest or else was exhausted of its fertility. But all this is changed, and now, as Macaulay remarks, a hundred acres, which under the old system, produced annually, as food for cattle and manures, not more than forty tons, under improved culture yields the vast increase of 577 tons. At the close of the seventeenth century, America was only just beginning to be settled by colonies, widely separated along the Atlantic coast. The interior was one unbroken primeval forest, until the great prairie region of the West was reached, which, after passing west of the Mississippi river, gradually merged itself into what is now known as the great plains, east of the Rocky mountains. All this great country was then, and continued to be until long after the revolutionary war, inhabited by wild Indians, more savage and cruel than the wild beasts. But the fertile soil and the great diversity of climate and its great natural water systems, soon attracted emigration from all parts of the civilized world. They have continued to flock in from year to year, until now they have occupied much of the available land—in connection with our own hardy pioneers—from the Atlantic to the Pacific. It is true that many large and fertile tracts are yet remaining, but a very few years more will find these all settled. Of the agriculture of the early part of the present century we find the agricultural implements and farming operations of the United States, in most particulars, were very similar to those of Great Britain. Circumstances, however, required variations, which the sagacity of the American cultivator caused him to adopt, often in contradiction to the opinions of those who understand the science better than the practice of husbandry. In Europe, land was dear and labor cheap ; in the United States, the reverse was the case. The European cultivator was led, by a regard to his own interest, to endeavor to make the most of his land ; the American cultivator has the same inducement to make the most of his labor. Perhaps, however, this principle, in America, was generally carried to an unprofitable extreme, and the farmers might have derived more benefit from their land, if they had to limit their operations to such parts of their possessions as they could afford to till thoroughly and manure abundantly. A man may possess a large landed estate, without being called on by good husbandry to hack and scratch over the whole, as evidence of his title. He may cultivate well those parts which are naturally most fertile, and suffer the rest to remain wild, or, having cleared a part, lay it down to permanent pasture, which will yield him an annual profit, without requiring much labor. The climate and soil of the United States are adapted to the cultivation of Indian corn, which the climate of Great Britain is not. This entirely and very advantageously supersedes the field culture of the horse-bean, one of the most common fallow crops in that island. Root husbandry, or the raising of roots for the purpose of feeding cattle, is likewise of less importance in the United States than in Great Britain. The winters are so severe in the northern section of the Union, that turnips can rarely be fed on the ground, and all sorts of roots are with more difficulty preserved and dealt out to stock, in this country, than in those which possess a milder climate. Besides, hay is more easily made from grass in the United States than in Great Britain, owing to the season for hay-making being generally more dry, and the sun more powerful. There are many other circumstances which favor the American farmer, and render his situation more eligible than that of the European. He is generally the owner as well as the occupier of the soil which he cultivates ; is not burthened with tithes; his taxes are light, and the product of his labors will command more of the necessaries, comforts and innocent luxuries of life. In the early part of the century, a periodical publication, the American Farmer, was established at Baltimore, and still another, the New England Farmer, in Boston. Men of talent, wealth and enterprise have distinguished themselves by their laborious and liberal efforts for the improvement of American husbandry. Merino sheep were imported, as well as the most celebrated breeds of British cattle, and there prevailed a general disposition among all men of intelligence and high standing in the community, to promote the prosperity of American agriculture. We shall conclude with a few brief notices of prominent benefits and improvements which modern science has contributed to American agriculture in the early part of the century, which will not be uninteresting. The husbandmen of antiquity, as well as those of the middle ages, were destitute of many advantages enjoyed by the modern cultivator. Neither the practical nor the theoretical agriculturists of those periods had any correct knowledge of geology, mineralogy, chemistry, botany, vegetable physiology or natural philosophy; but these sciences have given the modern husbandman the command of important agents, elements and principles, of which the ancients had no idea. The precepts of their writers were comformable to their experience ; but the rationale of the practices they prescribed they could not, and rarely attempted to, explain. Nature's most simple modes of operation were to them inexplicable, and their ignorance of causes often led to erroneous calculations with regard to effects. We are indebted to modern science for the following, among other improvements: A correct knowledge of the nature and properties of manures — mineral, animal and vegetable; the best modes of applying them, and the particular crops for which particular sorts of manures are best suited. The method of using all manures of animal and vegetable origin while fresh, before the sun, air and rain, or other moisture has robbed them of their most valuable properties. It was formerly the practice to place barn-yard manure in layers or masses for the purpose of rotting, and turning it over frequently with the plow or spade, till the whole had become destitute of almost all its original fertilizing substances, and deteriorated in quality almost as much as it was reduced in quantity. The knowledge and means of chemically analyzing soils by which we can ascertain their constituent parts, and thus learn what substances are wanted to increase their fertility. The introduction in England of root husbandry, the raising of turnips, mangel-wurzel, etc., extensively, by field husbandry, for feeding cattle, by which a given quantity of land may be made to produce much more nutritive matter than if it were occupied by grain or grass crops, and the health as well as the thriving of the animals in the winter season greatly promoted. Laying down lands to grass, either for pasture or mowing, with a greater variety of grasses, and with kinds adapted to a greater variety of soils; such as orchard-grass for dry land; foul meadow-grass for very wet land; timothy or herds'-grass for stiff, clayey soils, etc. The substitution of fallow crops (or such crops as require cultivation and stirring of the ground while the plants are growing) in the place of naked fallows, in which the land is allowed to remain without yielding any profitable product in order to renew its fertility. Fields may be so foul with weeds as to require a fallow, but not what is too often understood by that term in this country. In England, when a farmer was compelled to fallow a field, he let the weeds grow into blossom and then turned them down; in America, a fallow meant a field where the produce is a crop of weeds running to seed, instead of a crop of grain. Again, the art of breeding the best animals and the best vegetables, by a judicious selection of individuals to propagate from. These improvements, with others too numerous to be here specified, have rendered the agriculture of the early part of the century very different from that of the middle ages when it had sunk far below the degree of perfection which it had reached among the Romans. In relation to the difficulties experienced in advancing agricultural art in the United States, it is well known that the earliest settlers found the country a wilderness, with many varieties of climate and soil, of which they were entirely ignorant, and to which the knowledge they had obtained in the mother country did not apply. Thus, they had to contend with the innumerable obstacles, such as the wilderness of nature, their ignorance of the climate, the hostility of the Indians, the depredations of wild beasts, the difficulty and expense of procuring seeds, farming implements and superior stock. These various difficulties are quite sufficient to explain the slow progress they made in the way of improvement. For many years agriculture was in an exceedingly backward and depressed condition. Stocks and tools were poor, and there were obstacles and prejudices against any innovations in the established routine of practice. This state of things continued for many years with very little change. Jared Eliot, a clergyman of Connecticut, one of the earliest agricultural writers of America, published the first of a series of valuable essays on Field Husbandry, in 1747, but with this and a few other exceptions, no real efforts were made to improve farming until after the revolution, when the more settled state of the country and the gradual increase of population, began to impress the intrinsic importance of the subject upon the minds of a few enlightened men. They sought by associated effort to awaken an interest in the subject, and spread abroad valuable information. The South Carolina Agricultural Society was established in 1784, and still exists, and the Philadelphia Society for the Improvement of Agriculture, established in the same year, and a similar association in New York in 1791, incorporated in 1798, and the Massachusetts Society for the Promotion of Agriculture, established in 1792, were active in their field of labor, and all accomplished important results. The correspondence at this period between Sir John Sinclair and Washington, shows how anxious was the father of his country to promote the highest interests of the people by the improvement of agriculture. But all the efforts of the learned, and all the investigations of the scientific, prove comparatively unavailing, unless the people themselves—the actual workers of the soil—are prepared to receive and profit by their teachings. Many years elapsed before the habit of reading became sufficiently common among the masses of the actual tillers of the soil, to justify an expectation that any profit would arise from the annual publication of the transactions of the several societies. The improvements proposed fell dead upon the people, who rejected book farming as impertinent and useless, and knew as little of the chemistry of agriculture as of the problems of astronomy. Such has been the increase of intelligence and the growth of liberal ideas among all classes of men during the last half century, both in this country and Great Britain, that we, at this distance of time, can with difficulty realize the extent of the prejudices which blinded the eyes of the people of those days. The farmer who ventured to make experiments, to strike out new paths of practice, or to adopt new modes of culture, subjected himself to the ridicule of a whole neighborhood. For many years, therefore, the same routine of farm labor had been pursued in the older settlements, the son planting just as many acres of corn as his father did, in the old of the moon, using the same number of oxen to plow, and getting in his crops on the same day, after having hoed them the same number of times as his father and grandfather. So all farm practices were merely traditional; no country or town agricultural societies existed to stimulate careful effort through competition. There were no journals devoted to the spread of agricultural knowledge, and the mental energies of the farmer lay dormant. The stock of the farm was such as one might expect to find under such circumstances; the sheep were small, and ill cared for in the winter, and the size of cattle generally was but little more than half the average of the present time. The value of manures was little regarded; the rotation of crops was scarcely thought of; the introduction even, of new and labor-saving machinery, was sternly resisted and ridiculed by the American farmers of that day as well as by the English laborers. It was long before the horse-rake was brought into use in opposition to the prejudices it encountered. It was equally long before the horse-power threshing-machine was adopted In some parishes of Great Britain, even so late as 1830, the laborers actually went about destroying every machine they could find. Now, on the contrary, the use of the flail is a drudgery to which very few are willing to submit, and steam-power has in many instances been substituted for the horse, while new and improved implements of all kinds are sought to an extent unprecedented in the history of agriculture. Changes are gradually made every where, and the success which attends the introduction of new implements disarms prejudice. Within the last half century, chemistry, the indispensable hand-maid of agriculture, has grown with great rapidity, and in each new discovery some new truth applicable to practical agriculture has come to light, while willing experimenters have labored in the field to prove the truth or falsity of the theories proposed, and thus the well established facts from which the science of agriculture is derived, and the sound theories deduced from these facts, are constantly increasing in number. The substitution of animal for manual power, and yet more, the saving of animal power by the substitution of natural and mechanical forces, are the surest indications of improvement. From the changes which have grown up in these respects, and from the more constant use of chemical analysis to determine the qualities of soils and manures within the last fifty years, we may safely assert that the progress made during that period, or within the last twenty years, is wholly unparalleled. To come down now to our own day, in comparing our husbandry, with European, we find that in all the older settled portions of the United States, the processes of agriculture will now compare favorably with those of any country on the globe, in the perfect adaptation of means to the end. The American farmer does not raise so great an average crop per acre as the English or the Belgian or the Holland farmer; the reason of this lies in the cheapness of the land, rendering it easier to work a larger area somewhat superficially, than to put a considerable expense on a smaller one. The fact that the conformation of the land, especially in the West, admits of working almost entirely by the use of machinery, is the reason that a large area per capita may be economically cultivated. It is this that has made the West to teem with abundant crops of Indian corn and the other cereal grains; that has enabled her farmers to produce the immense herds of cattle, droves of swine, and flocks of sheep. It has made this magnificent agricultural region to teem with every crop that may be produced in a temperate climate, and before which the productions of ancient Egypt, so much vaunted, sinks into utter insignificance. It has indeed made the West the granary of the world. To show something of this we give a statement showing our agricultural exports up to 1875, in periods of five years, extending back over fifty years, the figures being the average per annum for each period. These exports are divided into five classes: animals and their products, breadstuffs, cotton (including its manufactures), wood, and miscellaneous products. Necessarily the extension of raw materials, as manufactured meat-products, lumber, vegetable oils, must be considered, and the direct manufacture of a single and uncombined product of the farm, to render it available for exportation, was deemed for this purpose an agricultural product:

Periods.	Animals and their products.	Breadstuffs, etc.	Cotton, etc.	Wood, and wood products.	Miscellaneous.	Average annual aggregate.
1826-1830	$ 4,602,375	$ 8,472,623	$ 27,801,516	$ 3,126,501	$ 6,568,375	$ 50,571,390
1831-1835	4,873,044	9,619,072	43,489,612	3,490,600	7,569,751	69,042,079
1836-1840	4,061,852	9,422,982	67,312,345	4,008,762	10,482,429	95,288,370
1841-1845	6,779,297	10,341,102	54,678,009	3,866,231	10,429,520	86,094,159
1846-1850	12,694,772	28,446,477	63,915,365	4,0 6,636	9,799,988	118,933,233
1851 1855	13,579,737	26,836,313	105,247,092	6,049,727	15,438,588	167,151,457
1856-1860	20,844,187	40,609,279	156,514,271	12,270,881	26,531,647	256,770,265
1861 1865	51,311,851	72,820,959	17,017,960	11,069,359	34,171,187	186,391,316
1866-1870	35,434,754	55,262,657	209,250,210	16,405,155	34,920,511	351,273,287
1871-1875	85,560,083	107,228,367	208,818,938	22,730,065	40,376,374	464,713,827
1879	146,641,223	210,391,066	173,158,200	20,122,967	53,843,026	....

Total agricultural export, 1879, $604,156,492.

The advance has been most remarkable; progress without a faltering step, except in the period following the great financial depression which resulted from the great monetary crash of 1837, when the exports of cotton greatly declined. The average for the last of these ten periods is nearly ten times that of the first. As showing the immense proportions to which agriculture has grown, we present a general summary, showing the estimated quantities, number of acres, and aggregate value of the principal crops of the farm in 1879:

Products.	Number of bushels, etc.	Number of acres.	Value.
Indian corn, bu	1,547,901,790	53,085,450	$ 580,486,217
Wheat, bu	448,756,630	32,545,950	497,030,142
Rye, bu	23,639,460	1,625,450	15,507,431
Oats, bu	363,761,320	12,683,500	120,533,294
Barley, bu	40,283,100	1,680,700	23,714,444
Buckwheat, bu	13,140,000	639,900	7,856,191
Potatoes, bu	181,626,400	1,836,800	79,153,673
Total	2,619,108,700	104,097,750	1,324,281,392
Tobacco, lbs	391,278,350	492,100	22,727,524
Hay, tons	35,493,000	27,484,991	330,804,494
Cotton, bales 450 lbs.	5,261,202	12,595,500	242,140,987
Grand total	....	144,670,341	1,919,954,397

What has brought all this about? It is the complete and general system of education in our country by which every child is enabled to glean current facts relating to his profession as fast as they come up. It is the perfection of machinery and the improvement of stock; this added to a fertile soil has enabled the agriculture of to-day to keep pace with the growing events of a teeming and increasing population. It has enabled the farmer of the United States not only to supply the demand at home, but to send abroad yearly the vast surplus of every kind which is accumulated from year to year. Science has enabled the farmer to plow his ground, sow his seed, cultivate his crops, harvest his grain, and make it ready for the stook, thresh, winnow, and send it to the market by the mere act of superintending machines, which do the work like so many creatures of intelligence. He mows his grass, makes it into hay, rakes it into windrows, cocks or loads it directly on the wagon, stacks or puts it in the barn, and even does the heavy work of feeding, entirely by machinery. Water is pumped for his stock and carried into his house by the agency of wind and steam. He digs drains, lays tile, makes roads, subsoils and trench-plows his land; and plants, hauls, and grinds his grain; prepares fodder for, and feeds it to his stock; pumps, saws, and threshes; spades and hoes; loads and unloads; stacks his hay and straw, and does an infinity of other work besides, by the power of automatic sinews of iron and steel. How? By the power of mind applied to the direction of material forces; by true knowledge of cause and effect; in a word, by science. And yet, if asked the question to-day, it is highly probable that a majority would laugh at any intimate relation between science and agriculture. And yet modern agriculture rests upon all science, chemistry being its corner stone and intelligence the power which applies it to agriculture.

AGRICULTURAL EDUCATION. Some years since the editor carefully prepared a digest of his ideas on education to the industries, in which he held to the Socratian doctrine, that a child should be taught in youth that which he was to practice in age; and, also, to the Divine precept, train up a child in the way he should go, and when he is old he will not depart from it. It was a subject that had long interested thinking men, and at the time spoken of a number of agricultural colleges were in operation, under the law of Congress, granting lands for the endowment, and others were projected. The law was broad enough in its conception to include all the industries, and also military tactics. In the formation of some of these schools of industrial education, it was sought to carry them directly back into the grooves of the old scholastic system. There was a long and bitter strife over the matter, and particularly in Illinois, which State was among the foremost in urging forward the new system of education, and in bringing it properly before the people. It is now generally conceded that to the persistent and continued efforts made by the true friends of industrial education, is due the fact that these colleges have been kept proximately near the mark originally intended for them. That is, to give a different education to the youth than that of the ordinary literary colleges—one founded upon the sciences underlying art. Our higher schools of learning had heretofore educated their students in an undeviating groove—the classics. Science had but little place in our colleges, except a smattering of some of the principles obtained from text-books. When the student left college, if indeed, it had not so far unfitted him for labor in agriculture and the mechanic arts as to render these disgusting, he had to unlearn much that he had acquired, and begin again—a self-education. Here was where, as far back as 1850, such men as President Wayland, of Brown University; Bishop Potter, of Pennsylvania; Washington Irving, Governor Hunt and Senator Dix, of New York; President Hitchcock, of Amherst College; Profs. Webster, Dewey, Henry and Bache; Prof. Mitchell, of Cincinnati; Prof. Pierce, of Cambridge; and that persistent wheel-horse of agricultural education in the West, Prof. Jonathan B. Turner, of Jacksonville, Ill., aided by Bronson Murray, John Gage, Smiley Shepherd, John Davis (now of Kansas) and others, had been preparing the public mind for years to the importance of education, grounded upon science rather than upon letters. At length a convention was called in 1851, at Greenville, Ill., at which this question was fully discussed. Two of the resolutions there adopted were as follows:

> *Resolved*, That, as the representatives of the industrial classes, including all cultivators of the soil, artisans, mechanics and merchants, we desire the same privileges and advantages for ourselves, our fellows and our posterity, in each of our several pursuits and callings, as our professional brethren enjoy in theirs; and we admit that it is our own fault that we do not also enjoy them.
>
> *Resolved*, That, in our opinion, the institutions originally and primarily designed to meet the wants of the professional classes, as such can not, in the nature of things, meet ours, any more than the institutions we desire to establish for ourselves could meet theirs.

The next resolution provided that immediate steps be taken for the establishment of a university, expressly to meet the wants of each and all the industrial classes in the State. It was also recommended to found high schools, lyceums, institutes, etc., in each county, on similar principles, so soon as it might be practicable to do so. At this convention Prof. Turner, in an exhaustive address, unfolded an elaborate plan for the establishment of a State University, which was subsequently made the ground-work upon which the act of endowment by the United States, and the law regulating the Industrial University of Illinois, were founded. A second convention was held at Springfield, Ill., June 8, 1852. On this occasion there was a prolonged controversy, forced upon the convention by the representatives of a few of the old classical and theological colleges, who had been admitted by courtesy to participate in the debate. As is usual with many of this class, they consumed the greater part of the time without making much, if any, impression for good on the minds of their auditors. These advocates of the colleges just named desired to be themselves made the custodians of, and instruments through which, the funds of the State should be applied to the education of the industrial classes. This the representatives of these classes then and since, in all their conventions, have unanimously and steadfastly opposed. It was still fought for after the law of Congress endowed a more practical system of colleges; and when the masses thought they had finally beaten the scholiasts, and had secured the fund to the uses of those for whom it was intended, they soon found that their foe had only been beaten off to come up again in another form. A third convention was held at Chicago, November 24, 1852, at which it was resolved to establish an Industrial League of the State of Illinois, which was subsequently chartered by the legislature. The League was empowered to raise a fund to defray various expenses as, first, to disseminate information, both written and printed; second, to keep up concert of action among the friends of the industrial classes; and third, to employ lecturers to address citizens in all parts of the State. At this convention much important business was transacted; many helpful methods and useful aims were presented, and many interesting ideas elaborated. Prof. J. B. Turner was appointed Principal Director of the League, and John Gage, Bronson Murray, Dr. L. S. Pennington, J. T. Little and William A. Rennel, Associate Directors. The convention was harmonious throughout, the members having wisely decided to exclude those professional educators who had no practical knowledge of the wants of the industrial classes. The most noteworthy action of this convention, however, was the passage of a resolution to memorialize Congress for the purpose of obtaining a grant of public lands to establish and endow industrial colleges in each and every State of the Union. Thus, was finally brought forth a definite plan of action, which immediately took firm hold of many leading minds throughout the country, consolidating, in valuable degree, persistent and unselfish efforts which had previously been more or less scattered. A fourth convention was held at Springfield, Ill., on the 4th of July, 1853, at which the duties of the members and terms of office of officers of the League were fixed. Nevertheless, the important business of this convention was the preparation of a memorial—this time to the legislature—setting forth in the strongest light, facts, figures, and arguments, to show the great need of a thorough and systematic education of the masses to the industries they would follow in after life. The following extracts from this memorial will show the animus and tenor of the work. We need the same thorough and practical application of knowledge to our pursuits that the learned professions enjoy in theirs through their universities and their literature, schools and libraries, that have grown out of them. For, even though knowledge may exist, it is perfectly powerless until properly applied; and we have not the means of applying it. What sort of generals and soldiers would all our national science (and art) make, if we had no military academies to take that knowledge and apply it directly and specifically to military life? Are our classic universities, our law, medicine and divinity schools, adapted to make good generals and warriors? Just as well as they are to make farmers and mechanics, and no better. Is the defense, then, of our resources of more actual consequence than their production? Why then, should the State care for the one and neglect the other? It was shown that only one in 260 of the population of the State were, in 1853, engaged in professional life, and not one in 200 in the Union, generally; and that a very great proportion, even of these, never enjoyed the advantages of classical and professional schools. Further, there were, in the United States, 225 principal universities, colleges, seminaries and schools, devoted wholly to the interest of the professional classes, besides many smaller ones, while there was not a single one, with liberal endowments, designed for the liberal and practical education of the industrial classes. It said: No West Point, as yet, beams upon the horizon of hope; true, as yet, our boundless resources keep us, like the children of Japhet emigrating from the ark, from the miserable degradation and want of older empires; but the resources themselves lie all undeveloped in some directions, wasted and misapplied in others, and rapidly vanishing away as centuries roll onward, under the unskillfulness that directs them. We, the members of the industrial classes, are still compelled to work empirically and blindly, without needful books, schools, or means, by the slow process of that individual experience that lives and dies with the man. Our professional brethren, through their universities, schools, teachers, and libraries, combine and concentrate the practical experience of ages and each man's life. We need the same. We seek no novelties. We desire no new principles. We only wish to apply to the great interest of the common schools and the industrial classes precisely the same principles of mental discipline and thorough, scientific, practical instruction, in their pursuits and interests, which are now applied to the professional and military classes. We would, therefore, respectfully petition the honorable Senate and House of Representatives of the State of Illinois, that they present a united memorial to the Congress now assembled at Washington, to appropriate to each State in the Union an amount of public lands not less in value than $500,000, for the liberal endowment of a system of industrial universities, one in each State in the Union, to coöperate with each other and with the Smithsonian Institute at Washington, for the more liberal and practical education of our industrial classes and their teachers, in their various pursuits; for the production of knowledge and literature needful in those pursuits, and developing, to the fullest and most perfect extent, the resources of our soil and our arts, the virtue and intelligence of our people, and the true glory of our common country. The result of these labors was a series of strong resolutions, adopted by the legislature of Illinois, to Congress, of which the following is important:

> *Resolved*, By the House of Representatives, the Senate concurring herein, that our Senators in Congress be instructed, and our Representatives be requested, to use their best exertions to procure the passage of a law of Congress donating to each State in the Union an amount of public lands not less in value than $5 0,000, for the liberal endowment of a system of industrial universities, one in each State in the Union, to coöperate with each other and with the Smithsonian Institute at Washington, for the more liberal and practical education of our industrial classes and their teachers—a liberal and varied education—adapted to the manifold wants of a practical and enterprising people; and a provision for such educational facilities being in manifest concurrence with the intimations of the popular will, it urgently demands the united efforts of our national strength.

A resolution was also passed by the legislature inviting the executive and legislatures of the other States to unite with Illinois to coöperate in the effort to induce popular industrial education. Meanwhile the friends of industrial education East had not been idle, as the following extracts from the history of the subject will show: The New York Tribune, of February 26, 1853, said: Here is the principle contended for by the friends of practical education abundantly confirmed, with a plan for its immediate realization. And it is worthy of note, that one of the most extensive of public-land (or new) States proposes a magnificent donation of public lands to each of the States, in furtherance of this idea. Whether that precise form of aid to the project is most judicious, and likely to be effective, we will not here consider. Suffice it that the legislature of Illinois has taken a noble step forward, in a most liberal and patriotic spirit, for which its members will be heartily thanked by thousands throughout the Union. We feel that this step has materially hastened the coming of scientific and practical education for all who desire, and are willing to work for it. It can not come too soon. Governor Hunt, of New York, in his annual message to the legislature of that State, used the following language: Much interest has been manifested for some years past in favor of creating an institution for the advancement of agricultural science, and of knowledge in mechanical arts. The views in favor of this measure, expressed in my last annual communication, remain unchanged. My impressions are still favorable to the plan of combining in one college two distinct departments for instructions in agriculture and mechanical sciences. I would respectfully recommend that a sufficient portion of the proceeds of the next sale of lands for taxes be appropriated to the erection of an institution, which shall stand as a lasting memorial of our munificence, and contribute to the diffusion of intelligence among the producing classes, during all future time. Hon. Marshall P. Wilder, of Boston, in advocating this system of education before the Berkshire Agricultural Society of Massachusetts, held that: For want of knowledge, millions of dollars are now annually lost to the commonwealth, by the mis-application of capital and labor industry. On these points we want a system of experiments directed by scientific knowledge. Are they not important to our farmers? Neither the agricultural papers, periodicals or societies, or any other agents now in operation, are deemed sufficient for all that are desirable:

We plead that the means and advantages of a professional education should be placed within the reach of our farmers. This would not only be one of the most important steps ever taken by the commonwealth for its permanent advancement and prosperity, but would add another wreath to her renown for the protection of our industry and elevation of her sons Rev. Dr. Hitchcock, President of Amherst College, while advocating the endowments of such institutions before the Massachusetts Board of Agriculture (1851), testified as follows: I have been a lecturer on chemistry for twenty years. I have tried a great many experiments in that time, but I do not know of any experiments so delicate or so difficult as the farmer is trying every week. The experiments of the laboratory are not to be compared to them. You have a half dozen sciences which are concerned in the operation of a farm. There is to be a delicate balancing of all these, as every farmer knows. To suppose that a man is going to be able, without any knowledge of these sciences, to make improvements in agriculture by hap-hazard experiments, is, it seems to me, absurd. A general convention on the subject of a national system of practical university education, was held at Albany, January 26, 1853. This convention was numerously attended by some of the most illustrious men of the country, including many distinguished educators, scientists and divines. A committee of twenty-one was appointed to report a plan of action. Rev. Dr. Kennedy spoke of the want that had long been felt for institutions different from those already established. Prof. C. S. Henry insisted that the welfare of our country was, in a great degree, dependent upon what should be done in regard to the proposed university. Rev. Ray Palmer said there was lack of opportunity for scientific men to perfect themselves in their various pursuits, and desired that this want should be supplied to all parts of the country. Rev. Dr. Wykoff considered that the first *desideratum* to the establishment of the institution was a conviction of its importance. When the souls of men are fired up, the money will not be wanting. He believed that the proper spirit was abroad—a feeling that would redound to the honor and benefit of the people, and that the work would be done. The enterprise was one for the masses. It would open the path of knowledge for all the youth in the land; and, from the common school to the highest university, he would like to see our educational institutions thrown open to all. Prof. Henry said that he would bid the enterprise God speed! He deprecated the idea of attempting to establish a university at a moderate outlay. One fitted for the wants of this country should throw open its lecture rooms freely, to all who might wish to avail themselves of their advantages. It should be the complete development of the principle which lies at the foundation of our common schools. Rev. President Wayland expressed the belief that such an establishment in New York would be an example, which, he believed, would be followed in other States. A university with a thousand students would abundantly sustain itself, and he thought the needed expense would not be so great as some gentlemen anticipated. Did these gentlemen know anything about the subject of practical education in America? Said the lamented Downing, the father of rural art in this country, in the last number which he edited of the Horticulturist: The leaven for the necessity for education among the industrial classes begin to work, we are happy to perceive, in many parts of the country. Speaking of the plan of Prof. Turner, he said: It is not often that the weak points of an ordinary collegiate education are so clearly exposed, and the necessity of workingmen's universities so plainly demonstrated. This was in July, 1853. Before the article was published this preëminent master of horticultural art and science was lost in the ill-fated steamer, Henry Clay. An editorial in the North American (the oldest paper in Philadelphia) on education and agriculture, said to be written by Judge Conrad, said: To secure the diffusion and practical application of agricultural science, it seems necessary that it should be interwoven with general education, and its acquisition made an object of early pride and animated ambition. The triumph of a republic can only be successfully achieved and permanently enjoyed by a people, the mass of whom are an enlightened yeomanry, the proprietors of the land they till, too independent to be bought, too enlightened to be cheated, and too powerful to be crushed. Said Dr. Lee, the talented editor of the Southern Cultivator, the leading monthly periodical of the southern planting interest, published at Augusta, Georgia, in reply to a letter inquiring for some practical agricultural school for the sons of the planters (which letter he published as a fair sample of scores of similar letters received every month): There is not a good agricultural school in the United States. The truth is, the American people have yet to commence the study of agriculture as the combination of many sciences. Agriculture is the most profound and extensive profession that the progress of society and the accumulation of knowledge have developed among mankind. This is why the popular mind is so long in grasping it. Whether we consider the solid earth under our feet, the invisible atmosphere which we breathe, the wonderful growth and decay of all plants and animals, or the light, the heat, the cold, the electricity of heaven—we contemplate but the elements of rural science. The careful investigation of the laws that govern all ponderable and unponderable agents is the first step in the young farmer's education. To facilitate his studies, he needs, as he preëminently deserves, a more comprehensive school than this country now affords. From the time of the general awakening on the subject of industrial education, the discussion of the subject was kept prominently before the people of the United States. This eventuated in the introduction of several bills into Congress, most of which fell still-born. One of them, however, successfully ran the gauntlet of Congressional opposition, only to be strangled in the very last stages of law making. The following is a brief summary of the matter: On the 14th of December, 1857, a bill was introduced into the House of Representatives by Hon. Justin S. Morrill, of Vermont, who was at that time Chairman of the Committee on Agriculture, to appropriate a portion of the public land to the several States for the purpose of founding colleges for the advancement of agricultural and mechanical education. Great opposition was manifested to the bill at once, and instead of being referred to the Committee on Agriculture, where it should legitimately have gone, it was referred to that on Public Lands. There it was held four months, when the Chairman of that Committee, Mr. Cobb, of Alabama, reported upon it adversely. Notwithstanding this, the subject was earnestly discussed by the House, and the bill finally passed by a small majority. The Senate reached it in the winter of 1859, when it was strongly advocated by Senators Wade, Harlan and Stuart, and as determinedly opposed by Senators Davis, Mason and Pugh Subsequently, it was passed by a majority of two and went to the President,—Mr. Buchanan,—who, with great alacrity, returned it with his veto The same bill was again introduced into the Senate in 1862, by Mr. Wade, was favorably reported by Mr. Harlan, and was passed on the 10th of June, by the decisive vote of thirty-two to seven. From thence the bill went to the House, where on the 17th of June, it was passed by the equally decisive vote of ninety to twenty-five. It was approved by President Lincoln, and on the second day of July became a law. So much has been said and argued by the various minds who have endeavored to interpret this law, that it will not be out of place here to give this bill, and the amendment to the fifth section in full, so that every reader of this work may judge for himself what was the true intent and meaning of this act for the education of the masses to industrial pursuits. The text of the act of Congress, donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts is as follows.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State, in quantity equal to 30,000 acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the census of 1860: *Provided*, That no mineral lands shall be selected or purchased under the provisions of this act.

§ 2. *And be it further enacted*, That the land aforesaid, after being surveyed, shall be apportioned to the several States in sections or sub-divisions of sections not less than one quarter of a section: and whenever there are public lands in a State, subject to sale at private entry, at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled, shall be selected from such lands, within the limits of such state; and the Secretary of the Interior is hereby directed to issue to each of the States, in which there is not the quantity of public lands subject to sale at private entry, at one dollar and twenty-five cents per acre, to which said State may be entitled under the provisions of this act, land scrip to the amount in acres for the deficiency of its distributive share; said scrip to be sold by said States, and the proceeds thereof applied to the uses and purposes prescribed in this act, and for no other use and purpose whatsoever: *Provided*, That in no case shall any State to which land scrip may thus be issued, be allowed to locate the same within the limits of any other State, or of any Territories of the United States; but their assignees may thus locate said land scrip, upon any of the unappropriated lands of the United States subject to sale at private entry, at one dollar and twenty-five cents or less per acre. *And provided, further*, That not more than one million acres shall be located by such assignees in any one of the States: *And provided, further*, That no such locations shall be made before one year from the passage of this act.

§ 3. *And be it further enacted*. That all expenses of management, superintendence, and taxes from date of selection of said lands previous to their sales, and all expenses incurred in the management and disbursement of the moneys which may be received therefrom, shall be paid by the States to which they may belong, out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied, without any diminution whatever, to the purposes hereinafter mentioned.

§ 4. *And be it further enacted*, That all moneys derived from the sale of lands aforesaid, by the States to which the lands are apportioned, and from the sales of land scrip hereinbefore provided for, shall be invested in Stocks of the United States, or of the States, or some other safe stocks, yielding not less than five per cent. upon the par value of said stocks; and that the money so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated by each State, which may take and claim the benefit of this act, to the endowment, support and maintenance of, at least, one college, where the leading object shall be—without excluding other scientific and classical studies, and including military tactics—to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.

§ 5. *And be it further enacted*, That the grant of land and scrip hereby authorized, shall be made on the following conditions, to which, as well as to the provisions hereinbefore contained, the previous assent of the several States shall be signified by legislative acts:

First—If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall, by any action or contingency, be diminished or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminished: and the annual interest shall be regularly applied without diminution to the purposes mentioned in the fourth section of this act, except that a sum, not exceeding ten per centum upon the amount received by any State under the provisions of this act, may be expended for the purchase of lands for sites or experimental farms, whenever authorized by the respective legislatures of said States.

Second—No portion of said fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation or repair of any building or buildings.

Third—Any State which may take and claim the benefit of the provisions of this act, shall provide, within five years, at least not less than one college, as prescribed in the fourth section of this act, or the grant to such State shall cease; and said State shall be bound to pay the United States the amount received of any lands previously sold, and that the title to purchasers under the State shall be valid.

Fourth—An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters, including State industrial and economical statistics, as may be supposed useful; one copy of which shall be transmitted by mail free, by each, to all the other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth—When lands shall be selected from those which have been raised to double the minimum price in consequence of railroad grants, they shall be computed to the States at the maximum price, and the number of acres proportionally diminished.

Sixth—No State, while in a condition of rebellion or insurrection against the government of the United States, shall be entitled to the benefits of this act.

Seventh No State shall be entitled to the benefits of this act, unless it shall express its acceptance thereof by its legislature within two years from the date of the approval by the President.

§ 6. *And be it further enacted*, That land scrip issued under the provision of this act, shall not be subject to location until after the first day of January, 1863.

§ 7. *And be it further enacted*, That land officers shall receive the same fee for locating land scrip issued under the provisions of this act, as is now allowed for the location of military bounty land warrants under existing laws: *Provided*, Their maximum compensation shall not be thereby increased.

§ 8. *And be it further enacted*, That the Governors of the several States to which scrip shall be issued under this act, shall be required to report annually to Congress all sales made of such scrip until the whole shall be disposed of, the amount received for the same, and what appropriation has been made of the proceeds.

Approved July 2, 1862.

An act to amend the fifth section of an act entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," approved July two, eighteen hundred and sixty-two, so as to extend the time within which the provisions of said act shall be accepted and such colleges established, was also passed as follows:

> *Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled*, That the time in which the several States may comply with the provisions of the act of July two, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," is hereby extended so that the acceptance of the benefits of said act may be expressed within three years from the passage of this act, and the colleges required by the said act may be provided within five years from the date of the filing of such acceptance with the commissioner of the general land office: *Provided*, That when any Territory shall become a State and be admitted into the Union, such new State shall be entitled to the benefits of the said act of July two, eighteen hundred and sixty-two, by expressing the acceptance therein required within three years from the date of its admission into the Union, and providing the college or colleges within five years after such acceptance, as prescribed in this act: *Provided, further*, That any State which has heretofore expressed its acceptance of the act herein referred to shall have the period of five years within which to provide at least one college, as described in the fourth section of said act, after the time for providing said college, according to the act of July second, eighteen hundred and sixty-two, shall have expired.
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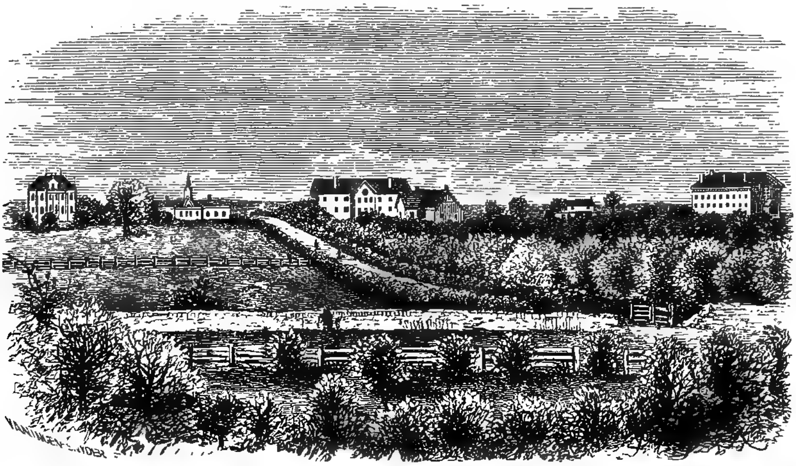
> Approved July 23, 1866.

The following table shows the number of acres which should fall to each State under the law, with other facts of value for future reference:

State.	Acres in scrip.	Designation and location of Colleges.
Alabama	240,000	
Arkansas	150.000	
California	150,000	Agricultural, Mining and Mechanic Arts College.
Connecticut	180,000	Sheffield Scientific School at Yale College, New Haven.
Delaware	90,000	Delaware State College, Newark.
Florida	90,000	
Georgia	270,000	
Illinois	480,000	Illinois, Industrial University, Urbana, Champaign county.
Indiana	390,000	Indiana Agricultural College.
Iowa	240,000	State Agricultural College and Farm, Ames, Story county.
Kansas	90,000	State Agricultural College, Manhattan.
Kentucky	330,000	Agricultural and Mechanical College (Kentucky University), Lexington.
Louisiana	210,000	
Maine	210,000	State College of Agricultural and Mechanical Arts, Orono.
Maryland	210,000	State Agricultural College, Hyattsville.
Massachusetts	360,000	Massachusetts Institute of Technology, Boston. Massachusetts Agricultural College, Amherst.
Michigan	240,000	State Agricultural College, Lansing.
Minnesota	120,000	Agricultural College of Minnesota, with State University, St. Paul.
Mississippi	210.000	
Missouri	330.000	
Nebraska	90.000	
Nevada	90,000	
New Hampshire	150,000	New Hampshire College of Agriculture (Dartmouth College), Hanover.
New Jersey	210,000	Rutgers' Scientific School and Rutgers' College, New Brunswick.
New York	990.000	Cornell University, Ithaca.
North Carolina	270.000	
Ohio	630,000	
Oregon	90,000	
Pennsylvania	780,000	Agricultural College of Pennsylvania, Center county.
Rhode Island	120,000	Scientific School of Brown University, Providence.
South Carolina	180.000	
Tennessee	300,000	
Texas	180,000	
Vermont	150,000	University of Vermont and State Agricultural College, Burlington.
Virginia	300.000	
West Virginia	150,000	Agricultural College of West Virginia, Morgantown.
Wisconsin	240,000	University of Wisconsin (College of Arts), Madison.
Total	9,510,000	

The schools thus endowed by Congress, and accepting the grant, have now gone into more or less successful operation. Among those most notably so, the pioneer school, which has given to some of the newer colleges professors who have already attained eminence in scientific agricultural investigation, may be noticed the Agricultural College of Michigan, which college, working singly and constantly in the interest of agricultural education, now leads in real utility many later and more pretentious ones which have tried to set a "full table," and spread their energies over the whole ocean of literature, science and art. Other western colleges which are not attached as a part of other colleges and which have done constant good work, are those of Iowa and Kansas. The Industrial University of Illinois, in its early attempts to cover too much ground in the direction of general literature, allowed agriculture and mechanics to take a second place in the studies. Of late years, under the persistent lashings of the press and the voice of the people, it has done better work; under the liberality of the State, in the erection of masterful buildings and the appropriations for apparatus, it may now be said to take rank in its scope and aim with any in the country. Especially so during the year 1880, under the management of the new regent. To continue to do so all these colleges should bear constantly in mind that experiment is the key to all agricultural knowledge. The professors must be men of more than ordinary attainments in science, since agriculture is founded upon all science, or rather includes in its scope something of all science. Thus these professors have not one or two, but all the sciences to deal with. It is their province to investigate as well as teach. They must educate in the fields as well as in the lecture hall and the laboratory. If this combination can not be found, then the working professor must take the students just where the theoretical professor left them, for the farm is the field where problems propounded in the lecture room or study must be worked out The soil is nature's great laboratory, where the elements are formed into grass, timber, grain, vegetables, fruits, fibers and flowers. So, also, the animals of the farm are laboratories for the conversion of grass, grain, vegetables, etc., into flesh for the sustenance of man. Agriculture consists primarily of chemical changes and transformations, which result in elaborating from the elements, through the medium of the soil, all the varied and wonderful vegetable wealth that clothes the earth, from the minute lichen upon the bare rock to the giant monach of the forest, which slowly accumulates its structure through decades of centuries. The farmer assists nature in these transformations by such mechanical means as he may be able to employ. Scientific agriculture should go still further. It should teach why certain conditions were necessary and how produced. This is what makes the difference between the farmer and agriculturist. The farmer knows how, by mechanical effort, under favorable influences, he may produce crops. The agriculturist seeks to know why certain causes produce favorable or unfavorable results, in order that he may increase the one or guard against the other. This knowledge has made a Colling, a Bakewell, a Buel, a Downing, and many other self-educated men. They, however, bear no greater proportion to the masses than the great oak does to the various trees of the forest. We need this class of minds in our agricultural colleges, to develop the practical application of science to agriculture. The agriculturist wants to know something of many things, but it is folly to suppose that, in order to acquire this certain knowledge, he must follow out the science relating to a coördinate study in its most abstruse bearings or minuter details. A single example will illustrate our meaning. Of the commoner insects there are between two hundred and three hundred varieties noxious or beneficial to vegetation. The farmer should be conversant with these, and should learn their history and habits—the means for the destruction of the first and the manner of increasing and protecting the second, etc. Under the old system, the student must learn all about the infinite orders, families and sub-families that compose insect life, in order to acquire what he wants. To follow out this idea, life would be too short to get even a smattering of agriculture, and hence the disrepute into which the system has fallen. If, on the other hand, these insects, destructive or beneficial to vegetation, were thoroughly classified, and their history and habits presented as far as known, with natural specimens properly arranged in cases, the student would soon acquire a correct knowledge of all that would be necessary for him to know of entomology. Similar principles should govern the other sciences—at least in the case of the student of two, three or four years. The knowledge in the various sciences pertaining to agriculture should be condensed, so that the student expecting soon to return to the farm might work directly towards the end sought; while his "chum," who is aiming to make scientific pursuits his profession for life, either as a teacher or writer, might climb and explore science after science at will. The farmer, of course, though less profoundly versed in mere technics, might still keep pace with the new discoveries in his profession by a judicious system of reading. The ordinary farmer is not able to give his children more than one, two or three years of scientific education. In this time the student should acquire a knowledge of the nature and composition of soils, and of the economy of animal and vegetable life; should investigate the effects produced upon soils by mechanical means, such as deep and shallow, trench and sub-soil plowing; should study the benefits of thorough drainage and other methods of working the soil; should master the principles of a proper rotation of crops; should store his mind with information relative to the application of special manures adapted to certain crops, and the like practical details, etc. The agricultural student should also understand something of the formation and nature of soils, and the chemical changes they undergo other than from mechanical disintegration. He should know precisely the action of certain manures, their effects upon various soils, either as a top dressing or plowed under. He should understand just where and when fall or spring plowing, or both, would be most beneficial. He should acquaint himself with the various and best manner of sheltering and feeding stock and fitting them for market; not in ten thousand dollar barns and stables, but practically. He should also become well versed in the adaptation of farm animals to the uses required; to sheltering and fitting them for market; and with farm structures, fences and fencing materials. In vegetable economy the student should understand as much as possible of the nature and growth of plants; their botanical characteristics, including variation and varieties; the adaptability



KANSAS AGRICULTURAL COLLEGE AT MANHATTAN.

of various plants to certain climates, with the proper means of their acclimatization, etc. He should study entomology, so far as it concerns insects beneficial or injurious to vegetation, and mineralogy and geology so far as they relate to soil. So with other subjects. The student should pursue them to the bounds within which they pertain to his profession, but no further than this, if he wishes to put to practical every-day use on the farm simply the knowledge he has acquired. The education of girls should differ from that of boys in its practical bearing. This is really one of the most vital questions of the day. Girls should be educated with reference to their duties as wives and mothers as well as to the economy of the household. They should be well versed in pomology, floriculture, bee-keeping, the care of poultry, and other light and suitable branches of agriculture. They should understand the chemical and other changes which milk undergoes during its manufacture into butter and cheese. They should understand structural botany, vegetable physiology, and the various other studies that would enable them in after life to become true counselors and partners in all that pertains to farm life. Let us examine this point in some of its bearings. How many farmers are there who know the power which water has exerted in the earth's history, and still exerts upon the farm every day? that by its action all our stratified rocks were formed? that to its solvent power and chemical action we owe our useful minerals and our metallic deposits? that it is the great mechanical power in nature? that it has moved mountains and filled valleys through its glacial action? or that through its agency our most fertile soils have been deposited over vast areas? Again, how many know that the sun is the real, moving life-power upon the earth, and that through the action of its rays upon water we have dew, clouds, fogs, rain, snow and frost? How many know that the crystalline rocks at the earth's surface contain a greater quantity of water than all the seas and rivers of the globe; that if the conditions surrounding us should change so that the earth would absorb only one part in four thousand of water, more than it now contains, the ocean would disappear, and we should lose not only our moisture, but the atmosphere itself? How many comprehend that it is the sun, after all, which is the great master power that moves all on earth, water being only the agent? Now, the student in agriculture should understand, for instance, how the agency of water is exerted for the benefit of the farmer; but it is not necessary that he should know every thing which science teaches about water in all its forms and phases. Life is too short for such all-embracing investigations. Nature's silent operations on the farm are a succession of miracles, until we understand the laws by which she works. Then they become to our wondering minds as simple as they are beautiful, even in their vastness and complexity. The number of tons of water raised by an acre of corn, during its summer growth, is simply marvelous. How many farmers understand the process by which it is accomplished, or can realize the immense measure of force and energy expended by nature in producing his twenty to fifty bushels of corn per acre? How many appreciate the important fact that it is in his power to assist nature in economizing a portion of this vast force, by enabling her to produce ten, twenty, thirty bushels more of grain per acre than his land now yields? Hardly one in a thousand, and why? Simply because they have never been educated to their calling—have never been taught to use their senses aright; to store their minds with useful, expansive knowledge; or to reason from cause to effect, and from effect back to cause. It is this knowing something of many things that makes the practical man; the knowing all about some one or two special things, the scholar. This knowledge, as gray hairs grow, comes slowly to a thinking man. What we want is to hasten the ripening of this practical knowledge among the masses, through schools especially devoted to the departments of science relating to agriculture and other pursuits. A man may be a good chemist and botanist; may understand the anatomy and structure of animals, with their diseases and the remedies necessary to their cure; may understand the nature and composition of soils—all these without being a farmer; nevertheless, if a farmer, he can not have studied the several branches in their bearing upon agriculture without being a much better one therefor. Afterward, if he chooses to make a specialty of any one of the sciences, what should hinder? He has the foundation to work on, if he so desire. On the other hand, those whose means might allow them to spend a longer time would necessarily want a different curriculum. To the one class of students the classics would not be beneficial; to the other they would be necessary, as enabling them to pursue their higher studies more surely. The ground work of all education is begun in our common schools. From these the student should go to our colleges for special education, and should have a definite idea of what he or she wants. The agricultural college must commence just where the other schools leave off, and carry the student forward in such of the sciences as will apply to his case. First of all, however, he must come to understand that labor, of whatsoever kind it may be, is always honorable, and none more ennobling to the man of broad mind than agriculture. With this he must come to know that education to this industry will place him far in advance of the one who practices husbandry as a mere manual art.

AGRIONIDÆ. The family of insects called dragon flies. *Libellula*, *Agrion*.

AGRONOMY. The cultivation of land; agriculture.

AGROSTIS. The genus of bent grasses, found growing mostly in moist places, and flowering late. They are generally perennial plants, with creeping roots, many of them being difficult to exterminate. The variety in most common cultivation in the United States and Canada is red-top, *A. vulgaris*. (See Grasses.)

AIGRETTE. The down or pappus of the seeds of compositæ.

AILANTHUS. The Ailanthus, when first introduced into the United States, many years ago, under the various names of, Tree of Heaven, Chinese Sumac, Tillow and Tallow Tree, was advertised as possessing so many admirable qualities that many were induced to plant it, North and South, only to be disgusted with the odor of the staminate flowers. This offensive odor may be prevented, in a measure, by cutting away the staminate trees after they once have bloomed. North of the latitude of 40° the tree is not entirely hardy, and anywhere it can not be considered a tree of special value for extensive planting.

AILANTHUS GLANDULOSA, or glandulous ailanthus, has the calyx five-toothed; petals five, inserted with the ten stamens under a hypogynous disk: carpels three to five, samaroid, tumid in the centre, one-celled and one-seeded. Stigmas capitate, radiately five-lobed. Flowers diœciously polygamous. The leaves are odd pinnate, leaflets oblong—lanceolate, acuminate, coarsely dentate at base, with a gland on the under side of each tooth. Darlington, in Weeds and Useful Plants, says of it: Stem, thirty to sixty feet or more high, much branched; young branches never multiplying during growth, but developed only from the buds of the preceding year. Leaves (on young trees especially) much elongated and consisting of many pairs (fifteen to twenty) of smooth leaflets, which are three to five inches in length and entire, except a pair or two of coarse teeth at base. Flowers pale greenish yellow. Cultivated as a shade tree, and native of China.

AIR. (See Atmosphere.)

AIRA. The genus of hair grasses. They are perennial, usually grown in wet places, and are of little moment in agriculture.

AIR, AND THE GROWTH OF CROPS. The importance of air as an agent in the growth of crops is but little known by the majority of farmers. The action of the oxygen of the air in connection with heat and moisture causes the seed to germinate, and during the whole growth of the plant, air is essential to growth and the proper ripening of the seed. For this reason the ground is required to be kept mellow; for this reason we cultivate often and thoroughly, and to enable the soil to become aerated, we break the crust as often as it is formed. As showing the importance of air in the soil, a series of experiments made some years ago exhibits the agency of air and carbonic acid gas in the growth of crops. These experiments were made with three glass vessels, in depth two and a half feet, which were filled with soil of a like character, and planted in oats and peas. They grew 110 days, and then the plants, with their roots, were taken out and dried and their ashes analyzed, and the soluble mineral substances ascertained that were left in the soil. In one of these vessels no air was introduced; in another, it was by a hole in the bottom of the vessel; and in the third one, air and carbonic gas by the same means. The result is as follows, the estimates being made for the acre: Experiment without additional supply of air—quantity of dry plants, in pounds, per acre—oat plants, 1,560; pea plants, 688; roots of both, 108. Soluble mineral substances, in pounds, per acre—in the ashes of the plants, 208; left in the soil, 608. Experiment with supply of air—quantity of dry plants, in pounds, per acre—oat plants, 3,060; pea plants, 984; roots of both, 152. Soluble mineral substances, in pounds, per acre—in the ashes of the plants, 380; left in the soil, 1,104. Experiment with supply of air and carbonic gas—quantity of dry plants, in pounds, per acre—oat plants, 3,396; pea plants, 1,304; roots of both, 240. Soluble mineral substances, in pounds, per acre—in ashes of plants, 448; left in the soil, 1,548. These experiments exhibit the important action of air and carbonic gas in the growth of vegetable matter. The first increased the plants in size about eighty per cent.; the mineral substances in the plants about eighty per cent., and the soluble minerals left in the soil about eighty per cent. The carbonic gas increased the growth of plants over that caused by air alone about thirty per cent.; the mineral substances absorbed by the plant thirty-five per cent., and the soluble minerals left in the soil about seventy-five per cent. The element of the air which causes such important action is its oxygen. It is the great destroyer either by rapid burning or by slow decay. It is this which, uniting with the wood of plants, turns it into carbonic gas. It aids in rendering soluble the insoluble minerals of the soil; that is, it so changes them that they dissolve in water and are carried by it into the roots of the plants. Hence it is the great destroyer of the mould of the soil, as before stated, turning it into carbonic gas, and thus making it useful to form new vegetable growths. By returning these to the soil we increase the amount of the mould, for in addition to the amount of carbonic gas they have derived from the old mould, they have received much from the atmosphere.

AIR CELLS. In plants, enlarged cavities in the cellular tissue, to produce buoyancy in aquatic plants. In birds, membranous cavities communicating with the lungs, and traversing all parts of the bird, even to the interior of the bones and quills. In some insects the air vessels are enlarged into cells.

AIR PLANTS. Those which grow without striking their roots into the soil. They usually derive sustenance from other plants. Orchids are air plants.

AIR PUMP. A pump for removing air to produce a vacuum. The principle is simple. The essential part of the machine consists of an exhausting syringe formed of a tube or barrel of brass, closed at one end, with the exception of a small orifice, to which a valve, opening inward, is attached. An air-tight piston is worked in the barrel. The piston has also an orifice with a valve, which opens upward, or in the same direction as the valve of the tube. The syringe communicates, by means of a small pipe fitted into the opening at its lower extremity, with a vessel (receiver) from which the air is to be extracted. The principle is applied wherever a vacuum is to be produced. In agriculture the air-pump is used as a portion of the machinery attached to the vaccuum pan in condensing the juice of the cane or other saccharine plants, in the manufacture of sugar.

ALBUMEN. A substance occurring in the blood and nerves of animals, in the eggs of birds, and in grains and vegetables, in almost exactly identical composition. These we give, and also that of fibrin and casein, as follows. Albumen differs from fat in its composition, having the four elements—carbon, hydrogen, nitrogen and oxygen —while fat contains but three. All the organs of the bodies of animals contain these four elements, and food must necessarily contain them to be nutritious. We find the carbonaceous foods to be fat-producing or heat-giving. The nutritious foods containing the four elements are called nitrogenous or flesh-forming foods. They are all included in the three forms, albumen, fibrin and casein, which contain the four elements in nearly the same proportions. When we consider that albumen, or at least the group of which it is a member, is one of the constituents of food without which young animals can not thrive, that it is a chief constituent of the eggs of birds, and of the milk of animals, we shall see the importance and necessity of food containing largely of the so-called protein compounds, especially for young and growing animals. Boussingault gives the results of analysis performed by Messrs. Dumas and Cahours to prove this fact, as follows:

ALBUMEN.

Name.	Animal.	Vegetable.
Carbon	53.5	53.7
Hydrogen	7.1	7.1
Oxygen	23.6	23.5
Nitrogen	15.8	15.7
	100.0	100.0

Fibrin is the principal element of which the muscles of animals are formed; it also forms the clot and globules in blood. Like albumen, fibrin is found in vegetables in nearly identical composition with that of animals. Analysis shows:

FIBRIN.

Name.	Animal.	Vegetable.
Carbon	52.8	53.2
Hydrogen	7.0	7.0
Oxygen	23.7	23.4
Nitrogen	16.5	16.4
	100.0	100.0

Casein is found in the milk of mammals, and is identical with that called legumen, of the leguminous seeds, such as beans, peas, etc., in which it exists more abundantly than in milk itself. Analysis shows the composition of the animal and vegetable casein to be also nearly identical:

CASEIN.

Name.	Animal.	Vegetable.
Carbon	53.5	53.5
Hydrogen	7.0	7.1
Oxygen	23.7	23.4
Nitrogen	15.8	16.0
	100.0	100.0

Again, we see that the composition of albumen, fibrin and casein, is nearly similar, and that they contain a large percentage of that important and scarce element in agriculture, as well as necessary constituents in all plants and animals. Albumen abounds in bone, muscle, the membrane of shells, sponges and cartilage, the nails, claws, horns and hoofs. The horns of animals are almost entirely composed of it. Albumen is found in the fluid state in the serum of blood and the whites of eggs. In the moist state it easily putrefies in the presence of heat and air and coagulates at about 180° Fahrenheit. Dry, it is a transparent, brittle substance, resisting decay. Many plants contain notable quantities of albumen, and the juice of all plants contain more or less, being found in all their parts as necessary to growth. The accumulation ends in the seeds, the cereal and leguminous grains being especially rich in albumen. Besides carbon, oxygen and hydrogen, albumen contains from fifteen to eighteen per cent. of nitrogen, a small quantity of sulphur, and sometimes phosphorus. The albuminoids are both soluble and insoluble in water. The insoluble albuminoids sometimes occur in both plants and animals. When purified it resembles white, flocky, lumpy or fibrous bodies, without taste or odor.

ALBURNUM. The sap wood lying between the inner bark and heart wood (Duramen). It is usually of a different color, and much more perishable than the heart wood.

ALCOHOL. Spirits of wine. It is formed during the vinous fermentation. The pure spirit has a specific gravity of 0.792, and consists, chemically, of C_4, H_6, O_2. It is present in brandy, whisky and strong spirits, to the extent of fifty per cent., twenty-five per cent. in strong wines, ten per cent. in cider and ales, and six per cent. in beer. It is of great use in the laboratory as a solvent of resins, etc., and for the hot flames it produces when burned in lamps. The history of alcohol is as follows: Alcohol is the name first given by the alchemists to the liquid obtained by the distillation of wine, beer and other fermented spirits. These seem to have been known in the earliest ages. Noah, who planted a vineyard, drank wine, and the heathen writers deemed the invention worthy of being ascribed to their greatest kings and heroes. Beer, there is little doubt, was invented by the Egyptians. They certainly used it in the days of Herodotus. The Germans drank it extensively when Tacitus wrote. These were probaby the purest varieties of alcohol then generally made, although they were known in the dark ages, and it is probable have been employed in the north of Europe from a very remote period. The process, however, of separating the impure alcohol from these is very easy; upon subjecting the wine or "wash" to a moderate heat, the spirit arises, and is easily collected in a worm surrounded by cool water. It is in this way that gin is procured from the distillation of fermented barley or other grain, rum from molasses, brandy from wine. It must not be supposed, however, that the product of these distillations is pure alcohol, for even the strongest brandy contains between forty and fifty per cent. of water. The first who procured alcohol in a state of tolerable purity is supposed to have been Arnold, of Villa Nova, a celebrated alchemist of the fourteenth century. When impure alcohol is concentrated by repeated distillations, and by mixing it with some salt, like the salt of tartar, that has a strong attraction for water, it gradually parts with a considerable portion of its water and becomes reduced in specific gravity to about 0.820; that of commerce, however, is rarely of less specific gravity than 0.8371. At the greatest strength, however, at which it has been observed, such as that of 0.792, which M. Lowitz obtained by repeatedly distilling rectified spirits from potash, it possesses the following properties: it is transparent, colorless, of a strong, agreeable, penetrating taste, and produces, when swallowed, intoxication. It does not freeze, even by exposure to the most intense cold; it is very volatile, boiling at 176° of Fahrenheit, and in a vacuum at 56°. It unites with water in all proportions, and is entirely combustible—burning without leaving any residuum. It is, however, not found in commerce pure, since the cost of making it chemically so is too expensive. Hence it is never found pure, except when wanted for special scientific purposes. Alcohol, according to the analysis of M. Saussure, is composed as follows:

Hydrogen	13.70
Carbon	51.98
Oxygen	34.32
	100.00

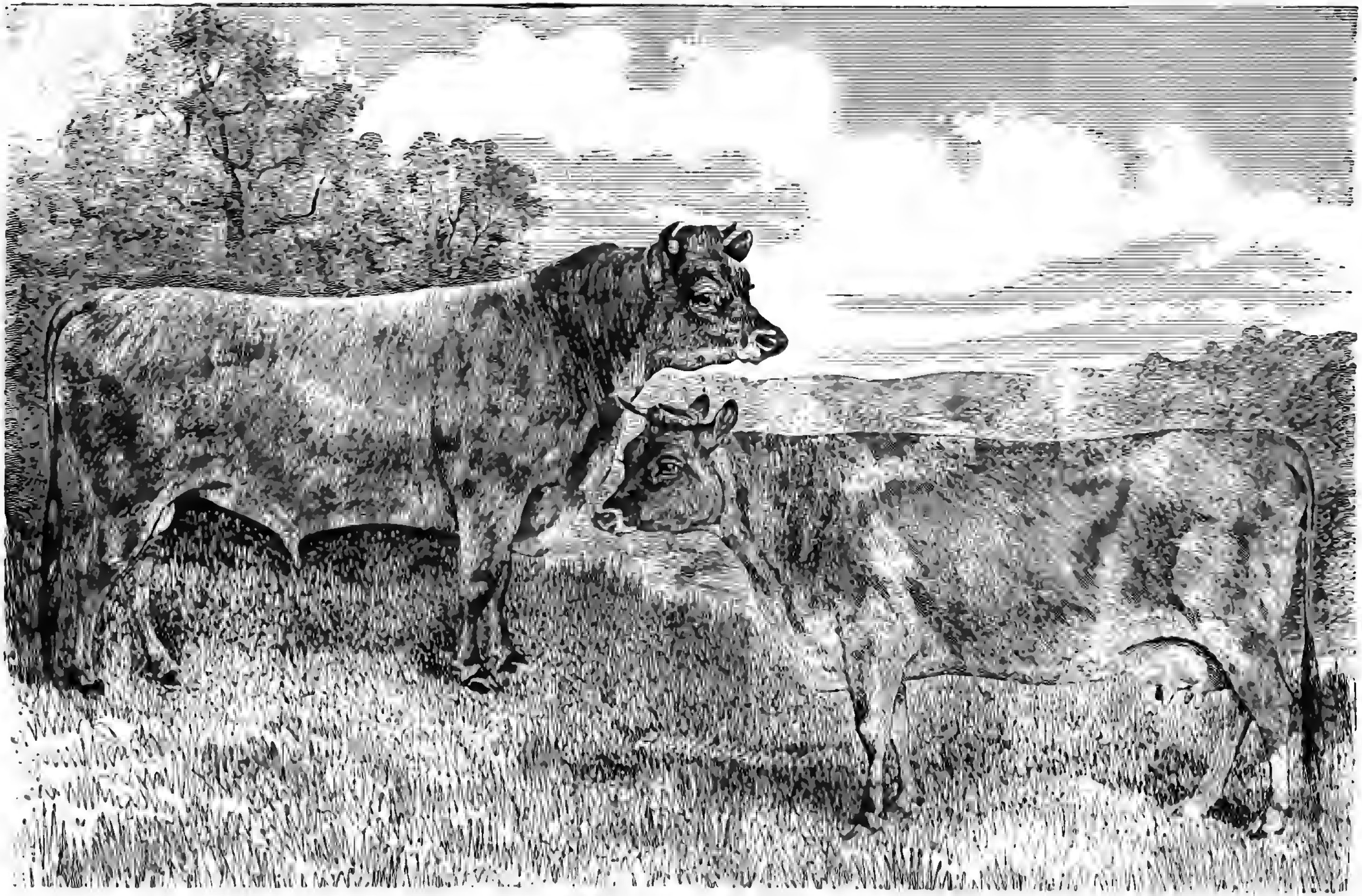
The following table will show the ordinary proportion of alcohol per cent. by measure in various fluids, according to the experiments of Prof. Brande:

Port	12.40	Constantia	17.75
Madeira	19.34	Tent	13.30
Sherry	18.25	Sheraz	15.52
Claret	12.91	Syracuse	15.28
Lisbon	18.94	Nice	14.63
Malaga	17.26	Tokay	9.88
Red Madeira	18.40	Raisin	25.77
Malmsly Madeira	16.40	Grape	18.11
Red Champagne	11.30	Currant	20.55
White Champagne	12.80	Gooseberry	11.84
Burgundy	14.53	Elder	9.87
Hock	14.37	Cider	9.87
Vin de Grave	12.80	Perry	9.87
Frontignac	12.79	Brown Stout	6.80
Coti-Roti	12.32	Ale	8.88
Roussillon	17.26	Brandy	53.39
Cape Madeira	18.11	Rum	53.68
Cape Muschat	18.25	Hollands or Gin	51.60

The spirits distilled from different fermented liquors, says Davy, differ in their flavor, for peculiar odorous matters or oils rise in most cases with the alcohol. The spirit from malt usually has an empyreumatic taste, like that of oil formed by the distillation of vegetable substances. The best brandies seem to owe their flavor to a peculiar oily matter, formed probably by the action of tartaric acid upon alcohol; and rum derives its characteristic taste from a principle in the sugar cane. The cogniac brandies contain prussic acid.

ALDER. Shrubs of the genus *Alnus*, which is closely allied to the birch. The common swamp alder is the *A. surrulata*. The *A. glauca* (Black Alder) is used by dyers for the production of a black.

ALDERNEY CATTLE. Jersey or channel cattle, are natives of the islands belonging to England, lying in the British channel about twelve miles from France. The largest of the group (Jersey) is about twelve miles long by five in breadth, and here the largest number and the best of these distinctive and excellent milking cows—if we consider them purely for the richness of the milk in cream and butter—are now produced. Hence they are now generally known as Jerseys. Of late years strict attention to purity of blood and careful selection have rendered this breed of cattle quite uniform in their characteristics, and in breeding to type, although one may infer that up to Yonatt's time little attention was paid to their breeding, since this careful writer bestows but little space upon their history. Briefly stated, they were carried to the channel islands long ago from Normandy, in France, and in the course of time developed into the peculiar and deer-like race which is now most perfectly fixed. Mr. Louis F. Allen, a careful, usually correct, and a conscientious writer, though apt to form a standard from his favorite Short-horns, describes them with accuracy as follows: Beginning with the head—the most characteristic feature—the muzzle is fine; the nose either dark brown or black, and occasionally a yellowish shade, with a peculiar mealy, light-colored hair, running up the face into a smoky hue, when it gradually takes the general color of the body; the face is slightly dishing, clean of flesh, mild and gentle in expression; the eye clear and full, and encircled with a distinct ring of the color of the nose; the forehead bold; the horn short, curving inward, and waxy in color, with black tips; the ear sizable, thin, and quick in movement. The whole head is original, and blood-like in appearance,—more so than in almost any other of the cattle race,—reminding one strongly of the head of our American elk. The neck is somewhat depressed—would be called ewe-necked by some—but clean in the throat, with moderate or little dewlap; the shoulders are wide and somewhat ragged, with prominent points, running down to a delicate arm, and slender legs beneath; the fore-quarters stand rather close together, with a thinnish, yet well developed brisket between; the ribs are flat, yet giving sufficient play for good lungs; the back depressed and somewhat hollow; the belly deep and large; the hips tolerably wide; the rump and tail high; the loin and quarter medium in length; the thigh thin and deep; the twist wide, to accommodate a clean, good-sized udder; the flanks medium: the hocks or gambrel joints crooked; the hind legs small; the udder capacious, square, set well forward, and covered with soft, silky hair; the teats fine, standing well apart and nicely tapering; the milk veins prominent. On the whole she is a homely, blood-like, gentle, useful little housekeeping body, with a most kindly temper. loving to be petted, and, like the pony with the children, readily becomes a great favorite with those who have her about them, either in pasture, paddock, stable or the lawn. The colors are usually light red or fawn, occasionally smoky grey, and sometimes black, mixed or splashed more or less with white. Roan colors, and a more rounded form, are now and then seen among them, but we do not like them (as they savor of a Short-horn cross, which they should not have), as anything but their own blood and figure, and that of the ancient stock, deteriorates them—as Alderneys. The first importation of Jerseys into the United States is said to have been made by the late Nicholas Biddle, of Pennsylvania. They were coarse, and were probably nearer Guernseys than Alderneys or Jerseys. Later, Mr. Roswell Colt, of New Jersey, imported a superior herd Mr. Motley, of Massachusetts, and Mr. Taintor, of Connecticut, also imported superior animals soon after. Subsequent importations of the choicest blood have rendered this breed quite common, and they are pretty generally disseminated throughout the United States. Various attempts have been made in crossing the Jersey with other improved breeds, but the results have always proved unsatisfactory. When crossed, however, upon the native mixed stock of the country, it has always resulted in an increase in the richness of the milk, and often in an increased flow. The colors vary much in the Jerseys. Fawn color, fawn color and white, yellow, mouse color, brown, and even almost black are found The bulls are darker than the cows, and the color increases with age. A yellow or fawn-colored calf will sometimes, at one or two years of age, assume so dark a tint as to leave scarcely a trace of the lighter color. The butter from the cows is very rich in cream and deep yellow in color, so much so that a few cows in a herd will decidedly change the color of the



JERSEY BULL AND COW.

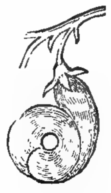
butter of the whole herd. The percentage of cream to milk varies from eighteen to twenty-five per cent., and the proportion of butter to cream varies from 3.70 to 8.07 in 100 parts. Twenty-six quarts per day has been recorded as the product of an individual cow, and fourteen pounds of butter per week. Sixteen quarts per day may be regarded as a good yield, and when we take into consideration the light weight of the cow, and the fact that the milk will yield from one-quarter to one-sixth of the richest cream, we need not wonder that these gentle and deer-like cattle have become universal favorites as a family cow. (See cut, opposite page.)

ALE-HOOF. Ground ivy.

ALEMBIC. A retort with a movable cover or cap, used in chemical manipulations.

ALEXANDERS. An umbelliferous plant, formerly cultivated like celery.

ALFALFA. Lucerne; *Medicago Sativa.* Under the name Alfalfa this plant has been extensively cultivated in some portions of the United States, especially in California, where it constitutes one of the important forage crops. It is especially adapted to a dry, gravelly soil, and once established, survives the winter up to the latitude of Central Indiana and Illinois, Northern Missouri and Southern Iowa. It is strictly a perennial plant. It is also widely known by its French name, Lucerne. Its Spanish name is Alfalfa, and having been originally introduced and cultivated by the Spaniards, in their possessions—since ceded to the United States—it has popularly preserved this name with us. It belongs to the pulse family, and is allied to the clovers, which it somewhat resembles in its growth. The seed, however, is formed in spiral-shaped pods. In Northern Mexico, Texas, and in California, it is successfully cultivated, being cut several times in a season. Its botanical description is as follows: Root, perennial; stem one and two feet high, branched, smoothish; leaflets half an inch to an inch long, the lateral ones subsessile, the terminal one petiolulate; common petiole one-fourth to three-fourths of an inch long. Racemes erect, on peduncles half an inch to an inch long. Corolla, violet purple, nearly twice as long as the calyx. Introduced; cultivated. Native of Spain. Flowers in June and July; fruits in August. Saint foin (*Hedysarum Onobrychis, L.*, or *Onobrychis sativa*, Lam., a plant of the *Hedysarum* tribe), is cultivated for fodder on the calcareous soils of Europe.



SEED POD OF LUCERNE.

ALGÆ. The family of sea-weeds and fresh-water weeds (*Confervæ*) They are cellular and cryptogamic.

ALIMENTARY CANAL. The passage from the mouth through the stomach and intestines.

ALITRUNCK, ALITRUNCUS. In entomology, the posterior segment of the thorax of an insect to which the abdomen is affixed, and which bears the legs, properly so called, or the two posterior pairs, and the wings.

ALKALI. A term originally applied to the ashes of plants. The term is now generally used to designate potash, soda, and ammonia. Lime and magnesia are alkali-earths. Potassium, sodium, lithium and rubidium are alkali metals. The alkali-earths, lime and magnesia, are formed by the union of calcium and magnesium with oxygen. According to Heyne and Lenk, the functions of alkalies and alkali-earth is as follows: The organic acids, viz.. oxalic, malic, tartaric, citric, etc., require alkalies and alkali-earths to form the salts which exist in plants, as bitartrate of potash in the grape, oxalate of lime in beet-leaves, malate of lime in tobacco; and without these bases it is, perhaps, in most cases impossible for the acids to be formed, though in the orange and lemon citric acid exists in the uncombined or free state, and in various plants, as *Sempervivum arboreum*, and *Cacalia ficoides*, acids are formed during the night which disappear in the day. The leaves of these plants are sour in the morning, tasteless at noon, and bitter at night Alkaloids are a class of bodies very numerous in poisonous and medicinal plants, of which they constitute the active principle. Nicotine, caffein and theo-bromin are the three having an agricultural interest, and are described by Johnston in How Crops Grow, as follows. the figures attached to the letters C, H, N, O, designating the relative proportion contained of carbon, hydrogen, nitrogen and oxygen: Nicotine, C_{10}, H_{14}, N_2, is the narcotic and extremely poisonous principle in tobacco, where it exists in combination with malic and citric acids. In the pure state it is a colorless, oily liquid, having the odor of tobacco in an extreme degree. It is inflammable and volatile, and so deadly that a single drop will kill a large dog. French tobacco contains 7 or 8 per cent., Virginia 6 or 7 per cent., and Maryland and Havana about 2 per cent. of nicotine. Nicotine contains 17.3 per cent. of nitrogen, but no oxygen. Caffein, C_8, H_{10}, N_4, O_2, exists in coffee and tea, combined with tannic acid. In the pure state it forms white, silky, fibrous crystals, and has a bitter taste. In coffee, it is found to the extent of one-half per cent.; in tea it occurs in much larger quantity, sometimes as high as 6 per cent. Theo-bromin, C_7, H_8, N_4, O_2, resembles caffein in its characters, and is closely related to it in chemical composition. It is found in the cocoa bean, from which chocolate is manufactured. The alkaloids are remarkable as containing nitrogen, and from having strongly basic characters. They derive their designation, alkaloids, from their likeness to the alkalies.

ALKALIMETER. A graduated glass tube employed in determining the quantity of real alkali in commercial potash and soda, by the quantity of dilute sulphuric acid of a known strength, which a certain weight of these saturates.

ALKANET. *Anchusa tinctoria.* The root of this plant, which is a native of the warmer parts of Europe, contains a red resinous coloring matter, which it imparts to alcohol and oils; it is used to tinge some ointments, especially lip-salves, of a red color.

ALLANTOIS. A membrane attached to the extremity of the alimentary canal in the fœtus of animals. It contains the cellantoic fluid.

ALLUVIUM, or **ALLUVION.** A term which, in the English language, has no very defined meaning. Some authors use it to designate all those rocks which have been formed by causes now acting on the surface of the earth, including those of volcanic origin; while others, adhering to the literal meaning of the original term, confine its application to deposits, whatever be their character, that have resulted from inundations. Neither of these definitions convey the same meaning as is usually attached to the word, the one including too much, the other too little. The term is now used in its proper application to designate all those deposits recently formed, or now forming, by the agency of water, whether from an uninterrupted and constant stream, or from casual inundations. All streams, lakes, rivers, seas, and the ocean itself, hold a large quantity of earthly matter in mechanical solution, which they deposit in their beds. The character of the sediment is governed by the nature of the rocks over which the waters flow; and the quantity depends partly upon the constitution of the rocks, and partly upon the power of the water. If the rock be easily destroyed, and a large body of water flow over it with a considerable velocity, the destructive effect will be great, and much worn materials (*detritus*) being formed, the stream will have a thick and turbid appearance. The same effect is frequently produced by the discharge of a number of tributary streams into a river, all of which accumulate a greater or less quantity of the earths over which they flow. The distribution of water at the present time, more particularly refering to rivers, is very different from that of former periods. The majority of the valleys through which rivers are now flowing, have been produced by the action of water. which, running from higher lands, has not only scooped them out, but has spread over them the worn material which it accumulates in its passage. By the operations which have since been going on, the waters have been collected together in comparatively narrow channels of considerable permanency. On this account, the influence of water that flows over the portions of the earth inhabited by terrestrial animals is greatly restricted; and the production of new beds of rock or soil is rather an accidental than a necessary consequence. But, although the influence of water has been thus confined, all lands, and especially the surfaces of mountainous districts, are undergoing change, and the superficial covering on one district is conveyed to another. The showers of heaven are constantly sweeping away the soil and decomposed rocks of the uplands into the valleys, over which they are transported by streams and rivers, the larger and heavier particles falling to the bottom, the smaller being united with the water in mechanical mixture. That portion of earthy matter which is carried away from a district by the running water is, as far as the district itself is concerned, the most valuable, being the superficial covering or soil, and would be forever lost to that portion of the earth inhabited by man, were it not arrested in its passage to the ocean, by deposition in the bed of the river, or on those lands which the waters may happen to overflow. It is well known to those who have visited elevated districts, that many mountains are already deprived of their soils, and are but the skeletons of the earth, without covering or life. By this action the valleys are in the process of elevation, and the mountains of depression; and if we could conceive it to proceed without limitation, we may imagine a time when all the varieties of elevation and depression, which now give beauty to the surface. will be destroyed, and an entirely different condition of the distribution of land and water will be established. But, at the same time, it can not be denied that these changes, as far as they have hitherto proceeded, have been advantageous to man, whatever might be their result under the conditions to which we have alluded. The mountainous regions are, from their elevation, less suited to the progression of society, so intimately connected with agricultural prosperity, than the plains. As we rise above the level of the sea, the atmosphere becomes more rarefied, and the cold more intense, both of which are injurious to vegetation in general, and unsuited to promote the comfort of animal life. The plains are, therefore, preferred by men when they congregate together and form societies. It can not be considered an unwise or unfit result, that the lowlands should be enriched with alluvial soils, produced by the destruction of the rocks and natural soils of mountainous regions. It is reported of Dioclesian, that he told his colleague, Maximilian, he had more pleasure in the cultivation of a few pot-herbs which, in the garden of Spalatro, grew in the soil that on the top of Mount Hæmus had only produced moss and dittany, than in all the honors the Roman empire could confer. From the definition here given of the word "alluvium," it must include the gravels and sands that are of recent formation among the alluvial deposits; but our attention is chiefly directed to the soils, or those beds which are suited to sustain vegetable life. It is true that the gravels may be made available for the cultivation of some plants, but the beds which are so used belong rather to that class of rocks denominated *diluvial* by geologists, than to the deposits of which we are speaking. If we trace the circumstances under which alluvial soils are formed to their cause, we shall find that they have their origin in the fall of heavy rains, and the melting of snows, in mountainous regions. The water, in its passage to the valleys, collects the superficial soil and decomposed earthy material that lies in its path, and transports them into the channels towards which it flows. The streams that are formed on the mountain slopes are generally united together before they reach the plains, and form impetuous torrents, overcoming all obstacles, until their velocity is lost, when, in their winding courses, they meet each other and form rivers. Rivers, in every part of their course, are subject to inundation; when, throwing their waters over a considerable space, they deposit the earthy materials they have accumulated. If such inundations had not occurred, the accumulated worn materials (*debris*) would have been deposited in the bed of the river, or carried into the lake or sea where the waters themselves are discharged. There are abundant instances on record of the filling up of rivers by the worn materials (*detritus*) which have been carried into their courses, and the rivers of our own country will afford excellent examples of this result. Many rivers and estuaries, in some portions of the globe, which a few years since were navigable, have ceased to be so on account of the large amount of alluvial matter deposited in their beds; and many towns and cities which were once populous and wealthy, have on this account become poor and almost deserted. If we would see the effect of the transport of worn materials into lakes, we can not have a more favorable opportunity than in Switzerland. Many of the lakes of this sublime and majestic country are rapidly filling from this cause; and in some of them water plants are seen above the surface of the water. But when a river suffers inundation, the earthy matter, which is held in mechanical mixture, is arrested, and deposited on the land that is overflowed, and a richly productive soil is formed. One or two examples may illustrate these remarks. The Ganges annually overflows its banks, and deposits a rich alluvial soil over the country it inundates. This magnificent river was supposed to take its rise on the northern side of the Himalaya mountains, until it was proved, in 1819, by Lieutenant Webb, that all the streams which unite to give its existence, take their rise on the south side of the Hindoo Coast, or Snowy mountains. The melting of the snows, and the heavy periodical rains augment the volume of the water, and by the end of June, before the rainy season has commenced in the low country, the river has generally risen fifteen feet; but after the rains in Bengal it usually attains a height of thirty-two feet above its ordinary level. By the end of July all the low countries adjoining the Ganges and the Burrampooter are overflowed, and nothing but houses and trees are seen for many miles inward. The province of Bengal is divided into two nearly equal parts by the Ganges; and as a large portion of the country on the banks of the river is low, it is especially exposed to inundation, from which circumstance it probably derives its name, such districts being called *beng*. A deep bed of rich soil is deposited during the period of the overflow, and the vegetable productions are of the most varied and luxuriant character. Rice, wheat, barley, tobacco, indigo, cotton, the mulberry, and the poppy, are all cultivated with success on the alluvial soils. It is well known that Egypt has been, from time immemorial, indebted to the overflow of the Nile for a rich alluvial soil, as well as for the means of irrigating the land. The ancients seem to have been altogether at a loss to account for the periodical overflow of this river; and when we consider the appearances before them, we are not surprised at the difficulties they experienced. They observed it in a country that was not moistened by a drop of rain, and when it was unaided by a single stream, and yet, at its stated period, it began to lift its waters from their bed, and rising higher and higher, overflowed its banks, and spread itself like a sea over Lower Egypt, refreshing the parched earth with moisture, and aiding its productiveness with the formation of a superficial covering of rich loam. The philosophers speculated without success upon its cause; but while they were disputing as to the origin of the phenomenon, year by year the Nile rose, and left the evidence of its beneficial sway in the richness of the crops and the luxuriance of the country. From the investigations that have now been made, we know that the rise of the Nile is occasioned by the rains which fall on the high mountains in the interior and tropical regions, and not, as many of the ancients supposed, from the Etesian winds, which, blowing periodically from the north, prevent the waters from reaching the sea. The great importance of rivers, as agents in the production of alluvial soils, can not be more strongly proved by any positive evidence than by a consideration of the state of Australia, a country remarkable for the fewness of its rivers, and the general poverty of its soil. Contrary to all precedents, the richest soils in this land, excepting the alluvial, are found on the summits of hills. The fires which so frequently happen on the plains, the peculiar character of the vegetation (chiefly consisting of evergreens), and the sparing distribution of water, are the principal causes of the sterility of this otherwise desirable country. There are, however, spots which, covered with alluvial soil, can rival the richest and most cultivated districts of England; and the comparison of these with other lands impresses the observer the more strongly with the great importance of the natural provision for the restitution of that portion of the earth inhabited by man, by the disposition of new earthy matter and a virgin soil. The alluvial flats of the Nepean, the Hawksbury, and the Hunter rivers, are spoken of by all writers as remarkable for their fertility. The rich valley in which the Lake Alexandrina is situated may be noticed as another example of the influence of alluvial soils. The country around this lake appears to be one of the most beautiful and fertile in Australia; and a glance at the map will immediately inform the inquirer of the cause. It is so situated as to receive the worn materials of the mountain chain that ranges along the promontory of which Cape Jervis is the southern point, and also to obtain moisture from the lake, and a renovating soil whenever it may overflow its banks. Alluvial soils are produced by the discharge of mountain streams into valleys, as well as by the overflow of rivers. We have already explained the manner in which they collect the superficial covering of mountainous districts, and being charged with earthy matter, bring it into the plains. This may be deposited before the streams are united together in an individual channel as well as after, and should this be done, the valley may be covered with alluvial products. The formation of a river is a process which requires time, and many changes must happen before the flowing waters can form for themselves a local habitation; obstacles must be removed, a bed must be scooped out, and an outlet must be formed, in the performance of which earthy matter must be accumulated, and extensive deposits be formed. A third cause in the production of alluvial deposits may be mentioned. The sea is making great inroads upon many of its shores, carrying a destructive war against the cliffs that vainly indeavor to oppose its force; while on the other hand it is in some instances receding from the shores against which it once beat; and thus, as though to recompense man for what it takes away, gives to him a portion of its own territory. Those districts which are thus added to the land are usually superposed by a fine, rich, alluvial soil, as also are those which have at a former period been covered by the sea, and would be at the present day, were it not for the ingenuity and works of man The districts in which are situated New Orleans, in America, and Missolonghi, in Greece, are chiefly alluvial, and nearly the whole of Holland has the same character, and can only be described as a district of which man has robbed the ocean. That part of the coast of Germany which is bordered by the North Sea is alluvial, and additions are constantly made to the shores by the gradual deposition of earthy matter upon the immense flats which extend along them. The first sign of vegetation on these lands is the appearance of the saltwort (*Salicornia maritima*), which is succeeded by the sea grass (*Poa maritima*), and when the land is very rich, by the marsh starwort (*Aster Tripolium*). The land is afterwards dyked, and used as pasture for sheep and cattle; so that the spot over which the sea has perhaps for ages exercised an undisputable control, is brought under the power of man in a state most admirably adapted to suit his wants. But it may be asked, whence does the sea obtain the earthy matter with which it abounds? Rivers discharge themselves into the ocean, and it has been already stated that their waters are charged, more or less, with superficial soil of mountainous countries and the destroyed materials of rocks. A part of this may be arrested by occasional or periodical inundations, and by deposition in the bed of the river, but a large quantity must still be carried into the ocean. It must also be remembered that the waters which is conveyed in a channel is constantly endeavoring so to arrange its course so as to suffer the least possible resistance. In this attempt, it attacks the banks that confine it, and widens its course, precipitating much earthy matter into the stream, to be removed by the flowing water. It frequently happens, and especially after the fall of heavy rains, that the water at the mouths of rivers is thick and turbid from the quantity of alluvial matter it holds in solution, and very many large rivers are rendered unsafe for navigation by the existence of large bars of sand or clay at their outlet. But the sea is not merely a passive recipient of the product of destructive causes, but is itself a cause. Sea coasts are constantly suffering depredation by the action of the waves that beat upon them. Whether we look at the soft and almost unresisting rocks of the eastern coast of England, or the hard primary rocks of Devonshire, Cornwall, and the Shetland Isles, the same result will be observed. During the stormy months of winter, when the waves are tossed upon the coasts with an almost uncontrolled violence, no rock is sufficiently hard to resist its energy, and when unruffled by a passing breeze in the months of summer, its influence upon the softer rocks is hardly less destructive, though more insidious, for it then attacks the base of the cliffs, and removing the support of the superincumbent mass, causes the precipitation of large portions into the sea. By these two causes the sea is provided with the materials for the formation of alluvial soils. Some estimate may be formed of the violence and extent of these causes, by an examination of the present state of the German Ocean, one fifth of which is covered by banks that appear to have been produced in the same way as the alluvial soils on the northern coast of Germany. Water, then, is a most powerful agent in the destruction and production of rocks, and were there no conservative principle, the changes that are going on would be more extensive than they are in the present day. The floods to which some rivers are subject are so impetuous that they frequently sweep away all opposing objects, and involve an entire district in ruin. These effects, however, are much more common in countries that are thinly covered by vegetation than in those where it is luxuriant, for it acts as a conservative agent, increasing the power of the resistance by binding the soil more closely together. This, therefore, will account for the diminished influence of floods upon low lands, and for the frequent deposition of rich and fertile alluvial soils. The composition of the alluvial soils that have been brought under cultivation is exceedingly various; but they are generally remarkable for their fertility, and are admirably suited for pasture lands. In general, says Sir Humphrey Davy, the soils, the materials of which are most various and heterogeneous, are those called alluvial, or which have been formed by the deposition of rivers; many of them are extremely fertile.—Appleton's New Cyclopædia.

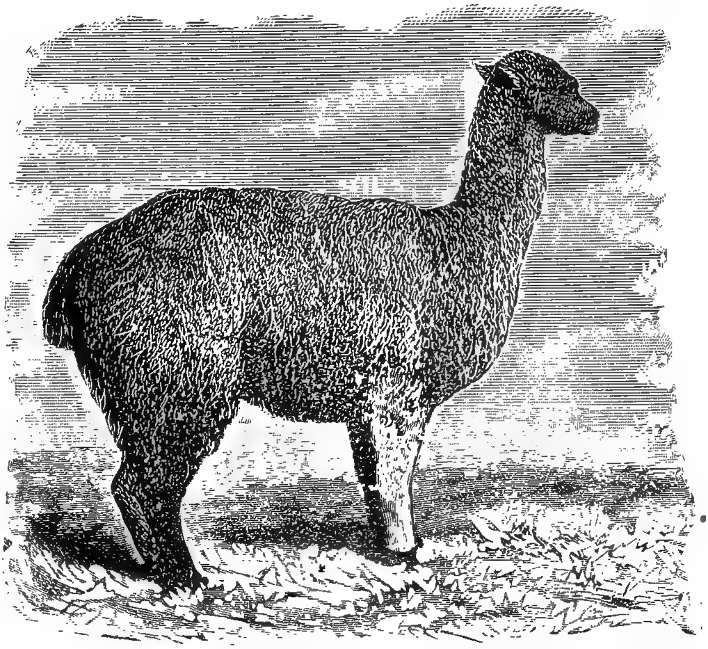
ALMOND. The common almond tree (*Amygdalus communis*) is a native of Northern Africa, and so late as the time of Cato had not been introduced into Italy, as he calls the fruit Greek nuts. It was introduced into Britain about 1548. It will grow to the height of twenty or thirty feet, dividing into a head of numerous spreading branches. The leaves very much resemble those of the peach, but they proceed from buds both above and below the flowers. There are also small glands on the lower saw-toothing of the leaves. The form of the flowers is not very different from those of the peach, but they come out usually in pairs, and vary more in their color, from the fine blush of the apple blossom to a snowy whiteness The chief obvious distinction is in the fruit, which is flatter, with a leather-like covering, instead of the rich pulp of the peach, and the nectarine, and it also opens spontaneously when the kernel is ripe. The shell of the almond is never so hard as a peach stone, and is sometimes even tender and exceedingly brittle. It is flatter, smoother, and the furrows or holes are more superficial than those of the peach stone. In the United States the almond is hardy in the Gulf States, and even to the latitude of Kentucky. It is not, however, cultivated for market, we believe, except in California, where already very considerable plantations of it are grown.

ALOES. The dried juice, or an extract of numerous species of Aloe, particularly the *Aloe spicata.* The plants inhabit arid countries in the tropics, and have long, rather fleshy leaves, and a liliaceous inflorescence arranged in spikes. The drug is a nauseous bitter, and warm purgative. It is administered to horses in balls of four to five drachms.

ALOPECURUS. The genus of Fox-tail grasses; they resemble the cat's-tail. Many are of great agricultural value.

ALPACA. An animal inhabiting the mountains of Peru (the *Camelus paca* of Linnæus), used as a beast of burden. The wool is particularly valuable, and many attempts have been made to introduce them into various countries, but as a rule not with success. Of the late attempt to introduce them into the United States, Hon. Frederic Watts, Commissioner of Agriculture under President Grant's administration, in his report says in relation to the Alpaca, that, in the latter part of 1875, correspondence was had between the Commissioner and Hon. Francis Thomas, late minister to Peru (since deceased), concerning a small flock of Alpacas which that gentleman had imported from Peru and placed on his farm at Frankville, Alleghany county, Md. In a letter dated October 8, 1875, Mr. Thomas, inclosing a sample of the wool of four months' growth, remarked: The fiber of a fleece of twelve months' growth often exceeds fifteen inches in length, and fleeces average from seven pounds to ten pounds each in weight. The animals live to the age of twenty, twenty-five, and sometimes thirty years; are too large and bold to be worried by dogs, and are very docile and tractable. I think you will concur with me in the opinion that this experiment which I am conducting is well worth the expense which I have incurred, especially when we consider the public benefit which would accrue in case of my success. Attempts have been made at various times in this country, in Europe and in Australia, to introduce the Alpaca, but generally without profitable result. Various causes have contributed to the failure of these efforts. Sometimes the confinement on shipboard during a long voyage, with impure air and unaccustomed food, has almost destroyed the stock. Again, the animals, when brought to their destined abode have been placed on luxuriant clover pasture, or other feed, so much richer than the coarse herbage of their native regions, that disease has fastened on the whole flock. The Alpaca is indigenous in the mountain regions of Peru, and thrives in the highest inhabited districts of the Andes, where the cold is more severe than in most parts of the United States. Accustomed to the vicissitudes of such regions, and inured to cold, damp, hunger, and thirst, it is especially adapted to bleak hill districts. Yet it is said to do well in most localities where the air is pure, the heat not oppressive, and water for bathing readily accessible. The latter is stated to be indispensable to the health of the animal, which, when deprived of this requisite, soon becomes fevered and infected with scab. While the introduction of the Alpaca into this country still remains a matter of experiment, there is no known reason why such experiments should not be successful, when properly conducted, in localities affording some approximation to the native conditions of the animal. Not to mention many elevated situations in the Atlantic, Northern and Central States, the regions lying along the Rocky mountain ranges have been indicated as presenting good opportunities for such trials.

ALSIKE CLOVER. Swedish clover, *Trifolium hybridum.* This variety of clover has been introduced into various localities, and with varying results—some authorities speaking highly of it and others as severely denouncing it. It is generally, however, agreed that it is a good bee pasture, and that it succeeds in moist soils better than the common red clover. It grows to about the height of medium red clover. The blossoms are white. It would seem from the evidence that it is not so liable to winter kill as red clover, and that it suffers less from cold, wet weather, being in this respect like the small white or Dutch clover. On dry soils, especially those of a sandy nature, it is conceded not to do well, but is better adapted to moist, loamy soils. It may be mown for hay when the blossoms are fully mature, at which time red clover has lost much of its succulence. Its aftermath is both dense and heavy, furnishing pasturage late in the season. Both the aftermath and the hay are fairly well liked by cattle, and it is undoubtedly valuable on the soils we have named.



ALPACA SHEEP.

ALTERATIVES. Medicines which improve the health without any active effect.

ALTERNATE HUSBANDRY. That sort of management of farms which has one part in the state of grass or sward, while the other is under the plow, so as to be capable of being changed as there may be occasion, or as the nature of the land may require. This system of management is supposed to lessen the expense of manure and keep the land more clean. (See Husbandry.)

ALUM. The sulphate of alumina and potash. The powder is a powerful styptic, and used to arrest bleeding. In lotion it is astringent and stimulating. When burned the powder becomes caustic. The lotion may be made with six to eight drachms of alum to a quart of water. It is used for grease, cracks in the heels of horses, and ulcers after the inflammation is subdued. The alum is used by dyers, but the solution of acetate of alumina is superior for most purposes.

ALUMINA. Alumina, or alumine, is one of the component parts of alum, from which it was originally extracted. It is the principal constituent of clays, in which it is found generally mixed with other subtances that impart to it a color, it being naturally white. It is a compound of oxygen and the metal aluminum. The precious stones, corundum, sapphire, emery and other varieties, are nearly pure crystallized alumina, particularly the sapphire, which is very hard, and is cut by means of diamond powder and is polished on lead wheels with the same powder, or that of emery, a less pure variety of the same mineral. The specific gravity of alumina is 2 (water being unity). It is without smell, and has little or no taste, but is not altogether void of astringency. It has a strong affinity for water, and gives it off with readiness when heated. The tenacious, sticky nature of clay soils is owing to this property, and is marked in proportion as the soil approaches to pure alumina. As it gives off water under the effects of the sun or the wind, it hardens, cracks, and becomes obdurate and unyielding. Of all soils pure clay is therefore the most difficult to manage or subdue by cultivation. Sir Arthur Young has said that no man ever throve upon a stiff soil. Strong teams are required to work it, and this can be done at the proper moment only, as it is not only difficult and expensive, but to a certain extent injurious at other times. Clay has merits which should not be underrated, such as the retention of fertilizers more effectually perhaps than any other material, and its capability of absorbing ammonia when exposed to the air, as is apparent to the smell when a piece of clay is breathed upon, for the peculiar odor emitted on such an occasion is due to the presence of this alkali. Alumina is rather an essential element of soils, or purveyor of food, than a constituent of plants; for the ashes of plants rarely contain it, and even then but sparingly. There is reason to suppose that those analyses which give alumina as a constituent in certain plants are erroneous, and that what was rendered as alumina may have been in reality phosphate of lime. Thus, it is stated that three-fifths of a grain of alumina are found in thirty-two ounces of the grains of wheat, and about four grains in thirty ounces of the grains of barley and of oats. It is also said to constitute 3.72 parts in 100 of the entire plant of the sunflower, 7.11 of the entire plant of Turkey wheat, and 14 of the entire plant of the fumitory. It is seldom or never found uncombined, but rather in the form of silicate, sulphate, or phosphate of alumina. It is an important part of the crystalline rocks. Aluminous minerals, so manifestly essential to the fertility of soils, are extensively diffused throughout the surface of the globe. They occur in all soils susceptible of cultivation, which may be owing to the fact that they are retentive of fertilizing salts; and, according to a paper lately published by Prof. Voelcker, aluminous earths possess the power of absorbing and retaining fertilizing principles in such a state of combination as to readily yield them to plants, without their being subject to detraction from that combination by rain or water as it usually falls or passes through soils. In order to form a distinct conception of the quantities of alkalies in aluminous minerals, says Liebeg, it must be remembered that feldspar contains 17¾ per cent. of potash, albite (soda feldspar) 11.43 per cent. of soda, and mica from 3 to 5 per cent., and that zeolite contains from 13 to 16 per cent. of alkalies. The analyses of Gmelin, Lowe, Fricke, Meyer and Redtenbacher, have also shown that basalt and clinkstone contain from ¾ to 3 per cent. of potash, and from 5 to 7 per cent. of soda; that claystone contains from 2.75 to 3.31 per cent. of potash, and loam from 1½ to 4 per cent. of potash. The quantities of these substances present in any specimen can not give a correct estimate of its presence in all portions of the rock; nor are the alkalies the only fertilizers to be anticipated, where analysis has not heretofore mentioned or detected their presence, since the presence of phosphoric acid has been shown in a variety of rocks which were considered free from that substance and from all organic remains, such as clinkstone, phonolites, hornblende, augite, compact basalt, trap rock, pumice stones, obsidian, mica, granite, chlorite-slate, porphyry, mica-slate and gneiss, and in native borax from the East Indies. Soils eminently aluminous, as has been stated, are absorbents of water and retentive thereof. This renders them stiff, waxy and cold, as well as damp, and exceedingly difficult to cultivate and subdue. It has been said that this property of clay soils may be modified by the application of sand; but this is often expensive, and at all times laborious and attended with difficulty in making the admixture. The cohesive nature of clays may be overcome, and they made comparatively porous, dry, warm and fertile, by the operation of paring and burning, the particles being thus partly fused and made to cohere and form a gritty mass containing the elements inherent to the clay with the properties of sand. Besides this, burnt clays have an increased power for the absorption of ammonia; but clays thus heated lose a great proportion of their retentiveness of moisture. The most cohesive clays may, by this process, be converted into a fine, dry, powdery soil as light as an ash bank; and where rushes, and coarse grasses, and semi-aquatic plants have got hold, a new growth will come in, and the soil will become fertile and easily cultivated. The roots and fibers of weeds and plants, and all noxious seeds, may be eradicated by paring and burning; and in a vast number of instances soils of a clayey nature that can not otherwise be brought into economical culture, may by this operation be rendered fruitful. The alteration in the inert vegetable fiber existing in soils, when subjected to this operation, will often have a decided effect upon its productiveness, by converting useless and injurious matter into assimilable plant food; or a product may be thus obtained having an advantageous chemical action upon the inorganic constituents of the soil. The transformation of inert vegetable fiber by charring, or even roasting, will add to the absorbent quality of the soil in proportion to the amount of those substances in the earth; for it is known that charcoal has surprising qualities of absorption and condensation, not of water, but of those gases which have an evident influence upon fertility. The paring and burning process, though applicable and advantageous to deep clays that are barren from their closeness and their wetness, would be followed by disastrous consequences if applied to shallow arenaceous lands. In this case it would drive off or destroy even the scanty vegetable matter that such a soil might contain, leaving an arid sandy waste. Sandy soils are frequently too porous, and the heat generated by paring and burning could not give consistence to such a material as silicious sand, since silex, however fusible when in contact with bases such as alumina, lime, magnesia and the alkalies, is refractory by itself.

ALVEOLATE. Covered with little pits; honey-combed.

ALVINE. Relating to the bowels.

AMALGAM. A compound of mercury with a metal.

AMANITA. A genus of poisonous mushrooms.

AMAUROSIS. Total blindness, without loss of brilliancy in the eye. It is a disease to which horses are very subject, and should never be treated with the hope of cure.

AMBLE. The same as the pace in horsemanship.

AMBUSTION. A scald or burn.

AMELIORATING CROPS. Root crops; clovers and grasses fed on the land.

AMENTABOLIANS. Insects which do not undergo metamorphoses.

AMENTUM. The catkin; a deciduous spike, such as that of willows, poplars, etc. Trees with this inflorescence are called amentaceous, and usually contain much potash in their ashes.

AMERICAN BREEDS OF SWINE. (See Cheshire, Chester White, Jersey Reds, Poland China, and Victoria Swine.)

AMIDINE. The soluble, internal portions of the starch globules.

AMMONIA. Volatile alakli, spirits of hartshorn. Ammoniacal gas is the gaseous state of pure ammonia before it is dissolved by water, in which it is extremely soluble; it is also rapidly absorbed by charcoal, clays, rust, etc. Ammonium is a hypothetic base of ammonia, consisting of nitrogen and hydrogen. The oxide of ammonium is the common base, as found in the salts of ammonia, and consists of nitrogen, hydrogen and oxygen. (See Nitrogen.)

AMNION. The delicate membrane which surrounds the fœtus in utero; it contains the amniotic fluid, or liquor amnios. The fluid within the nucleus of the young seed, on which the embryo feeds, is called amnios.

AMORPHOUS. Without regular figure or form.

AMPHIBOLE. A variety of horn blende.

AMPHITROPAL. In botany, an embryo which is turned round in the albumen, or curved upon itself in such a manner that both its ends are presented to the same point.

AMPLEXICAUL. Clasping or embracing the stem.

AMYGDALIN. A white, sweetish, soluble matter in bitter almonds, changeable into oil of bitter almonds by the action of emulsin.

AMYGDALOID. Rocks in which other minerals are embedded; pudding-stone.

AMYGDALUS The generic name of the peach and almond.

AMYLACEOUS. Starchy; full of starch.

AMYLIN. Pure starch.

ANÆSTHETICS, ADMINISTERING. Anæsthetics are of value in rendering an animal wholly or partially insensible. Vapors, sprays and fumes are also valuable, and nearly related in the form of administering. When a surgical operation is to be performed, anæsthetics may be administered, held directly to the nose by means of a sponge, or a sponge may be placed in a net, fastened under the nose, and the anæsthetic introduced thereon. In diseases of the throat and windpipe,—as catarrh, sore throat and strangles,—steam, either clear or in combination with belladonna, laudanum, sulphurous acid, vinegar, etc., will often give quick relief. So vapors may be easily produced by charging a liquid, as water, with the medium to be used, by means of a hand-ball atomizer; these will be found useful for diseases of the nostrils, mouth and throat. Powders are also used to cause expulsion of the secretions of the nostrils, thus clearing the nasal passages or inner surface of the nose. A tube and hollow rubber ball is used for this purpose. A hollow section of alder, or sumac, charged with the powder, and one end furnished with a piece of rubber tubing, answers well the operation of blowing it into the nostrils with the breath. A good anæsthetic is composed as follows: One ounce alcohol, two ounces chloroform, three ounces ether. Shake the bottle well before using it, and two or three minutes time will cause the strongest animal to succumb, when used as heretofore directed. In chronic cough, flowers of sulphur or the fumes of burning tar will soon fill a stable, and is valuable for treating the lining membranes of the breathing organs. The first is an agent of great value for disinfecting purposes.

ANAL GLANDS. Glands for the secretion of various substances, situated near the anus.

ANALYSIS. Analysis consists in determining the constituent elements of the subject of analysis. By it we show either the organic or inorganic elements. In soils, for instance, we may find how much sand, lime, alumina, phosphoric acid, potash, magnesia and other constituents are contained in the sample; but we can not through analysis arrive at any definite determination of the amount of plant food which is at the disposal of the present crop. It may or may not be locked up in insoluble forms. Hence it has been found that experience alone must demonstrate the productions of the soil. But an analysis of a soil may show its adaptation naturally to certain crops. Here, again, experience is sufficient in the generality of cases. It is the fact that the chemist may compound a soil artificially containing every element of plant food in abundance, and yet which will be perfectly sterile, because locked up in insoluble combinations. Nitrogen, phosphoric acid and potash, are the three important constituent elements in soils, because these are, as a rule, the substances whose absence or deficiency impair fertility. Yet there are many cases when lime, magnesia, oxide of iron, chlorine, sulphuric acid, etc, may be needed, because absent or deficient, and hence they become prime integers. Analysis will show the absence of a constituent, and hence its value, in special cases, when particular crops are to be raised, the soil, perhaps, lacking only one or two of the constituents necessary to perfect the crop. When we come to the plants or grains themselves, analysis becomes more practically important, since it shows just the amount of nutrition contained. Thus, in special feeding, it becomes of especial value to know the constituents of certain foods. And in the feeding of calves, when skim milk or whey is to be used, analysis will show what should be added to either to form a comparatively perfect food We say comparatively, for in combined food, however perfectly or scientifically it may be compounded, it can not equal the whole and natural milk of the cow. This is the type of all animal food, milk being conceded to be practically as well as theoretically a perfect food. Several analyses of milk taken together we have averaged as follows:

Water	86.0
Flesh-formers	5.0
Fat-formers	8.0
Mineral matter	1.0
	100.0

In the manufacture of butter the fat-formers are the principal constituent removed. Hence in practice, the addition of linseed meal, or mush from finely ground Indian corn, or both, brings up the skimmed milk and buttermilk, relatively, to its normal condition as food for calves, after they are three or four weeks old. If the milk is converted into cheese, the flesh-formers are also removed. Hence the difficulty of bringing whey again to a perfect food. To do so, the equivalent of the casein, albumen, etc., must be restored. This may be measurably attained by the addition of oatmeal mush, and a little of linseed cake. Economically, milk may be stated to contain the following constituents:

Water	86.0
Casein	5.0
Fatty matter	3.5
Sugar	4.5
Mineral matter	1.0
	100.0

The following table will show results of many analyses of various food substances, economically considered, in comparative equivalents:

Foods.	Percentage of flesh-formers in 100 pounds.	Percentage of fat-formers in 100 pounds.	Total nutritive percentage in 100 pounds.	Nutritive equivalents of 100 pounds of superior meadow hay.
Irish potatoes	1.4	18.9	20.3	245.3
Carrot	0.6	6.6	7.2	691.6
Parsnip	1.2	7.0	8.2	607.3
Jerusalem artichoke	1.0	18.8	19.8	251.5
Sugar beet	0.9	13.6	14.5	336.5
Swedish turnip	1.0	5.2	6.2	803.2
Common white turnip	0.9	3.3	4.2	1185.7
Mangel-wurzel	1.0	12.6	13.6	367.6
Green pea stalks	0.9	7.9	8.8	565.9
Common vetch (green)	1.9	2.6	4.5	1106.6
Green oats (fodder)	1.0	8.5	9.5	524.2
Green timothy grass	4.0	9.7	13.7	363.4
Green red-top grass	3.3	8.7	12.0	415.0
Superior meadow hay	13.5	36.3	49.8	100.0
Red clover (green)	2.0	3.6	5.6	907.1
White clover (green)	1.5	2.7	4.2	1185.7
Lucerne (green)	1.9	3.6	5.5	905.4
Red clover (hay)	22.5	18.7	41.2	120.8
White clover (hay)	18.7	40.0	58.7	84.6
Lucerne (hay)	12.7	38.0	50.7	98.2
Wheat flour	14.7	66.4	81.1	61.4
Indian corn	11.0	66.7	77.7	64.2
Rye meal	14.3	55.8	70.1	71.0
Barley meal	13.0	52.0	65.0	76.0
Oat meal	18.0	51.1	69.1	72.0
Buckwheat meal	9.0	52.1	61.1	81.5
Peas	23.1	41.9	65.0	76.0
Kidney beans	23.9	39.3	63.2	78.7
White field beans	24.0	39.7	63.7	78.2
American linseed cake	22.2	48.6	70.8	70.3

In relation to analyzing a soil, says Prof. Hitchcock, in his report of the Geological Survey of Massachusetts, Dr. Davy sets out by stating that geine constitutes the basis of all the nourishing part of vegetable manures. By the term geine, he means all the decomposed organic matter of the soil, chiefly derived from decayed vegetable matter. Animal substances, he says, produce a similar compound containing azote or nitrogen. There may be undecomposed vegetable fibres so minutely divided as to pass through the sieve, but as one object of this operation is to free the soil from vegetable fibre, the portion will be quite inconsiderable, and can only affect the amount of insoluble geine When so minutely divided, it will probably pass into soluble geine in a season's cultivation. Geine, or the vegetable nourishing matter of soils, exists in two states, in one of which it is soluble in water, etc., whilst in the insoluble state it resists the solvent power of water. Soluble geine he considers the immediate food of growing plants, whilst insoluble geine becomes food after sufficient exposure to air and moisture. Hence the reason and result of tillage. We quote the following rules of analysis: 1. Sift the soil through a fine sieve. Take the fine part; bake it just up to browning paper. 2. Boil 100 grains of the baked soil, with 50 grains of pearl ashes, saleratus or carbonate of soda in four ounces of water, for half an hour; let it settle; decant the clear; wash the grounds with four ounces boiling water; throw all on a weighed filter, previously dried at the same temperature as was the soil (1); wash till colorless water returns. Mix all these liquors. It is a brown-colored solution of all the soluble geine. All sulphates have been converted into carbonates, and with any phosphates, are on the filter. Dry therefore that, with its contents, at the same heat as before. Weigh—the loss is soluble geine. 3. If you wish to examine the geine; precipitate the alkaline solution with excess of lime-water. The geate of lime will rapidly subside, and if lime-water enough has been added, the nitrous liquor will be colorless. Collect the geate of lime on a filter; wash with a little acetic or very dilute muriatic acid, and you have geine quite pure. Dry and weigh. 4. Replace on a funnel the filter (2) and its earthy contents; wash with two drachms muriatic acid, diluted with three times its bulk of cold water. Wash till tasteless. The carbonate and phosphate of lime will be dissolved with a little iron, which has resulted from the decomposition of any salts of iron, beside a little oxide of iron. The alumina will be scarcely touched. We may estimate all as salts of lime. Evaporate the muriatic solution to dryness, weigh and dissolve in boiling water. The insoluble will be phosphate of lime. Weigh—the loss is the sulphate of lime. (I make no allowance here for the difference in atomic weights of the acids, as the result is of no consequence in this analysis) 5. The earthy residuum, if of a greyish white color, contains no insoluble geine—test it by burning a weighed small quantity on a hot shovel—if the odor of burning peat is given off, the presence of insoluble geine is indicated. If so, calcine the earthy residuum and its filter—the loss of weight will give the insoluble geine; that part which air and moisture, time and lime, will convert into soluble vegetable food. Any error here will be due to the loss of water in a hydrate, if one be present, but these exist in too small quantities in granitic sand to affect the result. The actual weight of the residuary mass is granitic sand. The clay, mica, quartz, etc., are easily distinguished. If your soil is calcareous—which may be easily tested by acids—then before proceeding to this analysis, boil 100 grains in a pint of water, filter and dry as before, the loss of weight is due to the sulphate of lime, even the sulphate of iron may be so considered; for the ultimate result in cultivation is to convert this into sulphate of lime. Test the soil with muriatic acid, and having thus removed the lime, proceed as before, to determine the geine and insoluble vegetable matter. In applying Dr. Dana's rules given in the text, to the soils of Massachusetts, I found it necessary to adopt some method of carrying forward several processes together. I accordingly made ten compartments upon a table, each provided with apparatus for filtering and precipitations, also ten numbered flasks, ten evaporating dishes, and a piece of sheet-iron pierced with ten holes, for receiving the same number of crucibles. I provided, also, a sheet-iron oven, with a tin bottom large enough to admit ten filters, arranged in proper order, and a hole in the top to admit a thermometer. The sand bath was also made large enough for receiving the ten flasks. In this manner I was able to conduct ten processes with almost as great facility as one could have been carried forward in the usual way. As before stated, Dr. Dana regards geine as the basis of all the nourishing part of vegetable manures. The relation of soils to heat and moisture, he says, depend chiefly on geine. It is in fact, under its three states of vegetable extract, geine and carbonaceous mould, the principle which gives fertility to soils long after the action of common manures has ceased. In these three states it is essentially the same. The experiments of Saussure have long ago proved that air and moisture convert insoluble into soluble geine. Of all the problems to be solved by agricultural chemistry, none is of so great practical importance as the determination of the quantity of soluble and insoluble geine in soils. This is a question of much higher importance than the nature and proportions of the earthy constituents and soluble salts of soils. It lies at the foundation of all successful cultivation. Its importance has been not so much overlooked as undervalued. Hence, on this point the least light has been reflected from the labors of Davy and Chaptal. It needs but a glance at any analysis of soils, published in the books, to see that fertility depends not on the proportion of the earthy ingredients. Among the few facts, best established in chemical agriculture, are these: that a soil, whose earthy part is composed wholly or chiefly of one earth; or any soil with excess of salts, is always barren; and that plants grow equally well in all soils destitute of geine, up to the period of fructification,—failing of geine, the fruit fails, the plants die. Earths, and salts, and geine, constitute, then, all that is essential; and soils will be fertile, in proportion as the last is mixed with the first. The earths are the plates, the salts the seasoning, the geine the food of plants. The salts can be varied but very little in their proportions, without injury. The earths admit of wide variety in their nature and proportions. I would resolve all into granitic sand; by which I mean the finely divided, almost impalpable mixture of the detritus of granite, gneiss, mica-slate, sienite, and argillite; the last, giving by analysis, a compound very similar to the former. When we look at the analysis of vegetables, we find these inorganic principles constant constituents—silica, lime, magnesia, oxide of iron, potash, soda, and sulphuric and phosphoric acids. Hence, these will be found constituents of all soils. The phosphates have been overlooked from the known difficulty of detecting phosphoric acid. Phosphate of lime is so easily soluble when combined with mucilage or gelatine, that it is among the first principles of soils exhausted. Doubtless, the good effects, the lasting effects, of bone manure, depend more on the phosphate of lime, than on its animal portion. Though the same plants growing in different soils are found to yield variable quantities of the salts and earthy compounds, yet I believe that accurate analysis will show, that similar parts of the same species, at the same age, always contain the inorganic principles above named, when grown in soils arising from the natural decomposition of granite rocks. These inorganic substances will be found not only in constant quantity, but always in definite proportion to the vegetable portion of each plant. The effect of cultivation may depend, therefore, much more on the introduction of salts than has been generally supposed. The salts introduce new force. So long as the salts and earths exist in the soil, so long will they form voltaic batteries with the roots of growing plants, by which, the granitic sand is decomposed and the nascent earths, in this state readily soluble, are taken up by the absorbents of the roots, always a living, never a mechanical operation. Hence, so long as the soil is granitic,—using the term as above defined,—so long is it as good as on the day of its deposition; salts and geine may vary, and must be modified by cultivation. The universal diffusion of granitic diluvium will always afford enough of the earthy ingredients. The fertile character of soils, I persume, will not be found dependent on any particular rock formation on which it reposes. Modified they may be, to a certain extent, by peculiar formations; but all our granitic rocks afford, when decomposed, all those inorganic principles which plants demand. This is so true, that on this point the farmer already knows all that chemistry can teach him. Clay and sand, every one knows; a soil too sandy, too clayey, may be modified by mixture, but the best possible mixture does not give fertility. That depends on salts and geine. If these views are correct, the few properties of geine which we have mentioned, will lead us at once to a simple and accurate mode of analyzing soils; a mode which determines at once the value of a soil, from its quantity of soluble and insoluble vegetable nutriment; a mode requiring no array of apparatus. nor delicate experimental tact; one, which the country gentleman may apply with very great accuracy, and, with a little modification, perfectly within the reach of any man who can drive a team or hold a plow.

ANASARCA. A dropsy in the cellular tissue of the limbs.

ANASTOMOSIS. The interlacing and union of small veins or arteries proceeding from different parts. Formerly supposed to be the opening of the vessels, and excretion of contents.

ANATOMY OF THE HORSE. (See Horse, Anatomy of.)

ANATROPOUS. A very common embryo, produced by one side of the ovule growing upon itself, while the other remains immovable, till, at last, that part of the ovule which was originally next the apex is brought down to the hilum, the base of the nucleus in such cases being at the apex of the ovule. The common apple, and the greater part of plants, offer an example of this.

ANBURY. In farriery, a spongy, soft tumor, commonly full of blood, growing on any part of an animal s body. Sustances of this kind may be removed either by means of ligatures being passed round their bases, or by the knife, and the subsequent application of some caustic, in order to effectually destroy the parts from which they arise.

ANCHYLOSIS. A stiff, immovable joint.

ANCIPITOUS. Having two edges.

ANDROCEUM. The male parts of the flower.

ANDROGYNOUS. Hermaphrodite; a union of both sexes.

ANELLIDES. *Anellata.* The class of articulated animals formed of ring-like segments, as the earth-worms.

ANELYTROUS. Without elytra or wing-cases.

ANEMOMETER. An instrument for measuring the force or velocity of the wind; a wind gauge.

ANEMOSCOPE. An instrument showing the direction of the wind; a weathercock.

ANEURISM. In farriery, a throbbing tumor, produced by the dilitation of the artery coats in some part of the body of an animal. Aneurisms in the limbs may be cured by making an incision, exposing the artery, and tying it above and below the tumor with a proper ligature

ANGINA. In farriery, a name sometimes applied to the quinsy, or what in animals is termed anticor; sore throat.

ANGLE BERRY. In farriery, a sort of fleshy excrescence, to which cattle and some other animals are subject under different circumstances, and are supposed to proceed from a rupture of the cutaneous vessels, which give vent to a matter capable of forming a sarcoma or fleshy excrescence. They frequently appear upon the belly and adjacent parts, hanging down in a pendulous manner

ANGUSTATE. Narrow; diminishing rapidly in breadth.

ANGUSTURA BARK. The bark of the *Cusparia febrifuga* of South America; used as a tonic.

ANHYDROUS. Without water; a chemical term to express the entire absence of water in a salt or acid substance.

ANIMAL. Any object capable of voluntary motion; a function dependent on the nervous system, which is peculiar to animals and absent in plants.

ANIMAL ACIDS. Acids existing in animals or produced from their tissues. The principal are the oily acids, choleic, lactic and uric. (See Acids.)

ANIMALCULES. Infusorials. Miscroscopic life, both animal and vegetable; some of these vegetable forms have the power of motion.

ANIMAL MANURES. (See Urine, Manure.)

ANIMAL POISONS. The bites of venomous reptiles, rabid dogs, the contagious diseases produced by decaying meat, cheese, infected cattle, glanders, are all called animal poisons. They usually produce great prostration, and call for the use of ammonia and stimulants.

ANIMALS. The animals of the farm are horned cattle, horses, mules, asses, swine, sheep, goats, and in some sections of the country, as in some hill regions of the South and California, the alpaca. So, also, the llama, the guanaco and the vicuna have been introduced, but not successfully. Some years before the war, camels were introduced into Texas, but they did not prove profitable, although some specimens of them still exist in the far southwest and in Arizona, where they have been used for transporting goods to the mines. On the whole, however, mules prove better adapted to the necessities of the country. The productive farm animals will be treated of under their proper names, which see.

ANISE-SEED. *Pimpinella anisum.* The aromatic seeds of a well known umbelliferous plant. The oil is a grateful aromatic to the stomach.

ANISOTOMIDÆ. A family of coleopterous insects, having moniliform or beaded antennæ, sub-elongate, slender at the base, gradually increasing towards the apex, with a terminal club-shaped multarticulate joint; palpi various, generally filiform; head small and ovate; body convex, never linear.

ANNUALS. Plants which perfect seeds in one year and die, as wheat, rye, etc.

ANNULUS. An organ resembling a ring, as the collar which surrounds the stem of some mushrooms.

ANODYNE. A drug which allays pain, as opium, camphor, henbane, etc.

ANOTTO (Annoto). An elegant coloring substance used in the arts, and in the dairy for coloring butter and cheese, obtained from the pulp of the seed vessels of the *Bixa orellana.* (See Dairy.)

ANTACIDS. Medicines which neutralize the acid of the stomach in disease, as chalk, carbonate of soda, etc.

ANTENNA. *Antennæ.* The hair-like jointed organs on the heads of insects. They are very movable, and are supposed to be organs of sensation.

ANTEPECTUS. In insects, the under side of the main trunk, in which the first pair of legs is inserted.

ANTHELMINTICS. Drugs which are used to destroy intestinal worms. Turpentine, worm-seed oil, pink-root and aloes are the most important.

ANTHER. The bilobate organ, containing pollen, situated at the summit of the filament, the two constituting the male organ, or stamen of plants.

ANTHODIUM. A head of flowers, as in the thistle or sunflower; a capitulum.

ANTHOXANTHUM. A genus of grasses, of which *A. odoratum* is the sweet-scented vernal grass. (See Grasses.)

ANTIBRACHIUM. The forearm.

ANTICLINAL AXIS. The line lying between strata which dip in opposite directions.

ANTICOR. An inflammation of the throat and gullet in horses, attended with fever and prostration; a kind of quinsy.

ANTIDOTE. A remedy against a poison.

ANTIMONY, TARTRATE OF. (See Tartar Emetic.)

ANTIPHLOGISTIC. Remedies opposed to an inflammatory state.

ANTISEPTICS. Substances which prevent putrefaction.

ANTISPASMODICS. Remedies which cure spasms or cramps, as opium, camphor, asafœtida, etc.

ANTITROPAL. When in a seed the radicle of the embryo is turned to the end farthest away from the hilum. This, although a comparatively unusual position of parts, is, nevertheless, the normal position, if the exact nature of the development of an ovule is rightly understood.

ANTRUM. A cavity.

ANTS. A genus belonging to the entomological classification *Hymenoptera*. The food of ants consists both of vegetable and animal juices. As a rule they are more troublesome than they are noxious, and not specially beneficial, since they do not kill insects but eat only such as they find dead or maimed. Ant-hills are readily destroyed by digging up in the depth of winter and scattering the earth; the exposure will thus destroy the entire colony.

ANTS, BLACK. To destroy, remove the upper portion of the hill, so as to form a basin as large as the entire nest. Let this be the deposit of dry ashes for one week, each morning, as they are taken from the stove, or the hill may be excavated in the middle, and the hole filled with rough salt. About a house ants may be destroyed by placing bones about where they collect, and when covered with ants they can be burned, or killed with scalding water, and the bones replaced. Anise-seed oil is also said to drive them away.

AORTA. The great arterial vessel which issues from the left ventricle of the heart, and by its branches distributes blood to every part of the body.

APATITE. A greenish, crystalline mineral found in primary rocks, consisting of a phosphate and silicate of lime. It is found in the eastern and northern States, but only in small quantities. In Spain and Norway large quantities are developed. It has been spoken of as a manure in the place of bones.

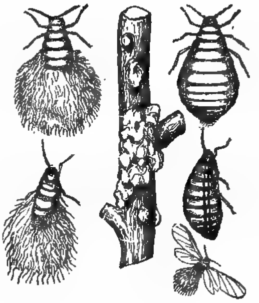
APERIENTS. Gentle purgatives.

APETALOUS. Without corolla.

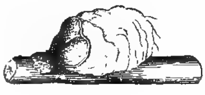
APEX. The summit.

APHANIPTERA. An order of apterous insects, with rudimentary elytra, and undergoing a change of form. The flea (*Pulex irritans*) is of this kind.

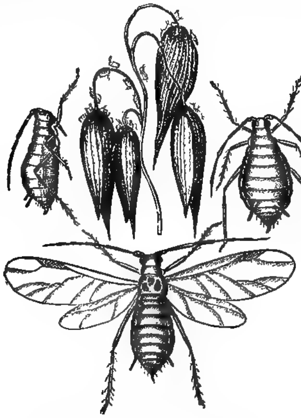
APHIDES, or plant lice, as they are usually called, are among the most extraordinary of insects. They are found upon almost all parts of plants—the roots, stems, young shoots, buds and leaves—and there is scarcely a plant which does not harbor one or two kinds peculiar to itself. They are, moreover, exceedingly prolific, for Réaumur has proved that one individual, in five generations, may become the progenitor of nearly six thousand millions of descendants. It often happens that the succulent extremities and stems of plants will, in an incredibly short space of time, become completely coated with a living mass of these little lice. These are usually wingless, consisting of the young and of the female only; for winged individuals appear only at particular seasons, usually in the autumn, but sometimes in the spring, and these are small males and larger females. After pairing, the latter lay their eggs upon or near the leaf-buds of the plant upon which they live, and, together with the males, soon afterward perish. The genus to which plant lice belong is called *Aphis*, from a Greek word which signifies to exhaust. The following are the principal characters by which they may be distinguished from other insects: Their bodies are short, oval and soft, and are furnished at the hinder extremity with two little tubes, knobs or pores, from which exude almost constantly minute drops of a fluid as sweet as honey; their heads are small, their beaks are very long and tubular, their eyes are globular, but they have not eyelets; their antennæ are long and usually taper toward the extremity, and their legs are also long and very slender, and there are only two joints to their feet. Their upper are nearly twice as large as the lower wings, are much longer than the body, are gradually widened towards the extremity, and nearly triangular; they are almost vertical when at rest, and cover the body above like a very sharp-ridged roof. The winged plant-lice provide for a succession of their race by stocking the plants with eggs in the autumn, as before stated. These are hatched in due time in the spring, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the brood, without a single exception, consists wholly of females, which are wingless, but are in a condition immediately to continue their kind. Their young, however, are not hatched from eggs, but are produced alive, and each female may be the mother of fifteen or twenty young lice in the course of a single day. The plant-lice of this second generation are also wingless females, which grow up and have their young in due time; and thus, brood after brood is produced even to the seventh generation or more. without the appearance or intervention, throughout the whole season, of a single male. This extraordinary kind of propagation ends in the autumn with the birth of a brood of males and females, which, in due time, acquire wings, and pair; eggs are then laid by these females, and with the death of these winged individuals, which soon follows, the race becomes extinct for the season.—Harris' Insects Injurious to Vegetation. In the case of the oats aphis, we believe they are single-brooded; otherwise their habits are much the same as the other plant-lice, having honey


WOOLY APPLE-TREE BLIGHT.

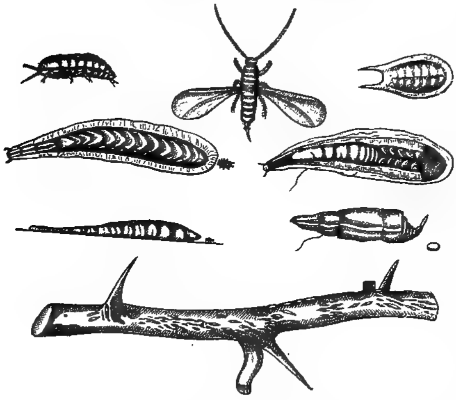
PEAR TREE FLEA LOUSE.


MAPLE BARK SCALE INSECT.

tubes, except that, although these are well developed, they emit no honey and therefore are not followed by ants. They are also stated to freeze fast with the plants in the fall and revive in the spring. The mussel-shell orange-scale insect (*Aspidiotus aloverin*) is found on the orange in Florida, where it does much injury to the orange trees, sometimes killing whole orange groves; it is found, also, on citron and lemon trees, and even sparingly on a camelia grown under an orange tree. The female scale resembles the upper half of a miniature brown mussel-shell, with its flat side downward on the leaf. These scales, when placed singly and not crowded together, are generally straight in form, but when in clusters, they are curved to suit the inequalities of the surface or contiguity of the neighboring scales. The insect itself is sheltered under the scale, and is of a soft consistence, having the body gradually tapering from near the tail to the anterior part, which ends somewhat obtusely. This insect, like the oyster-shell bark-louse of the North, is single-brooded each season. That is, unlike the plant-lice, they do not propagate for several generations by the fertilization of a common ancestor.



GRAIN OR OAT PLANT-LOUSE.



MUSSEL-SHELL SCALE INSECT OF ORANGE TREE.

APHTHÆ. This contagious malady, after having been well known in Central Europe for more than two centuries, reached Great Britain in 1839, Denmark in 1841, and the united States in 1870. It is supposed to have been introduced from cattle shipped from England in that year and landed in Canada. It made its appearance in Oneida county, N. Y , in September, from which it spread over various portions of the seaboard States. It is known by various names in England, principally as foot and mouth disease, and among veterinarians as epizootic, aptha and aphthous fever. Investigations under the direction of the Commissioner of Agriculture at Washington, show the following facts in relation to the disease, its causes and cures: This contagious malady of stock belongs to the class of zymotic disease, or, in other words, it is caused, like specific fevers generally, by the introduction into the system of a poison germ, which propagates itself, and increases in the blood and tissues in a manner allied to the growth of a ferment in a saccharine solution. During this reproduction of the virus in such fevers, the system passes through a series of successive stages of disease, the nature and duration of which are determined by the character of the particular poison taken in, and during which the poison germs (contagious principles) are given off abundantly by one or other or all of the secreting surfaces. Hence, like other zymotic diseases, this is altogether specific in its cause, its nature, and its mode of propagation. As known in Western Europe and America, this disease is invariably due to a virus or contagion thrown off by some animal suffering from the disease; it is always manifested by a slight preliminary fever, and a period of eruption and decline, and these are respectively of constant and well defined duration. These different periods of the disease are characterized by varied manifestations. The first period is that of incubation during which the poison germs are in the body of the animal, and propagating themselves there, but have not yet affected the constitution so as to impair the functions, or give rise to the more manifest symptoms of illness. Towards the end of this period, however, the thermometer shows an increase of temperature in the interior of the body, of about two degrees beyond the natural standard. This period lasts twenty-four to forty-eight hours, though in rare cases it may apparently extend to a week. It is followed by a period of eruption, which is first manifested by the redness, heat and tenderness of the udder and teats, of the space between the hoofs, and of the membrane of the mouth. In the course of one day more, these parts are found to be the seat of numerous hemispherical elevations or blisters, caused by the effusion of a clear yellowish fluid from the blood-vessels beneath the cuticle or scarfskin. These increase in size for the next two or three days, burst, and dry up. The period of decline is marked by the drying and scabbing over of the sores caused by the rupture of the blisters, and by the reproduction of the lost cuticular covering or scarfskin. The elevated temperature, which had declined somewhat on the appearance of the blisters, now entirely subsides, unless maintained by exposure, or the irritation of the sores by dirt and other bodies. This period has passed and the disease is at an end by the fifteenth day, in favorable cases. The only known cause of itself capable of inducing the disease is contagion, or contact of a sound animal with the virus discharged from the sores of an aphthous patient. Many accessory causes may be named, such as a wet, muddy season, which insures the contact of the virus deposited on the soil with the skin about the top of the hoofs; the accumulation of cattle in large fairs or markets; the aggregation of large numbers of live stock for the supply of armies in the field; travel of stock by rail or road, and the like. Yet these are but means for the diffusion of the poison, while no one of them, nor all taken together, can call the disease into existence where the poison is not already present. Such comprehensive facts as these narrow the list of real causes down to the simple contact of the virus with a healthy animal. This virus, however, is perhaps the most contagious known. It is often carried on the clothes, boots and hands of man; on the fibers of hay or straw; preserved on the walls, floors, mangers, and other fittings of the building; on stable utensils; in yards, parks, roads and railroad cars; on drinking troughs; or it may be carried on the legs or bodies of dogs, chickens, rats, and other animals which themselves escape the infliction. In short, any solid body may retain, and be a bearer of, this contagion. Fortunately, it does not spread to any extent in the atmosphere. Nothing is more common than to find a herd on one side of a road struck down by the disease, while another in a field on the opposite side of the road remains perfectly healthy. It may be carried by a strong wind in the form of a virulent saliva, or the virus may dry up on light bodies, such as paper, hay, etc., which are afterwards borne off by the wind. It may be carried by men or animals, or by water running from the diseased to the healthy lot; but, in the absence of such agencies, the breadth of a common road is amply sufficient to circumscribe the disease Cloven-footed animals appear to be the natural victims of this disease, and all species are about equally obnoxious to its attacks; but it may be communicated to many if not all other warm-blooded animals by inoculation or by contact of the virulent discharges with the mucous membranes. Its transmission to man has been noticed during almost every great outbreak since that of 1695. It has been reported, among others, by Valentine, Nadberny, Levitzky, Kolb, Hertwig, Rayer, Bosquet, Londe, Levigny, Dundussy, Hübner, Holmes, Balfour, Karkeek and Watson. Cases of the disease in man have been seen in Albany and at South Dover, Dutchess county, N. Y., during the present outbreak. It shows itself in man by slight feverishness, and the formation on the tongue and inside the lips and cheeks, and sometimes on the hands, of small blisters, rarely amounting to the bulk of a lentil. In children and young animals, feeding exclusively on milk, diarrhœa and fatal inflammation of the stomach and bowels occasionally supervene. It is further to be dreaded that the malady, gaining a lasting hold on the dairies of our large cities, may swell the list of mortality of the infant population by inducing those fatal diarrhœas and enteritis reported by Hübner, Balfour and Watson. Its existence in horses is reported by Sagar, Cleaver and Laubender, but the susceptibility of the soliped is very slight, and he can probably be affected only by inoculation. In chickens it has been frequently noticed —among others, by Hennicke, Sagar, Lamberlicchi, Dickens and Youatt. Chickens were attacked in December, 1870, on the farm of Mr. Eighmie, La Grange, Dutchess county, N. Y. The drinking of the castaway milk is probably the common cause. Dogs and cats have been noticed by Lagar, Younghusband and others, to suffer from drinking the milk. A shepherd's dog at Mr. Eighmie's suffered from the disease, and another, Mr. Preston's, South Dover, N. Y., had only partially recovered when seen by the writer. The victims may usually be picked out from a herd, twelve to twenty-four hours before they show distinct signs of the disease, by the increase of temperature indicated by a clinical thermometer introduced into the rectum and retained there for three minutes. In cattle the eruption may be concentrated on the mouth (including the muzzle and nostrils), on the udder and teats, or on the space between the hoofs, though it usually attacks all of these parts simultaneously, and in rare cases even extends to the general integument or to the mucous membrane of the throat, stomach and bowels, or other internal organs. The symptoms are slight shivering or roughness of the coat, neglect of feeding and rumination, redness, heat, swelling and tenderness of the pasterns, teats and mouth, arching of the back, and a crouching, hesitating gait, accumulation of a white froth around the margin of the lips, and a loud smacking noise made by the tongue and lips. On the second or third day the blisters may be seen on the gums, on the dental pad behind the upper lip, on the tongue, on the teats, and around the upper borders of the hoofs and between them. In twenty-four to thirty-six hours more (sometimes at once) these burst, the cuticle is detached, and raw pink sores are left, most noticeable on the mouth and teats. With care the process of healing goes on rapidly, and is completed about the fifteenth day. Complications are rare, unless as the result of neglect, and consist in inflammation and loss of the udder; extensive formation of matter beneath the hoofs, causing them to be shed; extension of disease to the sinews, bones and joints of the foot, with wide-spread destruction of parts; eruption on the stomach and bowels, with dangerous or fatal inflammation; or implication of the womb with abortion or long-continued weakening discharges. In sheep the feet are mainly affected, and the malady bears a strong resemblance to foot-rot, and, under neglect, may merge into this. Swine also suffer severely in the feet, and, as they are too commonly neglected and left to stand on mud and filth, shedding of the hoofs is frequent. When the mouth suffers they champ the jaws, and frothy saliva collects around the lips. Losses can only be estimated by considering that every ruminating animal and hog exposed to the poison will almost invariably contract the disease; also, that the poison may be dried up in barns and elsewhere without losing its vitality or virulence, and thus be preserved for months and years. The depreciation of ordinary store and feeding stock, which have passed through the affection, may be approximately stated at $5 to $10 per head — sheep and swine at relatively smaller amounts; but for dairy stock no such low estimates can be accepted. Then there are frequent consequences of loss of the bag, or of the hoofs, abortions, and chronic discharges from the womb, which unfit the subjects for dairy purposes; and lastly, internal complications and fatal results. Such results imply serious losses for individuals, counties or States; but the great danger lies in the possible migration of the disease out west, and its final diffusion throughout the States. This is much less unlikely than was its importation from Europe nine months ago. We had then the safeguard of a restriction on direct importation; but now let a valuable Short-horn be sent from Massachusetts or New York, to Minnesota, Illinois, Missouri, Kansas or Texas; let him contract the disease on the roads or railroad cars, and convey it to the stock among which he is sent, and the chances are that all the more eastern States will suffer in turn. The aggregate loss in such a case would be virtually incalculable, and if the disease gained a permanent footing among us it would be liable to occur more or less widely at intervals of a few years. Under the head of treatment little need be said. Keeping the bowels open by soft diet, or, if necessary, mild laxatives, administering nourishing gruels if the animal threatens to sink, and keeping the seat of eruption scrupulously clean, will usually suffice. No vaunted preparations for the cure of the disease will really cut it short, as it passes through its successive stages, and terminates in recovery in ten to fifteen days, the time at which the venders of specifics claim that a cure can be effected. A dry floor must be secured, with perfect cleanliness, and the sores may be washed daily with a preparation of one part of carbolic acid dissolved in fifty or a hundred parts of water. For the teats, glycerine may advantageously replace the water. The milk must be fully withdrawn, using a silver milking tube if the teats are sore and the cow restive. Importation of ruminants and swine from all countries where it exists should be allowed only under the restrictions of a week's quarantine, examination by a competent veterinary surgeon, and sponging of the skin with a solution of carbolic acid. Diseased stock should be carefully secluded, together with infected barns, yards, fields, fodder, rugs, buckets and other utensils. One person should be appointed to attend to them, and forbidden to go near other stock, or even to cross the road or other place frequented by stock, until he has washed his boots with the carbolic acid solution. All other persons and animals should be excluded. Inspectors should wash and disinfect on leaving. Infected roads should be closed for a month at least. In infected countries or districts, all movements of live stock (cattle, sheep and swine) should be prohibited except under a written permit from the local authority, who should assure himself of their soundness before granting it. Railroad cars, yards, and loading-banks on which diseased stock have been, should be well washed or scraped, and then thickly sprinkled with carbolic acid. A similar thorough disinfection of infected buildings, yards, utensils, rugs, etc., is equally essential. Manure should be removed and plowed under by horses. No new stock should be brought on the same premises until after thorough disinfection, nor upon infected fields until one or more months after the last sick animal has left. While the disease prevails in the same State, or in an adjacent one, newly purchased stock should be placed on quarantine, in a separate building or park, with separate attendants, for a fortnight after purchase. During the prevalence of the disease the milk can not be safely used, but to young animals it may be given with impunity if it has first been boiled. The following will be found useful in the treatment of this disease: As a laxative, give a half pound of Epsom salts (sulphate magnesia); as an astringent wash, use one ounce each of borax and tincture of myrrh and one quart of water; if there is a bad smell, use one drachm carbolic acid, two ounces honey, one pint each of vinegar and water. As a lotion for the teats, use one-half drachm carbolic acid and ten ounces glycerine; as a dressing for the feet, apply, with a feather, one ounce of oil of vitriol, slowly poured into four ounces of water, first cleansing the feet. After dressing, tie up the feet in a tar bandage. The hind feet are easily dressed if two men raise each separately with a long, stout fork handle, passed in front of the hock. In dressing the feet all detached horn should be removed and a poultice applied if inflammation runs high. Soft cold mashes or thinly sliced or pulped roots are the best food throughout.

APHYLLUS. Leafless; without fully developed green leaves.

APIARY. A bee-house. (See Bees.)

APIS. The generic name of the bee.

APOCARPOUS. When the carpels of a fruit do not hang together.

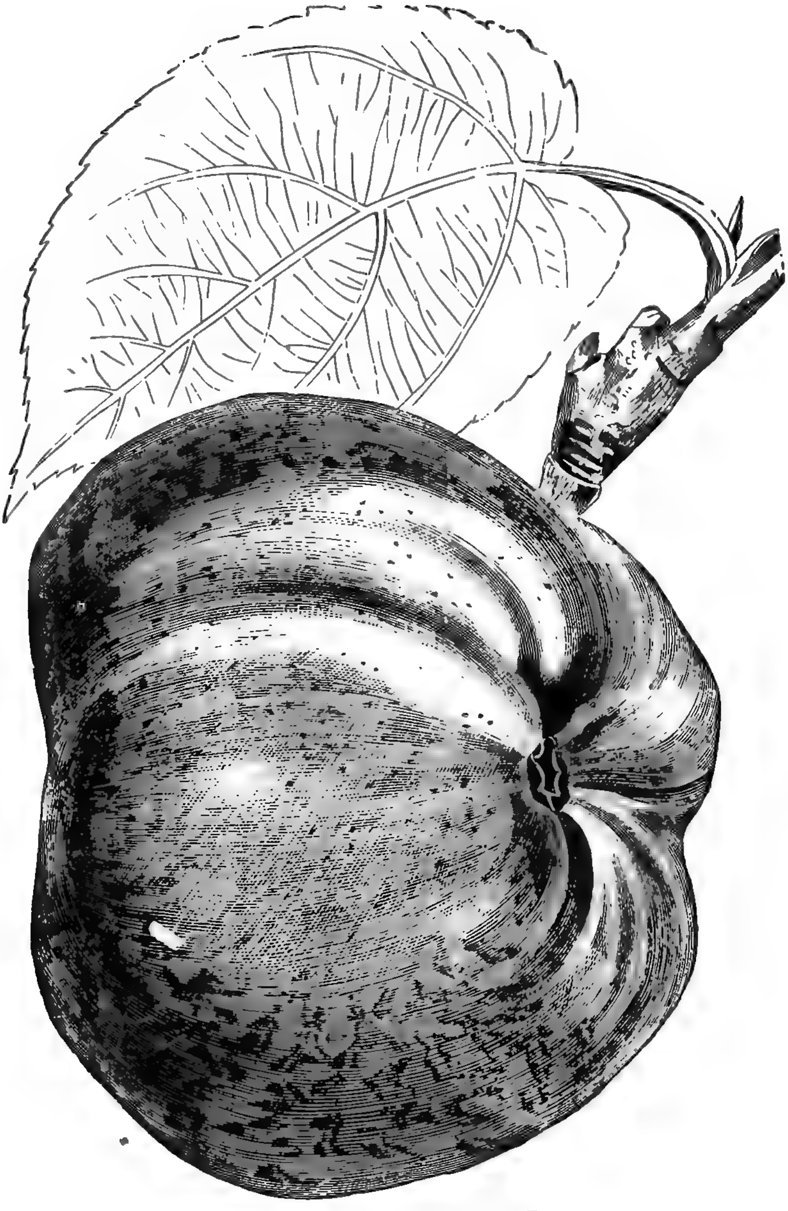
APOCRENIC ACID. (See Humus)

APOPHYSIS. A protuberance, process, or projection. In anatomy, restricted to processes of the osseous system.

APOPLEXY. This disease is rare in horses. Giddiness, megrims and vertigo are diseases of the brain analagous to apoplexy, occasioning loss of control of the muscles, loss of sensation, and slight spasms of the muscles, but without the exhibition of inflammation. The causes are overwork, tight collars, exposure to the sun, local irritation, as of worms, and hereditary tendency. The animal suddenly stops, reels, trembles, and perhaps falls suddenly to the ground, but again, after a time, staggering to his feet, and showing excitement and nervousness for some days. Remedial means are to bleed from the jugular vein, put the horse in a stable and give an active purge. In all diseases of this class, to which animals are subject, care should be taken that no arteries are pressed upon, and that the collar and harness are easy. The special cause should be found if this does not give relief—a veterinary surgeon alone being competent to determine. When it occurs in a stallion, castration often avoids these difficulties. Any form of apoplexy constitutes unsoundness, and an animal afflicted is dangerous to himself and driver.

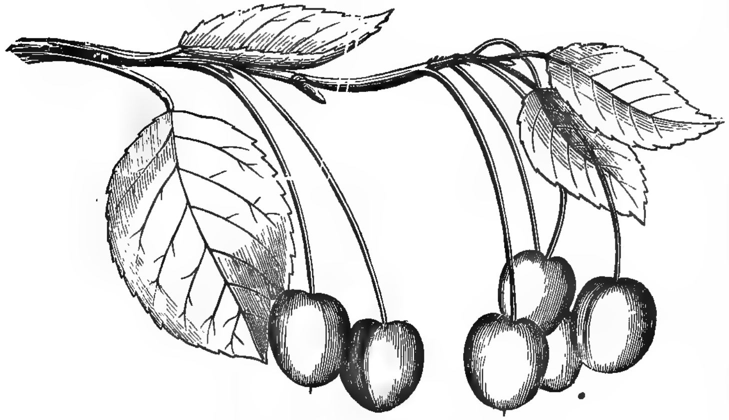
APOTHECIUM. The shield of lichens.

APPLE. *Pyrus malus.* This is the most important of the fruits of the temperate zone. The time when it was first brought into cultivation is lost in the obscurity of the past. It is, without doubt, one of the most ancient of fruits cultivated, since it is found in the remains of the lake dwellings of the Neolithic period, having then been apparently cultivated. Again, its name, as found in most Indo-European languages, is derived from a common root, Ab., Ap., Al , Av., Af., implying its transmission successively from its original place of cultivation, or home, through numerous tribes. It has one of the widest ranges of any fruit, being found in nearly the whole of Europe, Northern Africa, Northern Asia, China, Japan, in North America and in South America, being abundant in Southern Chili. It is also found in Australia. In fact, wherever civilization extends, and the

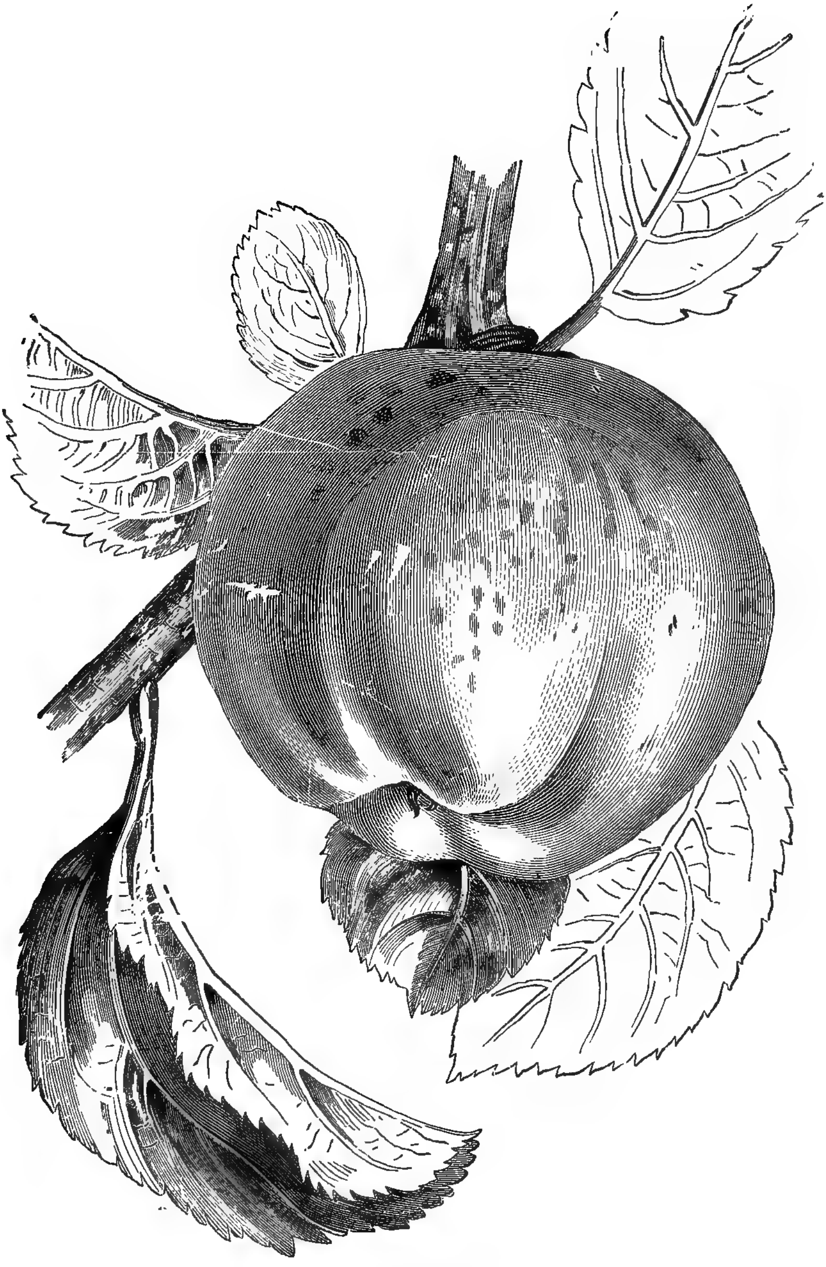


CANADA REINETTE.

climate is temperate, there this king of fruits may be found. In the United States, apple orchards are cultivated from Florida to Alaska Even at Sitka it blossoms the first of June, but does not usually perfect its fruit. It is held to be descended from the wild crab of Europe, but the Siberian crab, and most probably the Russian apples, are descendants of the *Pyrus prunifolia*. The wild crab-apples of the United States are as follows. *Pyrus augustifolia* (Ait.), or American crab-apple, is found growing wild in Pennsylvania, southward and westward; supposed by some to be only a variety of *P. coronaria* (Linn.) is the common crab-apple of the United States, found growing in glades, in the forests, and in thickets in the edges of groves. The fruit is variable, intensely sour, but it makes excellent preserves and jellies, and rich cider, with the addition of sugar and water. (See Gallizing.) Some Western varieties are as large as a black-walnut. *Pyrus Americana* (S. C.) is the American Mountain Ash. (See Ash.) *Pyrus rivularia* (Doug.) or Oregon crab-apple, is found in Oregon and the Rocky mountains. It is a small tree, ranging from California on the Pacific coast, northwards, even into Alaska. The fruit is the size of a cherry, is used by the Indians as food, and is not unpalatable. The cultivation of the apple in the United States is almost as universal as husbandry itself. Nearly every farm, however small, has its orchard, and many extensive plantations are devoted principally to this fruit. More than this, almost every person who owns or cultivates a garden, or village lot, has one or more trees. As an article of commerce it has assumed large proportions, being shipped extensively to England and the Continent of Europe, even from so far west as Michigan. It is also shipped to the North from the South early in the season, and again it is shipped to the South from the North later, since apples grown north keep through the winter much better and later than those grown south. It is only within the last 200 years that systematic attempts have been made in improving the quality of fruit by raising new and superior seedlings, and propagating them by grafting. And it is only within the last 100 years that varieties have multiplied, adapted to very early and very late ripening. It is probable that within the last forty years, more superior varieties have been given to the world than in all previous time heretofore. The apple may be propagated in a variety of ways—from seed, from cuttings, and by any of the many systems of budding and grafting. That they may come true to their kind, however, it is necessary that they be propagated by some one of the three last-mentioned ways, since if the seed is planted, the chances are against more than one in five hundred or a thousand plants proving superior fruit. The most usual and successful manner of propagation is by grafting, which see. Much difficulty has been experienced in the West in the cultivation of apple orchards, from the propagation of varieties unsuited to the soil and climate, and much loss and discouragement ensued in consequence. The horticultural societies of the several States, have narrowed down the list of profitable sorts out of the many thousands of varieties on the catalogues, to comparatively a few, with directions as to soils, situations, etc., adapted to special varieties. The reader is referred to the transactions of the horticultural societies of his State for such list, since those doing well in one locality or State, might not do so in another. As an indication of varieties, we append the list adopted by the American Pomological Society, for the several sections of country and latitudes named. The plan is shown on the following pages. We give illustrations, on pages 49, 51, 64, of four apples noted for quality or hardiness: Canada Reinette, Early Joe and Grimes' Golden, are fine in quality, and Tetofski, hardy even far north, and a good cooking apple. It may be interesting to some of our readers to know that the Mountain Ash belongs to the same class as apples and pears.


AMERICAN CRAB-APPLE.

The arrangement of the names of varieties in the catalogue is alphabetical and according to the nomenclature adopted by the society. Synonyms are given in a few instances where it seemed necessary, and these are placed under the adopted names in italics. The columns are arranged thus: In the first, the names of varieties, in the next seven columns the description, and in the remaining columns the States or districts. The State or district columns are not placed in alphabetical order, but are grouped in divisions somewhat similar in climate, and other characters affecting fruit culture. Thus: 1, Northern division, between 42° and 49°; 2, Central division between 35° and 42°; 3, Southern division, between 28° and 35°. The State or district in which a fruit is recommended for cultivation is designated by a star (*) and if the variety is of great superiority and value, two stars (**), if new and recently introduced and promising, by a dagger (†). Explanation of abbreviations: The size is understood by l. for large; m. for medium, and s. for small. The form—r. c. for roundish conical; ob. for oblong; r. ob. for roundish oblate; fl. for flat or oblate; r. for roundish. The color—y. r. for yellow and red; r. s. for red striped; g. y. for greenish yellow; rus. for russetted; y. rus. for yellow russet. The quality—g. for good; v. g. for very good; b. for best. The use—F. fruit valuable for all family purposes; K. M. valuable for kitchen or market purposes; F. M. family and market. The season—S. for summer; E. A. for early autumn; L. A. for late autumn, and W. for winter. Rus. is for Russian; Eng., English; Am., American; Ger., German; F., Foreign.



TETOFSKI.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
1	Alerson's Early	m.	r.	y.	v. g.	K.	S.	Am.				
2	Alexander	l.	r. c.	r. s.	g.	K. M.	E. A.	Rus.	*		*	
3	American Beauty	l.	r. ob.	y. r.	v. g.	F. M.	W.	Am.				
4	American Golden Pippin	l.	r. ob.	g. y.	v. g.	F. M.	W.	Am.				
5	American Summer Pearmain	m.	ob.	y. r.	b.	F.	S.	Am.			*	
6	Arnold's Beauty	m.	fl.	y. r.	v. g.	F.	W.	Am.				
7	Aromatic Carolina	l.	fl.	y. r.	v. g.	F.	A.	Am.				
8	Autumn Bough	m.	r. c.	g. y.	v. g.	F.	E. A.	Am.				
9	Autumnal Swaar	m.	r. ob.	g. y.	v. g.	F.	L. A.	Am.				
10	Bailey Sweet	l.	r. c.	r. s.	v. g.	F. M.	L. A.	Am.				
11	Baker	l.	r. ob.	y. r.	v. g.	K. M.	W.	Am.				
12	Baldwin	l.	r. c.	r. g.	v. g.	F. M.	W.	Am.	**		*	*
13	Baltimore	m.	r. c.	r. y.	v. g.	F. M.	W.	Am.				
	(Cable's Gilliflower. Mahaska.)											
14	Baltzley	l.	r. ob.	y.	g.	F. M.	A.	Am.				
15	Beauty of Kent	l.	r. c.	r. s.	g.	K. M.	L. A.	Eng.			*	
16	Belden Sweet	m.	r. c.	y.	g.	F.	W.	Am.				
17	Belmont	l.	r. c.	y. r.	b.	F. M.	W.	Am.				
18	Ben Davis	l.	r. c.	y. r.	g.	K. M.	W.	Am.				
	(New York Pippin.)											
19	Benoni	m.	r. ob.	y. r.	v. g.	F. M.	S.	Am.			†	**
20	Bentley's Sweet	m.	r. ob.	g. y.	v. g.	F. M.	W.	Am.				
21	Berkshire Spy	m.	r. c.	r. s.	v. g.	F.	E. W.	Am.				
22	Bethlehemite	l.	r. ob.	y. r.	b.	F. M.	W.	Am.				
23	Bevan's Favorite	m.	fl. c.	y. r.	g.	F.	S.	Am.				
24	Black Apple	m.	fl.	d. r.	g.	F.	W.	Am.				
	(Jersey Black.)											
25	Blackshear	l.	r.	y.	g.	F. M.	W.	Am.				
26	Blenheim Pippin	l.	r. ob.	y. r.	v. g.	F. M.	W.	Eng.	**			
27	Blue Pearmain	l.	r. c.	r.	g.	M.	W.	......	*		*	
28	Bonum	l.	r. ob.	y. r.	v. g.	M.	L. A.	Am.				
29	Bourassa	m.	r. c.	y. r.	g.	M.	L. A.	Ger.				
30	Bower's Nonpareil	l.	fl.	y. r.	v. g.	F. M.	W.	Am.				
31	Bowling's Sweet	m.	r.	y. r.	g.	M.	L. A.	Am.				
32	Broadwell	m.	r. c.	g. y.	v. g.	F. M.	L. A.	Am.	*			
33	Brittle Sweet	m.	r. c.	r. s.	v. g.	F.	E. A.	Am.				
34	Brown	l.	fl.	r. s.	v. g.	F. M.	L. A.	Am.				
	(Nottingham Brown.)											
35	Bruce's Summer	l.	......	......	......	......	S.	Am.				
36	Buckingham	l.	r. ob.	y. r.	v. g.	F. M.	E. W.	Am.				
	(Fall Queen of Kentucky, Bachelor, Equinetely.)											
37	Buff	l.	r. ob.	y. r.	g.	F.	W.	Am.				
38	Buffington's Early	m.	fl.	y.	g.	F.	S.	Am.				
39	Bullock's Pippin	s.	r. c.	y. rus.	b.	F. M.	W.	Am.				
	(American Golden Russet.)											
40	Burlington Pippin	m.	fl. c.	y. r.	v. g.	F. M.	W.	Am.				
41	Calkins' Pippin	l.	r. c.	y. r.	g.	F. M.	W.	N. S.	*			
42	Camak Sweet	m.	r. ob.	y.	g.	F. M.	W.	Am.				
43	Campfield	m.	r. ob.	g. r.	g.	M. K.	W.	Am.				
44	Canada Reinette	l.	r. c.	g. y.	v. g.	F. M.	W.	F.	*		*	
45	Cannon Pearmain	m.	r. c.	r. s.	v. g.	F.	W.	Am.				
46	Carolina Red June	m.	r. c.	r. s.	v. g.	F. M.	S.	Am.				
47	Carolina Watson	m.	fl. c.	g. y. r.	g.	M.	S.	Am.				
48	Carter's Blue	l.	r. ob.	g. r.	v. g.	F. M.	E. A.	Am.				
49	Cane Creek Sweet	m.	r.	y.	g.	F.	S.	Am.				
50	Chattahoochee	m.	fl.	y.	g.	M.	W.	Am.				
51	Chenango Strawberry	m.	ob. c.	g. r.	v. g.	F. M.	E. A.	Am.	*			*
	(Sherwood's Favorite.)											
52	Clark's Pearmain	m.	r. ob.	y.	v. g.	M.	W.	Am.				
53	Clayton	l.	c.	y. r.	g.	F. M.	W.	Am.				
54	Clyde Beauty	l.	r. c.	g. r.	g.	F. M.	W.	Am.	*			
55	Cooper	l.	r. ob.	g. y.	g.	M.	L. A.	......				
56	Cooper's Market	m.	r. c.	y. r.	g.	M.	W.	Am.				
57	Cooper's Early White	m.	r.	y.	g.	M.	A.	Am.				
58	Cogswell	m.	r. ob.	y. r.	b.	F. M.	W.	Am.				
59	Cole's Quince	l.	r. ob.	g. y.	v. g.	F. M.	W.	Am.			*	

2 Moderate bearer; showy.
5 Slender grower, but healthy.
13 A hardy tree; very productive.
15 A coarse, showy fruit.
17 Fine for table; too tender to ship.
18 Valuable shipping sort.
20 Fine winter variety.
22 Resembles Newtown Spitzenberg.
27 Liable to drop, at the West.

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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43 Valued for stock and cider. 46 Esteemed South and West. 48 Valued at the South.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
60	Colvert	l.	r. ob.	y. r.	g.	F. M.	L. A.	Am.	*	..	..	..
61	Cornell's Fancy	m.	oo.	y. r.	g.	F. M.	L. A.	Am.	..	..	..	..
62	Cracking	l.	r. ob.	y.	g.	K.	L. A.	Am.	..	..	..	..
63	Creek	m.	fl. c.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
64	Cross	l.	r. ob.	r. s.	v. g.	F. M.	S.	Am.	..	..	..	..
65	Cullasaga	m.	r. c.	y. s.	g.	M.	W.	Am.	..	..	..	..
66	Curtis Sweet	l.	r. c.	y. r.	g.	K.	L. A.	Am.	..	..	..	..
67	Danvers' Winter Sweet	m.	r. ob.	g. y.	v. g.	F. M.	W.	Am.	..	..	*	..
68	Dean	m.	fl.	r. s.	v. g.	F. M.	E. A.	Am.	..	..	*	..
69	Disharoon	m.	r. c.	g.	g.	F. M.	A.	Am.	..	..	..	..
70	Dominie	m.	r. ob.	g. r.	v. g.	F. M.	W.	......	..	..	..	..
71	Drap d'Or	l.	r. ob.	y.	v. g.	F.	S.	Ger.	*	..	..	..
72	Dutch Mignonne	m.	r. ob.	r. s.	g.	M.	W.	Ger.	..	..	..	..
73	Duchess of Oldenburg	m.	r. ob.	y. r.	g.	M.	S.	Rus.	*	..	**	**
74	Dyer, or Pomme Royal	m.	r.	g. y.	v. g.	F.	E. A.	F.	..	..	*	..
75	Early Harvest	m.	r. ob.	g. y.	v. g.	F. M.	S.	Am.	*	..	**	..
76	Early Red Margaret	m.	r.	r. s.	v. g.	F. M.	S.	Ger.	..	..	..	..
77	Early Joe	s.	fl.	y. r.	b.	F.	S.	Am.	..	..	..	..
78	Early Pennock	l.	r. c.	y. r.	g.	M.	S.	Am.	..	..	*	..
79	Early Strawberry	s.	r.	r. s.	v. g.	F.	S.	Am.	..	..	*	..
80	Early Ripe	m.	r. ob.	y.	g.	F.	S.	Am.	..	..	..	..
81	Edgar Red Streak (Walbridge.)	l.	r. ob.	y. r.	v. g.	F.	W.	Am.	..	..	..	..
82	Edwards' Early	....	......	....	......	......	S.	Am.	..	..	..	..
83	English Russett (Poughkeepsie Russet.)	m.	r. c.	y. rus.	v. g.	F. M.	W.	Eng.	..	..	*	..
84	Esopus Spitzenberg	l.	ob.	y. r.	b.	F. M.	W.	Am.	..	..	†	..
85	Eustis	m.	r. ob.	r. s.	v. g.	F.	E W.	Am.	..	..	..	..
86	Eutaw	....	......	....	......	......	A.	Am.	..	..	..	..
87	Evening Party	m.	fl.	r.	v. g.	F. M.	W.	Am.	..	..	..	..
88	Ewalt	l.	r.	y. r.	g.	M.	W.	Am.	..	..	..	..
89	Excel	l.	ob. c.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
90	Fallawater (Fornwalder, Tulpehocken.)	l.	r. c.	g. y.	g.	M.	W.	Am.	..	..	..	..
91	Fall Harvey	l.	r. ob.	g. y.	g.	M.	L. A.	Am.	..	..	*	..
92	Fall Jenneting	l.	fl.	g. y.	g.	M.	E. A.	Am.	*	..	†	..
93	Fall Orange	l.	r.	y. r.	g.	K. M.	L. A.	Am.	..	..	..	..
94	Fall Pippin (Holland Pippin, erroneously.)	l.	r. ob.	g. y.	v. g.	F. M.	L. A.	Am.	..	..	†	..
95	Fall Queen, or Hass, Gros Pommier	m.	ob. c.	y. r.	g.	F. M.	A.	Am.	..	..	..	..
96	Fall Wine	m.	r. ob.	r. y.	b.	F.	L. A.	Am.	..	..	..	..
97	Fameuse (Pomme de Neige, Snow Apple.)	m.	r. ob.	r. s.	v. g.	F. M.	W.	F.	*	..	**	**
98	Family	m.	fl. c.	y. r.	v. g.	M.	S.	Am.	..	..	..	..
99	Fanny	m.	fl.	r. s.	v. g.	F. M.	S.	Am.	..	..	..	..
100	Ferdinand	l.	fl.	o. y.	g.	......	A.	Am.	..	..	..	..
101	Ferris	m.	r. fl.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
102	Fink	m.	fl.	y. r.	g.	M.	L. W.	Am.	..	..	..	..
103	Fourth of July	m.	r. ob.	r. s.	g.	M.	S.	Ger.	..	..	..	..
104	Foust's Winter	...	......	....	......	......	W.	Am.	..	..	..	..
105	Foundling	m.	r. ob.	y. r.	g.	F.	A.	Am.	..	..	†	**
106	Fulton	m.	fl.	g. y.	g.	M.	W.	Am.	..	..	..	..
107	Gabriel	m.	r. ob.	r. y.	g.	M.	L. A.	Am.	..	..	..	..
108	Garden Royal	m.	r. ob.	y. r.	b.	F.	S.	Am.	..	..	*	..
109	Garretson's Early	m.	r. c.	y.	g.	K.	A.	Am.	..	..	..	..
110	Gilpin (Carthouse, Little Romanite.)	s.	r. c.	y. r.	g.	M.	W.	Am.	..	..	..	*
111	Gladney's Red	m.	r.	r. s.	g.	F. M.	W.	Am.	..	..	..	..
112	Goff	l.	fl.	y. r.	v. g.	K. M.	S.	Am.	..	..	..	..
113	Golden Dixie	m.	r. ob.	g. y.	v. g.	F. M.	S.	Am.	..	..	..	..
114	Golden Russet, of Western New York	m.	r. ob.	y. rus.	v. g.	F. M.	W.	......	†	..	..	..
115	Golden Sweet	l.	r.	g. y.	v. g.	F. M.	S.	Am.	*	..	..	..
116	Granite Beauty	l.	r. ob.	y. r.	g.	F. M.	W.	Am.	..	..	†	*
117	Gravenstein	l.	r. ob.	y. r.	v. g.	F. M.	L. A.	Ger.	**	..	**	*
118	Green Cheese	m.	fl.	g. y.	v. g.	F. M.	W.	Am.	..	..	..	..
119	Green Sweet	m.	r. ob.	g. y.	g.	K. M.	W.	Am.	..	..	..	..
120	Grimes' Golden	m.	r. ob.	g. y.	v. g.	F.	W.	Am.	..	..	..	..

70 Productive and hardy.
73 One of the most hardy varieties.
74 Valued for dessert.
75 Succeeds best on strong soils.
77 A delicious table sort; tree of small growth.
78 Popular market sort.
79 Continues a long time ripening; often called Red Juneating.

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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97 A hardy tree; one of the best for the North and West.

102 Valuable as a very late keeper.

103 Very hardy tree and handsome fruit.

108 Of a delicious pear flavor.

117 Ripens early and keeps late.

118 One of the best South.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
121	Gully	m.	fl.	g. y.	v. g.	F.	W.	Am.	..	..	..	..
122	Hall	s.	fl.	y. r.	v. g.	F.	W.	Am.	..	..	..	..
123	Hamilton	l.	r.	r. y.	g.	F. M.	A.	Am.	..	..	..	..
124	Haskell Sweet	m.	fl.	g. y.	v. g.	F.	E. A.	Am.	..	..	..	..
125	Hawthornden	m.	r. ob.	g. y.	g.	K. M.	E. A.	F.	..	..	..	*
126	Hartford Sweet	l.	r. ob.	r. s.	g.	M.	W.	Am.	..	..	..	..
127	Hewes' Virginia Crab	s.	r.	y. r.	g.	Cider	L. A.	Am.	..	..	..	..
128	Highby Sweet	m.	r. c.	y. r.	v. g.	F.	L. A.	Am.	..	..	..	..
129	Hightop Sweet	s.	r.	g. y.	v. g.	F. M.	S.	Am.	..	..	*	..
130	Hockett's Sweet	m.	r. ob.	y. r.	g.	K.	W.	Am.	..	..	..	..
131	Holland Pippin	l.	r.	g. y.	g.	K. M.	L. A.	F.	..	..	..	..
132	Holly	m.	r. ob.	y. r.	g.	K.	W.	Am.	..	..	..	..
133	Hoover	m.	r.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
	(Black Coal.)											
134	Horn	m.	fl.	g. r.	v. g.	F. M.	L. W.	Am.	..	..	..	..
135	Horse	l.	r.	y. r.	g.	K. M.	S.	Am.	..	..	..	..
	(Haas.)											
136	Hubbardston Nonsuch	l.	r. c.	y. r.	v. g.	F. M.	W.	Am.	*	..	**	*
137	Hunt Russet	m.	r. ob.	y. rus.	y. g.	F. M.	W.	Am.	..	..	..	..
138	Huntsman's Favorite	l.	ob.	y.	v. g.	F. M.	W.	Am.	..	..	..	..
139	Hurlbut	m.	r. ob.	y. r.	g.	F. M.	L. A.	Am.	..	..	†	*
140	Irish Pippin	m.	r.	r. s.	v. g.	F. M.	E. W.	Am.	..	..	..	..
141	Jefferson County	m.	r. ob.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
142	Jefferis	m.	r. ob.	y. r.	v. g.	F. M.	E. A.	Am.	..	..	†	..
143	Jersey Sweet	m.	r.	y. r.	v. g.	F. M.	E. A.	Am.	..	..	..	..
144	Jewett's Fine Red	m.	r. ob.	r.	g.	F. M.	W.	Am.	*	..	**	**
145	Jonathan	m.	r. c.	y. r.	g.	F. M.	W.	Am.	..	..	..	**
146	Julian	m.	fl. c.	w. r.	g.	K.	S.	Am.	..	..	..	..
147	Junaluskee	m.	r. ob.	g.	v. g.	F. M.	W.	Am.	..	..	..	..
148	Kentucky	l.	r. c.	y. r.	g.	M.	L. A.	......	..	..	..	..
149	Kentucky Red Streak	m.	r. c.	g. y d r	g.	F. M.	A.	Am.	..	..	..	..
	(Bradford's Best.)											
150	Keswick Codlin	r.	r. c.	g. y.	g.	K. M.	E. A.	Eng.	*	..	..	..
151	Key's Fall	m.	r.	rus.	v. g.	F. M.	E. W.	Am.	..	..	..	..
152	Kinnaird's Choice	m.	fl.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
153	Kinney's Winter	......	......	......	...	......	W.	......	..	..	..	..
154	King of Tompkins County	l.	r.	y. r.	v. g.	F. M.	W.	Am.	**	..	*	*
155	Kirkbridge White	m.	ob.	g. y.	g.	K. M.	E. A.	.....	..	..	..	..
156	Klaproth	m.	fl.	y. r.	g.	K. M.	E. A.	Am.	..	..	..	..
157	Lady Apple	s.	fl.	y. r.	v. g.	F. M.	W.	F.	..	..	..	..
158	Lady's Sweet	l.	r.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	*
159	Lansingburg	m.	r. fl.	y. r.	g.	M.	W.	Am.	..	..	..	..
160	Large Yellow Bough	l.	ob.	g. y.	v. g.	F. M.	S.	Am.	**	..	[illegible]	*
	(Summer Sweet Bough.)											
161	Late Strawberry	m.	r.	y. r.	v. g.	F. M.	L. A.	Am.	..	..	..	..
	(Autumn Strawberry.)											
162	Lawver	l.	r. ob.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
163	Limber Twig	m.	r. ob.	y. r.	g.	M.	W.	Am.	..	..	..	..
164	Long Island Russet	m.	r.	rus.	......	K.	W.	Am.	..	..	..	..
165	Loudon Pippin	l.	fl.	y. r.	g.	M.	W.	Am.	..	..	*	..
166	Lowell	l.	r. c.	g. y.	v. g.	F. M.	E. A.	Am.	[illegible]	..	..	
	(Orange, Tallow Pippin, Queen Anne, Michigan Golden Pippin.)											
167	Lyscom	l.	r.	g. y.	g.	F. M.	E. A.	Am.	*	..	..	..
168	Maiden's Blush	m.	r.	g. y.	g.	K. M.	E. A.	Am.	†	..	..	*
169	Major	l.	r. fl.	g. r.	v. g.	F. M.	W.	Am.	..	..	..	..
170	Mangum	m.	r. ob.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
171	Mann	m.	r. ob.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
172	Manomet	m.	r. ob.	y. r.	v. g.	F. M.	E. A.	Am.	..	..	..	..
173	Mary Womac	l.	r. fl.	y. r.	v. g.	F. M.	W.	Am.	..	[illegible]	..	..
174	Marquis of Lorne	l.	r. fl.	g. r.	v. g.	F. M.	W.	N. S.	*	..	..	..
175	Marston's Red Winter	m.	r. c.	r. s.	v. g.	F.	W.	Am.	..	..	..	[illegible]
176	Mason's Stranger	m.	fl.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
177	Mattamusket	s.	fl.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
178	Maverick Sweet	m.	r. ob.	y. r.	v. g.	M.	W.	Am.	..	..	..	..
179	Maxy	m.	r. c.	g. r.	g.	F. M.	W.	Am.	..	..	..	..

125 One of the most profitable of market sorts.
127 Valued only for cider.
128 A delicious dessert apple.
137 A hardy tree and fine fruit. Supposed to be identical with Golden Russet of Mass., but not fully decided.
143 Very valuable for market or stock.
163 Hardy and productive southwest.
168 A profitable market sort.
172 A valued sweet apple.

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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173 A seeding from Rambo, which it resembles.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
180	McAfee's Nonsuch (Large Striped Pearmain.)	l.	r. ob.	y. r.	v. g.	F. M.	W.	Am.				
181	McLellan	m.	r. ob.	y. r.	v. g.	F. M.	W.	Am.				
182	Mellinger	m.	r. c.	r. s.	v. g.	F. M.	E. W.	Am.				
183	Melon	m.	r. ob.	y. r.	b.	F. M.	W.	Am.				
184	Mexico	m.	r. ob.	r. s.	v. g.	F. M.	A.	Am.				
185	Milam	m.	r.	r. s.	g.	K. M.	W.	Am.				
186	Milden, or Milding	l.	fl.	y. r.	v. g.	F. M.	A. W.	Am.				**
187	Minister	l.	ob.	r. s.	g.	K. M.	L. A.	Am.			**	*
188	Monmouth Pippin (Red Cheek Pippin.)	l.	fl.	y. r.	v. g.	F. M.	W.	Am.				
189	Moore's Sweet	m.	r. ob.	r.	g.	K.	W.	Am.				
190	Mother	m.	r. c.	y. r.	b.	F. M.	W.	Am.	*		**	**
191	Munson Sweet (Orange Sweet.)	m.	fl.	y.	g.	K. M.	L. A.	Am.	*			
192	Nansemond Beauty	m.	r. ob.	r. s.	v. g.	F. M.	W.	Am.				
193	Newtown Pippin (Albemarle Pippin, Brook's Pippin.)	l.	r. ob.	g. y.	v. g.	F. M.	W.	Am.			†	
194	Newtown Spitzenberg (Vandevere, of New York.)	m.	r. ob.	y. r.	b.	F. M.	W.	Am.	†			
195	Nickajack	l.	r. ob.	r. s.	g.	F. M.	W.	Am.				
196	Nonpareil Russet	m.	r.	y. g.	g.	F. M.	W.	Eng.	*			
197	Northern Spy	l.	r. c.	y. r.	b.	F. M.	W.	Am.	**		**	
198	Northampton	m.	fl.	r. s.	v. g.	F.	E. W.	Am.				
199	Oconee Greening	m.	ob.	y.	g.	......	A.	Am.				
200	Ohio Nonpareil	l.	r. ob.	y. r.	v. g.	F. M.	L. A.	Am.				
201	Orange Pippin	m.	ob.	y.	v. g.	F. M.	A.	Am.				
202	Ortley (White Bellflower, Woodman's Long.)	m.	ob.	g. y.	v. g.	F. M.	W.	Am.				
203	Otoe Red Streak	m.	r. ob.	y. r.	v. g.	F. M.	W.	Am.				
204	Peach Pond Sweet	m.	fl.	r. s.	v. g.	F.	A.	Am.				
205	Peck's Pleasant	m.	r.	g. y.	v. g.	F. M.	W.	Am.	†		†	
206	Perry Russet	m.	r. c.	rus.	g.	F. M.	W.	Am.				
207	Pewaukee	l.	fl.	r. s.	g.	F. M.	W.	Am.				
208	Phillip's Sweet	m.	r. ob.	r. s.	v. g.	F. M.	W.	Am.				
209	Pickard's Reserve	m.	r. ob.	r. y.	g.	F.	W.	Am.				
210	Pilot	l.	r. ob.	g. y. r.	v. g.	F. M.	W.	Am.				
211	Pittsburgh Pippin	l.	fl.	g. y.	v. g.	F. M.	W.	Am.				
212	Pleasant Valley Pippin	m.	r. ob.	g. y.	v. g.	F. M.	W.	Am.				
213	Plumb's Cider	m.	r. c.	g. y. r.	g.	K. M.	A.	Am.				
214	Pomme Grise	s.	r. ob.	y. rus.	b.	F.	W.	F.	*			
215	Porter	l.	ob.	g. y.	b.	F. M.	W.	Am.	*		**	**
216	Premium	m.	r. c.	y.	v. g.	F. M.	E. W.	Am.				
217	President	l.	r. ob.	y.	g.	F.	A.	Am.			*	
218	Primate	m.	r. c.	g. y.	b.	F.	E. A.	Am.	*		*	*
219	Progress	m.	r. ob.	y.	g.	F. M.	W.	Am.				
220	Prother's Winter	m.	c.	y. r.	g.	F. M.	L. W.	Am.				
221	Pryor's Red	l.	r. ob.	y. r.	v. g.	F. M.	W.	......				
222	Pumpkin Sweet (Lyman's Pumpkin Sweet.)	l.	r. obl.	y.	g.	K. M.	E. W.	Am.			*	
223	Pyle's Red Winter	l.	r. ob.	r. s.	v. g.	F. M.	W.	Am.				
224	Ramsdell's Sweet	m.	ob.	y. r.	g.	K. M.	L. A.	......			*	*
225	Rambo	m.	fl.	y. r.	v. g.	F. M.	L. A.	Am.				
226	Rawle's Genet	l.	r. c.	y. r.	v. g.	F. M.	W.	....				
227	Red Astrachan	l.	r.	y. r.	g.	K. M.	S.	F.	**		**	**
228	Red Canada (Old Nonsuch, Richfield Nonsuch, Steele's Red Winter of some.)	m.	r. ob.	y. r.	b.	F. M.	W.	.....			**	
229	Red Cathead	l.	r. c.	y. r.	g.	F. M.	L. A.	Am.				
230	Red Crab	s.	r.	r.	.....	Cider	L. A.	Am.				
231	Red Rance	m.	r. ob.	r. s.	v. g.	F. M.	E. W.	Am.				
232	Red Winter Pearmain (Buncombe.)	m.	r. ob.	y. r.	g.	F. M.	W.	Am.				
233	Red Stripe	m.	ob. c.	y. r.	g.	K. M.	S.	Am.				
234	Rhode Island Greening	l.	r. ob.	g. y.	v. g.	F. M.	W.	Am.	*	*	**	*
235	Rhodes' Orange	m.	r. ob.	y. r.	g.	F.	S.	Am.				
236	Ribston Pippin	m.	r.	y. r.	v. g.	F. M.	W.	Eng.	**		*	

183 One of the most delicious apples; tree a poor grower.

190 Esteemed where known.

195 This apple is known South and West by over forty different names.

200 Esteemed where known.

202 An old variety; extensively planted at the West twenty or more years since.

	NORTHERN DIVISION. Between 42° and 49°.														
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.
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	II.—CENTRAL DIVISION. Between 35° and 42°.																			
Number.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.
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	III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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203 A new variety; originated in Nebraska.
214 A tree of small growth; succeeds well at the North.
220 Valued chiefly for its keeping qualities.
230 Best of all for cider.
232 Extensively grown South and West.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
237	Richard's Graft	m.	r. ob.	r. s.	v. g.	F. M.	E. A.	Am.	..	..	..	..
238	Ridge Pippin	l.	r. c.	y. rus.	g.	M.	W.	Am.	..	..	..	..
239	Robinson's Superb	l.	......	......	g.	F. M.	A.	Am.	..	.	..	..
240	Robertson's White	m.	r, ob.	g. y.	g.	F. M.	L. A.	Am.	..	..	..	..
241	Rock Pippin	m.	c.	y.	......	M.	W.	Am.	..	..	..	..
	(Lemon.)											
242	Rockport Sweet	m.	r. ob.	g. y.	v. g.	F.	W.	Am.	..	..	..	..
243	Romanite, of the South	s.	r. c.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
244	Roman Stem	m.	r.	y. rus.	v. g.	F. M.	W.	Am.	..	..	..	..
245	Rome Beauty	l.	r.	y. r.	g.	M.	L. A.	Am.	..	..	..	..
246	Roxbury Russet	m.	r. ob.	y. rus.	v. g.	F. M.	W.	Am.	*	..	*	..
247	Saint Lawrence	l.	fl.	y. r.	v. g.	M.	A.	......	*	..	..	..
248	Sarah	l.	fl.	r. s.	v. g.	F. M.	E. A.	Am.	..	..	*	..
249	Saxton	m.	r. ob.	y. r.	g.	F.	A.	Am.	.	..	..	..
	(Fall Stripe.)											
250	heppard's Sweet	m.	r. c.	r. s.	g.	F.	L. A.	Am.	..	..	..	..
251	Shiawassee Beauty	m.	fl.	r. y.	v. g.	F. M.	W.	Am.	..	..	..	..
252	Snockley	s.	r. c.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
253	Smith's Cider	l.	r. ob.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
254	Smokehouse	l.	r. ob.	y. r.	g.	K. M.	W.	Am.	..	..	..	..
255	Somerset, of Maine	m.	fl.	r. s.	v. g.	F.	S.	Am.	..	..	*	..
256	Somerset, of New York	s.	r. c.	y. rus.	v. g.	F.	E. A.	Am.	..	..	..	..
257	Sops of Wine	m.	r.	y. r.	g.	K. M.	E. A.	Eng.	..	..	**	*
	(Hominy.)											
258	Soulard	m.	r. ob.	y. r.	g.	M.	L. A.	......	..	..	..	..
259	Southern Porter	m.	r. c.	y.	v. g.	F. M.	S.	Am.	..	..	..	..
260	Spice Russet	s.	fl. c.	y. rus.	v. g.	F.	W.	Am.	..	..	..	..
261	Stansill	m.	r. ob.	g. y.	g.	F.	W.	Am.	..	..	..	..
262	Stark	l.	r. c.	y. r.	g.	F.	W.	Am.	..	..	.	.
263	Stevenson's Winter	m.	r. ob.	y.	g.	F.	W.	Am.	..	..	..	..
264	Summer Bellflcur	m.	c.	y.	g.	F. M.	A.	Am.	..	..	..	..
265	Summer Hagloe	l.	r. ob.	r. s.	v. g.	K. M.	S.	Am.	..	..	..	..
266	Summer King	m.	fl.	y. r.	g.	F. M.	S.	Am.	..	..	..	..
267	Summer Queen	l.	r. c.	y. r.	g.	K. M.	S.	Am.	..	..	..	..
268	Summer Pound Royal	l.	r. c.	y. rus.	g.	M.	E. A.	Am.	..	..	..	..
269	Summer Pippin	m.	ob. c.	y. r.	g.	K. M.	L. S.	Am.	..	..	..	..
	(Champlain.)											
270	Summer Rose	s.	r.	y. r.	b.	F.	S.	Am.	..	..	..	..
271	Summer Sweet Paradise	l.	r.	g. y.	v. g.	F.	E. A.	Am.	..	..	†	..
272	Susan's Spice	m.	fl.	y. r.	g.	F.	A.	Am.	..	..	..	..
273	Sutton Beauty	m.	r. ob.	r. s.	v. g.	F. M.	E. W.	Am.	..	..	..	..
274	Striped Sweet Pippin	l.	r. ob.	r. s.	v. g.	F. M.	E. W.	Am.	..	..	..	..
275	Swaar	l.	r. ob.	g. y.	b.	F. M.	W.	Am.	..	..	†	..
276	Sweet Belle et Bonne	m.	r. ob.	y. rus.	v. g.	F.	E. W.	Am.	..	..	..	..
277	Sweet Pear	m.	r. c.	y.	v. g.	F.	A.	Am.	..	..	..	..
278	Sweet Winesap	m.	fl.	r. s.	v. g.	M.	W.	Am.	..	..	..	..
279	Taunton	l.	r. c.	y. r.	g.	F. M.	A.	Am	..	..	..	..
280	Tetofsky	m.	fl. c.	y. r.	g.	K.	S.	Rus.	..	..	**	..
281	Tewksbury Winter Blush	s.	fl.	y. r.	v. g.	F. M.	W.	Am.	..	..	..	..
282	Tillaquah	m.	r. fl.	y. r.	g.	F. M.	W.	Am.	..	..	..	..
283	Tinmouth	m.	fl.	y. r.	v. g.	F.	W.	Am.	..	..	..	..
284	Talman's Sweet	m.	r.	g. y.	v. g.	K. M.	W.	Am.	*	..	**	**
285	Townsend	m.	r. ob.	r. s.	g.	M.	S.	Am.	..	..	..	..
	(Hocking.)											
286	Transparent Zoar	l.	fl.	w.	v. g.	F.	E. W.	Am.	..	..	..	..
287	Trenton Early	m.	r.	y.	g.	F.	S.	Am.	..	..	..	..
288	Twenty Ounce Apple	l.	r.	r. s.	v. g.	F. M.	L. A.	Am.	*	.	†	..
	(Cayuga Red Streak.)											
289	Utter	m.	r. ob.	y. r.	g.	F. K.	A.	Am.	..	.	..	..
290	Vandevere	m.	fl.	y. r.	g.	M.	W.	Am.	..	..	..	..
291	Victuals and Drink	l.	ob.	y. rus.	g.	F.	W.	......	..	..	..	..
292	Virginia Greening	l.	fl.	g. y.	g.	M.	W.	Am.	..	..	..	..
293	Wagener	m.	r. ob.	y. r.	b.	F.	W.	Am.	*	..	*	*
294	Warfield	l.	fl.	y.	g.	F. M.	A.	Am.	..	..	..	..
295	Washington	l.	r. c.	y. r.	v. g.	F. M.	E. A.	Am.	.	..	*	..
	(Washington Strawberry.)											
296	Washington Royal	m.	r. ob.	g. y.	g.	M.	W.	Am.	..	..	..	..

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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238 A long keeper.

243 Entirely distinct from Gilpin or Shockley.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
297	Water	m.	r. c.	y. r.	v. g.	F.	E. W.	Am.				
298	Waugh's Crab	s.	r. c.	r. s.	g.	Cider	W.	Am.				
299	Wealthy	m.	r. ob.	r. s.	v. g.	F. M.	W.	Am.				
300	Webb's Winter	m.	r.	y.	g.	F.	W.	Am.				
301	Wellford's Yellow	s.	r. ob.	g. y.	g.	M.	W.	Am.				
302	Western Beauty (Grosh, Summer Rambo, etc.)	l.	r. ob.	r. s.	v. g.	F. M.	S.	Am.				
303	Westfield Seek-no-further	l.	r. c.	y. r.	b.	F. M.	W.	Am.				
304	White Doctor	l.	r. ob.	g. y.	g.	K. M.	E. A.	Am.				
305	White Juneating, May, Early May, Etc.	s.	r.	g. y.	g.	F. M.	S.	F.				
306	White Paradise (Lady Finger.)	m.	r. fl.	y. r.	g.	M.	W	Am.				
307	White Pippin	l.	r. ob.	g. y.	v. g.	F. M.	W.	Am.				
308	White Winter Pearmain	m.	r. c.	y. r.	v. g.	F. M.	W.	Am.				
309	White Rambo	m.	r. ob.	g. y.	g.	M.	L. A.	Am.				
310	Williams' Favorite	m.	r. c.	y. r.	g.	M.	S.	Am.	*		**	**
311	Willis Sweet	l.	r.	y. r.	v. g.	K. M.	S.	Am.				
312	Willow Twig (James River.)	m.	r. c.	y. r.	g.	K. M.	W.	Am.				
313	Wine (Hay's Wine, Pennsylvania Red Streak.)	l.	r.	y. r.	v. g.	F. M.	W.	Am.				
314	Winesap	m.	r.	y. r.	v. g.	F. M.	W.	Am.				
315	Winter Sweet Paradise	l.	r. ob.	g. y.	v. g.	F.	W.	Am.				
316	Wythe	m.	fl.	r. s.	v. g.	F.	W.	Am.				
317	Yates	s.	fl.	y. r.	g.	F. M.	W.	Am.				
318	Yellow Bellefleur	l.	ob.	g. y.	v. g.	F. M.	W.	Am.	**		*	
319	Yellow June (Nantahalee.)	m.	r. ob.	y.	g.	F.	S.	Am.				
320	York Imperial	l.	fl.	y. r.	g.	F. M.	W.	Am.				
321	Yopp's Favorite	l.	r. c.	y.	g.	F.	A.	Am.				
322	Zachary Pippin	l.	fl.	r. s.	v. g.	F. M.	E. W.	Am.			*	

312 Valuable for late keeping.

II.—APPLES—CRABS.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
1	Byer's Beauty	s.	r. fl.	r.	g.	F. M.	E. A.	Am.				
2	Brier's Sweet (of Wisconsin)	l.		r. y.	v. g.	F. M.	A.	Am.				
3	Cherry	s.	r.	y. r.	g.	K.	A.	F.				
4	Glover's Early							Am.				
5	Hislop	l.	r.	r.	g.	F. M.	A.	Am.	*		*	
6	Lady Elgin	l.	r. ob.	y. r.	v. g.	F. M.	L. A.	Am.				
7	Marengo	l.	r. fl.	y. r.	g.	F. M.	W.	Am.			†	
8	Montreal Beauty	l.	r. ob.	y. r.	g.	F. M.	A.	Am.	*		†	
9	Red Siberian	m.	r.	r.	g.	F. M.	A.	F.				
10	Spitzenberg							Am.				
11	Sylvan Sweet	l.	r. fl.	y. r.	g.	F. M.	S.	Am.				
12	Transcendent	l.	r. ob.	y. r.	g.	F. M.	A.	Am.	*		**	
13	Yellow Siberian	m.	r.	y.	g.	F. M.	A.	F.				

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and District of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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II.—APPLES—CRABS.

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana.	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland and Dist. of Col.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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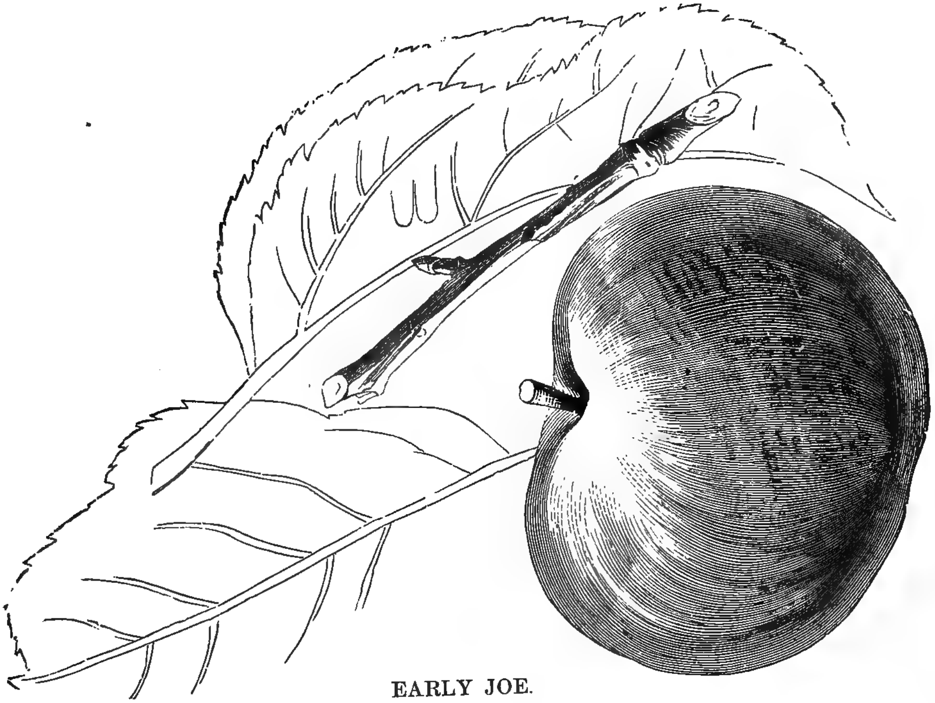

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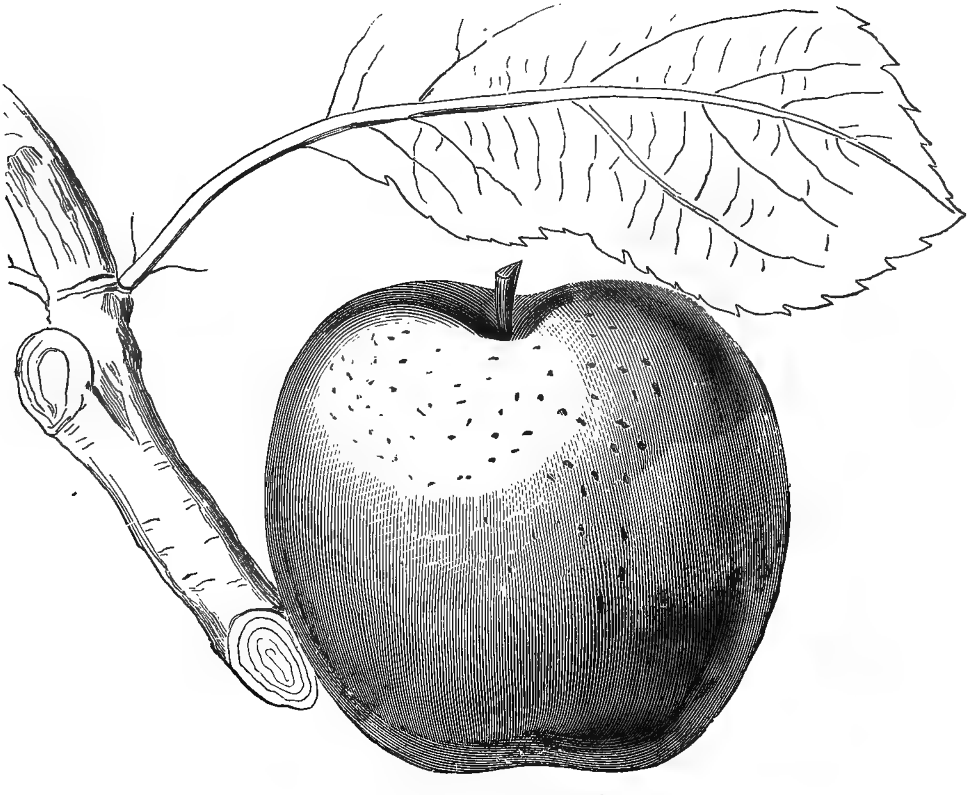
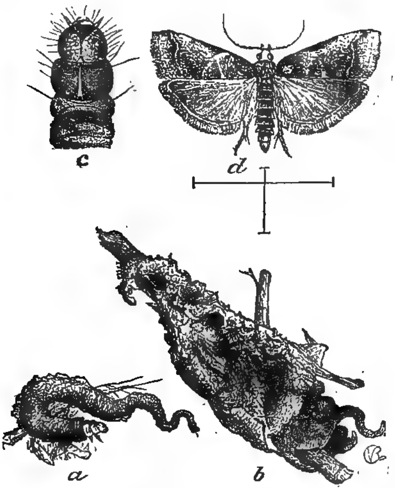


GRIMES' GOLDEN

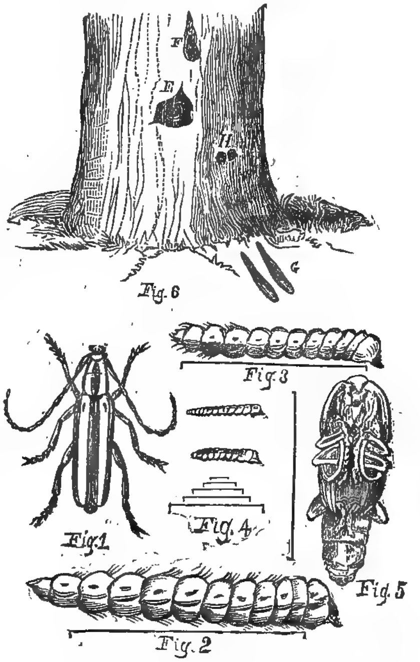
APPLE-LEAF CRUMPLER. *Phycita (Acrobasis) nebulo.* This insect is known under various names, as rascal leaf-crumpler, leaf-roller, and is found throughout the United States, especially in the more central latitudes. It is exceedingly voracious in its larval state, and from its habit of folding the leaf, is often not observed until extensive damage has been done to the foliage. The cut shows the insect in its several stages, enlarged, the cross lines at *d* representing the size of the mature moth. Sometimes the insects so multiply, especially in young orchards and in the nursery, as seriously to affect the growth and even the life of the tree. This insect is one-brooded, the caterpillar attaining its growth in May or June, according to the latitude The chrysalis is found inside the worm case, and the moths appear in June or July, according to the latitude. The eggs are deposited, hatch, grow, and hibernate in their cases. If these are picked in the autumn, winter or spring, and deposited in some vessel placed far from an orchard, the insects will die for want of food; but the parasites infesting them will mature, thus accumulating in numbers to destroy still others of the worms. The cases, if not removed, even form secure places for the deposit of eggs of other injurious insects, especially the Canker-worm.



APPLE-TREE CRUMPLER.

a, worm case; *b*, case attached to a limb; *c*, head and first segments of caterpillar; *d*, perfect moth.

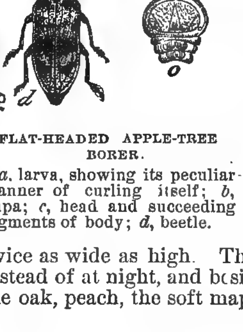
APPLE-TREE BORER. There are a number of species. The two-striped Saperda (*Saperda bivittata*) is extremely destructive to apple orchards, from the borings of the grub into the wood of the trees. The mature beetle, appears during May and June, and being strictly nocturnal is seldom seen except by the entomologist who hunts for it. The female deposits her eggs, mostly in June, in the bark near the foot of the tree, and also in the forks of the main branches. The eggs hatched, the minute grubs commence boring into the wood, generally downward the first year and upward and near the bark the second year. The borer lives in the wood of the tree until the third year when it emerges as a perfect beetle. It infests healthy as well as unhealthy trees and is very destructive. The illustration will show the insect in its various stages. The grub remaining intact until the third spring, when it assumes the pupa form:



ROUND-HEADED APPLE-TREE BORER.

Fig. 1, perfect beetle; fig. 2, full grown borer; fig. 3, borer at beginning of second winter; fig. 4, lines showing various stages of growth from the minute insect just hatched; fig. 5, pupa; fig. 6, shows its manner of entering the tree and its work.

The natural enemies of this insect are the woodpecker tribe. Artificial remedies are to find the cast of the young larvæ, and kill them by piercing with a flexible wire. Prevention is, however, the only sure remedy. Keep the base of every tree quite clear of weeds and trash, and apply soft soap thoroughly to the bark, laying cakes of strong bar soap in the forks of the trees, during May, June, and into July. The insect infests besides the apple, the mountain ash, pear, quince and June berry. The flat-headed borers (*Chrysobothris femorata*), while working in the same class of trees, is totally unlike the others, boring an oval hole twice as wide as high. The beetle flies by day instead of at night, and besides the apple, attacks the oak, peach, the soft maple, ash, willow, tulip



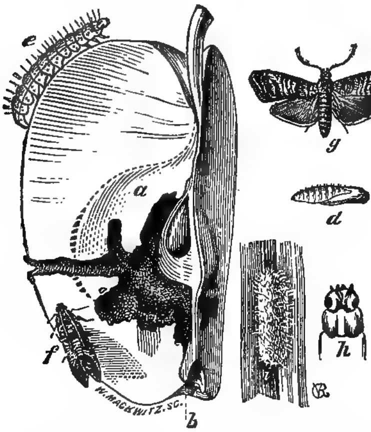
FLAT-HEADED APPLE-TREE BORER.

a, larva, showing its peculiar manner of curling itself; *b*, pupa; *c*, head and succeeding segments of body; *d*, beetle.

tree, and even the elm and cottonwood. It also attains its full size in one year from the egg. The insect attacks limbs and trunk indiscriminately. The soaping is as effectual for this as the round-headed species, but must be applied more generally over the larger limbs. Once either of these species get firmly fixed in the tree, the only remedy is to cut them out. Hence the value of the preventatives named.

APPLE-TREE CATERPILLAR. (See Yellow-necked Apple Caterpillar.)

APPLE-WORM. Codling Moth, *Carpocapsa pomenella.* The cut which we give below will represent the natural history of this noxious insect fully enough, since it represents the pest in all its stages. It is two-brooded; the first brood appearing with the opening of the leaves in the spring, and the second brood pass the winter in the larval state. Yet the two broods often run into each other, since some worms leave the apple while others are entering. The female is wingless. The eggs require from four to ten days to hatch; the worm lives in the larval state about four weeks, and the pupal state remains from two to three weeks. Various remedies are proposed. Two shingles nailed together and fastened to the trunks of trees, will catch large numbers. Paper or cloth bandages of several folds may be tied around the trunks, and removing them once in ten days, killing the worms by scalding, and again replacing them. Commence bandaging about a week later than early strawberry blossoms appear. Dr. Riley, in his Fourth Missouri Entomological Report, says: There has been some difference of opinion as to the best form of bandage to be used. To be thoroughly effectual and durable it should be sufficiently firm in texture that it can not be too easily cut through by the jaws of the worm, or drawn in folds and wrinkles by its silken threads. A stout and narrow piece of cloth or canvas, drawn around and fastened to the tree by a tack, is perhaps the simplest form of bandage and the most quickly fastened. Mr. James Weed, of Muscatine, Iowa, uses strips of cloth one and a-half inches wide. Every one must decide for himself what will be cheapest and most expedient, according to the extent of his orchard and the facility with which he can procure rags, cloth, hay-bands, or other substances. A good bandage, ready-made, is greatly needed in the country, and if some enterprising firm would manufacture canvas strips about six inches wide, lined on one side with four inches of tow cotton wadding, or some other loose material, and would put it upon the market at a reasonable price per yard, there would be an unlimited demand for it. Such strips would last for years, and could be cut of any desired length, drawn around and tacked, with little labor, to each tree, while, by smearing with tar or molasses, it might also be made to do good service, after the Apple-worm season, in those orchards infested with the Canker-worm. The advantage of the looser, thicker inside lining (which should, however, be closely and compactly pressed) would be, that it would enable us to fill up all the little inequalities of the bark, so as to absolutely prevent the young Canker-worms, as well as the moths, from ascending, and at the same time it would furnish a most enticing substance for the Apple-worm to spin up in.



APPLE-WORM.

a, section of apple showing the burrows and place of exit; *b*, the point at which the egg is laid, and mark of worm in entering; *d*, pupa; *e*, full grown worm; *f*, the moth just escaped from the chrysalis; *g*, moth with wings expanded; *h*, head of worm magnified; *i*, insect within cocoon.

APRICOT. This, one of the most delicate of fruits of the temperate zone, belongs to the plum family. Its generic name is *Prunas armeniaca.* Alexander the Great is reported to have sent this fruit from Armenia to Greece and Epirus. Like the peach, the apricot is propagated by budding, but it may also be propagated by grafting. The tree requires a rich, dry loam, such as is suited to the peach and the plum. It is also subject to the same class of insect enemies as the peach—the curculio being the great drawback to its general cultivation. It is not hardy north of Maryland, and indeed does not attain full perfection of hardiness even in that State. Only in California is it much grown, except in conservatories and in the gardens of amateurs, South

APTERANS, APTERA. Wingless insects.

APYREXIA. The cool or quiet stage of intermittent fevers.

AQUA FORTIS. Nitric acid, usually dilute.

AQUA REGIA. A mixture of nitric and muriatic acids.

AQUATIC PLANTS. Such as grow submerged, or partly so, in water; applied, also, to marsh plants.

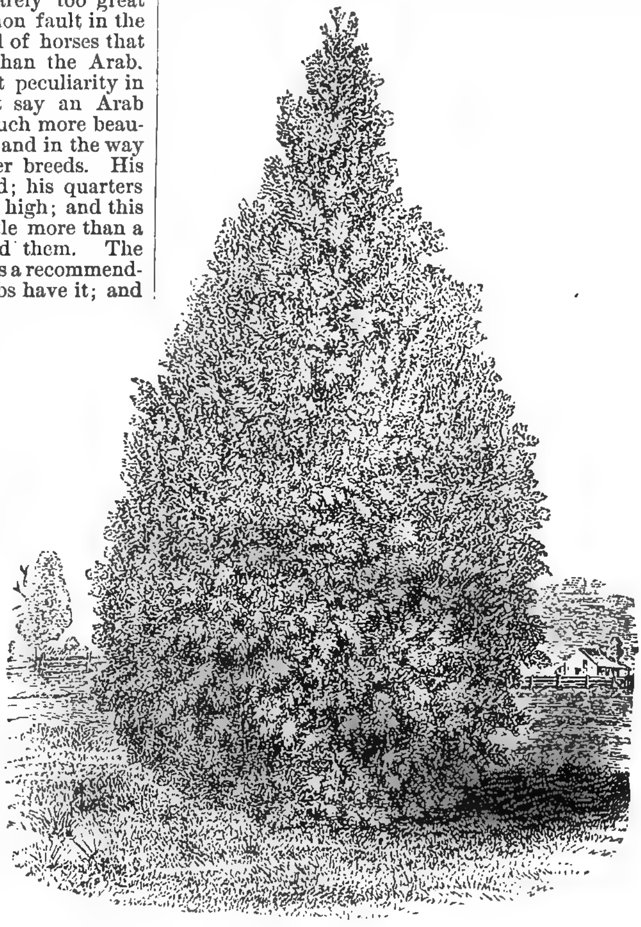
AQUEOUS HUMOR. The fluid in the anterior chamber of the eye.

ARAB HORSES. From the fact of the importation of Arabian horses into England, many years ago, for the purpose of improving the blood of the English horse, many persons suppose the Arab to be the type of all that is excellent in that noble animal—the horse. Others again suppose that Arabia is the native country of the horse. This again is a fallacy. The horse of Arabia is a rather small, compact horse, possessed of great bottom, that is capable of going long journeys, and of continuing many hours in action at a moderate rate of speed. He is docile, spirited, sagacious, attached to his master, a strong constitutioned, active, intelligent animal, capable of enduring considerable hardship, and of continuing a journey, without food or water, to a far greater extent than the more artificially reared horses of enlightened nations. Our Morgan horses come nearer the Arab in these respects than any other of our better bred horses. Yet in every trial with the modern-bred racer, even on the Arab's own deserts, the English blood horse has left him behind. He can neither carry the weight, nor, to use a racing term, "stay the pace." There is no evidence that there were horses in Arabia 900 years before the time of Christ; for then, while Solomon brought silver and gold and spices from Arabia, he brought his horses from Egypt; in fact, in the fourth century after Christ, 200 Cappadocian horses were sent by the then Roman Emperor, to one of the most powerful of the Arabian princes, as being the most acceptable present he could offer. So late as the seventh century after Christ, there were but few horses in Arabia, for when Mahomet attacked the Koreish near Mecca, he had but two horses in his army, and although vast numbers of camels and sheep were carried away and immense plunder in silver, not a single horse is mentioned as a part of the spoils; in fact, the most credible testimony would seem to show that the horse was gradually introduced into Arabia at a comparatively late period from Egypt, from whence, also, the adjoining Asiatic countries, derived their horses, and that from the same stock has also sprung the stock of horses in the whole south-eastern portion of Europe. What the Arabians have excelled in is in keeping their race of horses pure, by the most careful breeding, and attention to keeping the blood pure and without stain of intermixture; hence, when crossed upon other stock, the pre-potency of the blood has always shown itself. This has been especially shown in the English race-horse, and yet to-day so intelligently has this sub-family of horses been bred in England and America, that a further admixture of Arabian blood would prove disastrous to the stock. In England, an allowance of one stone (fourteen pound) is made in favor of the Arabians, in racing for the Goodwood cup, and yet none have ever won it. In India, a difference of from fourteen to twenty-one pounds is made in the carrying weights in favor of Arabian horses over English blood horses. Captain Shakspear, in his work on Wild Sports in India, gives a minute description of the Arab horse as it is found in India, as follows: The points of the highest caste Arab horse, as compared with the English thorough-bred, are as follows: the head is more beautifully formed, and more intelligent; the forehead broader; the muzzle finer; the eye more prominent, more sleepy-looking in repose, more brilliant when the animal is excited. The ear is more beautifully pricked, and of exquisite shape and sensitiveness. On the back of the trained hunter, the rider scarcely requires to keep his eye on anything but the ears of his horse, which give indications of everything that his ever-watchful eye catches sight of. The nostril is not always so open in a state of rest, and indeed often looks thick and closed; but in excitement, and when the lungs are in full play from the animal being at speed, it expands greatly, and the membrane shows scarlet and as if on fire. The game-cock throttle—that most exquisite formation of the throat and jaws of the blood-horse—is not so commonly seen in the Arab as in the thorough-bred English race-horse, nor is the head quite so lean. The jaws, for the size of the head, are perhaps more apart, giving more room for the expansion of the windpipe. The point where the head is put on the neck is quite as delicate as in the English horse. This junction has much more to do with the mouth of the horse than most people are aware of, and on it depends the pleasure or otherwise of the rider. The bones, from the eye down towards the lower part of the head, should not be too concave, or of a deer's form; for this in the Arab as in the English horse denotes a violent temper, though it is very beautiful to look at. Proceeding to the neck, we notice that the Arab stallion has rarely the crest that an English stallion has. He has a strong, light, and muscular neck, a little short, perhaps, compared to the other, and thick. In the pure breeds, the neck runs into the shoulders very gradually; and generally, if the horse has a pretty good crest, comes down rather perpendicularly into the shoulders; but often, if he is a little ewe-necked, which is not uncommon with the Arab, it runs in too straight, and low down in the shoulders. The Arab, however, rarely carries his head, when he is being ridden, so high in proportion as the English. He is not so well topped, which I attribute to the different way he is reared, and to his not being broken in regularly, like the English horse, before he is put to work. His shoulders are not so flat and thin, and he is thicker through in these parts generally for his size, than the English thorough-bred horse. His girth does not show so deep, that is, he does not look so deep over the heart; but between the knees and behind the saddle, where the English horse very often falls off, the Arab is barrel-ribbed; and this gives him his wonderful endurance and his great constitutional points. This also prevents him from getting used up in severe training or under short allowance of food, and in long marches. His chest is quite broad enough and deep enough for either strength or bottom. The scapula, or shoulder-blade, is both in length and backward inclination, compared to the humerus, or upper bone of the arm, quite as fine in the high-caste Arab as in the English horse; while both bones are better furnished with muscles, better developed, and feel firmer to the hand. But some of the very fastest Arabs have their fore legs very much under them; indeed, so much that no judge would buy an English horse so made. Yet, whether it be that this form admits of the joints between these bones becoming more opened, when the horse extends himself, or whatever be the cause, it is a fact that blood-horses thus made are almost always fast horses. The upper part of their shoulder-blade seems to run back under the front part of the saddle, when they are going their best. This formation is most common in the lower-sized Arab, and apparently makes up to him for his deficiency in height. The very finest-actioned Arabs have had this peculiarity of form. They are rather apt to become chafed at the elbow-points by the girths, and almost require to have saddles made on purpose for them. The elbow-point, that essential bone, which for sake of leverage should be prominent, is fine in the Arab, and generally plays clear of the body. The fore-arm is strong and muscular, and is pretty long; the knee square, with a good speedy cut for the size of the animal, equal to the English horse; while below the knee the Arab shines very conspicuously, having a degree of power there, both in the suspensory ligaments and flexor tendons, far superior, in proportion to his size, to the English horse. These are distinct and away from the shank-bone; they give a very deep leg, and act mechanically to great advantage. The bone looks small, but then it is very dense, the hollow which contains the marrow being very small, and the material solid, more like ivory than bone, heavy, and close-grained. The flexor tendons are nearly as large and as thick as the canon bone. The pasterns and their joints are quite in keeping with the bones above them, and are not so long, straight, and weak as those of the English horse. The feet are generally in the same proportion; but the Arabs themselves appear to be very careless in their treatment of them. The body or centre piece of the Arab horse has rarely too great length. This is a very uncommon fault in the pure breed; and there is no breed of horses that are more even in this respect than the Arab. Behind this, we come to a great peculiarity in the breed—his croup. I might say an Arab horse is known by it; he is so much more beautifully made in his hind quarters, and in the way his tail is put on, than most other breeds. His loins are good; he is well coupled; his quarters are powerful, and his tail carried high; and this even in castes that have very little more than a high-bred stallion to recommend them. The straight-dropped hind leg is always a recommendation, and almost all racing Arabs have it; and this, when extended, brings the hind foot under the stirrup, and the propellers being of this shape give a vast stride without fear of overreach. The thighs and hocks are good; the latter very rarely know either kind of spavin or curbs. The points and processes are preëminently well adapted for the attachment of the muscles, while the flexor tendons of the hind legs generally correspond with those of the fore. The hocks are not so much let down, nor the hind legs so greyhound-like, as in the thoroughbred English horse. In stride, too, he is somewhat different, inasmuch as it is a rounder way of going, and is not so extended or so near the ground, but is more like a bound. However, there are exceptions; and I have bred pure Arabs whose stride, for their size, was very extended, and quite like that of English race-horses. Ali Bey, an acute and apparently disinterested Oriental writer, describes six distinct breeds of Arabs. The first "Dgelfe," found in Arabia Felix. They are lofty in stature, with long ears, narrow in the chest, but deep in the girth; swift, high-strung animals, and yet docile in temper, and capable of supporting hunger and thirst for a long time. The second breed, named "Seclaoni," is reared in the eastern part of the desert and resembles the "Dgelfe," but is not considered so valuable. The third breed, "Mefki," is handsome, resembling the Andalusian horse in figure, but not remarkable for speed. The fourth, called "Sabi," resembles the "Mefki." The fifth, named "Fridi," are quite common, but apt to be vicious. The sixth breed, named "Nejdi," is from the neighborhood of Bussora, and considered equal to the first-named breed, the "Dgelfe," and either the first or last named will sell at two years old for about 2000 Turkish piasters ($160).

ARABLE LAND. So called from the Latin word *arare* (to plow), is that part of the land which is chiefly cultivated by means of the plow.

ARACÆ. The natural family of plants, including the Arum, Indian Turnip, and Skunk Cabbage.

ARACHNIDANS, ARACHNIDA. A class of apterous, spider-like *condylopes*, having the head confluent with the chest, and the body, consequently, consisting of but two segments, with eight legs, smooth eyes, and the sexual orifices situated on the thorax, or anterior part of the abdomen.



SIBERIAN ARBOR VITÆ.

ARBORESCENT. Inclined to, or becoming woody.

ARBORICULTURE. The cultivation of trees. (See Horticulture, Forestry, and trees under their proper names.)

ARBORETUM. A place for the cultivation of trees.

ARBOR VITÆ. The Arbor Vitæ belongs to the sub-order *Cupressineæ* (the cypress sub-family), and is sometimes called, incorrectly, White Cedar. The White Cedar is *Cupressus* *thyoides*. The Arbor Vitæ is *thuja-occidentalis*. Arbor Vitæ occurs in cool, swampy situations from New England to Pennsylvania, and sparsely in Northern Indiana and Illinois. In Wisconsin and Michigan, and north, there are extensive swamps of this tree, where it is much valued for posts, telegraph poles, and other purposes where strength combined with lightness is necessary. As a tree for ornamental hedging it is extensively used and is surpassed by few. From cultivation and hybridization, it is now broken up into numerous varieties. Some of them are very interesting, and which must be propagated from cuttings to get them true. Some of the golden and variegated varieties are most beautiful, while others are so extremely dwarf and compact as to prove valuable for the borders of walks, edgings, etc., in ornamental gardening. The cut of Siberian Arbor Vitæ, is one of the "sports," and does not come true from seed. It must be propagated from cuttings or by layers.

ARBUTUS. A genus of evergreen shrubs characterized by its fruit being a berry, containing many seeds. *Arbutus unedo*, or Strawberry Tree, is a well known variety.

ARCESTHIDA. A small succulent core, as the juniper berry.

ARCHIL. A purple dye-stuff procured from the *Rocella tinctoria* and *Fuci formis*, lichens growing on the rocks of the Canary Islands.

ARCHITECTURE. The architecture of the farm is generally of the simplest kind, and embraces dwellings, barns and stables for the various animals and birds kept; also green-houses, conservatories, hot-houses, and the simple frames used in forcing plants. In all farm structures, the object should be to combine as much practical utility with strength as may be possible. Where the pecuniary means of the individual will allow, ornamentation may be extended according to the length of the purse. The subject is too broad to be exhaustively treated in a work of this kind. Thus we shall only notice some of the more simple forms of dwellings here, but, under their appropriate heads, will give instructions for the more simple farm buildings, which see. The new settler must be content with the crudest structure until his means will allow him to build better. Thus, a log house where timber is handy, afford the means of a most comfortable dwelling. Straight logs, of a nearly uniform size and of equal lengths, are selected. These may be hewed square, or the two sides—outer and inner—may be hewn straight. The under side of the logs are then notched, eight or ten inches from the end, and the upper sides scarfed to fit, so the bark will come just near enough together to meet without riding one on another. They are then laid up, chinked when necessary, with slabs, which are pinned or nailed. The interstices are then stopped with clay or mortar. At the proper height from the ground for the ceiling, poles, hewed to a size of four by eight, are let into the logs to form the floor. This is covered with flooring, or in lieu of that with puncheons—slabs split out of free rifted timber and hewn into planks. The lower floor is usually laid on timbers placed directly on the leveled ground. The supports for the roof are made of rafters hewed fair on one side; a ridge-pole is laid on the top, and the supports for the shingles are placed at proper intervals. The shingles are generally made three feet long, split out of free rifted timber, and are nailed or held in place by straight poles pinned down at proper intervals. Thus we have the simplest structure possible, in a timbered country, combining strength with warmth in winter, and coolness in summer. The window and door places are then cut out and the casings put in, ready for the doors and windows. A space is then cut out at one end for a fire-place, six feet wide and five feet high; or calculation may be made for this and also the doors and windows when the logs are hewn. To do this, however, the measurements must be accurate; there must be no guesswork. In time, the log cabin, the Kansas dug-out or the rough shanty gives place to a dwelling where taste and comfort are combined with practical utility. Mistakes are too often made in the endeavor to have something showy and stylish. A farm house should be in keeping with its surroundings, unless money is to be spent to make the surroundings beautiful. A plain, comfortable house is more in harmony with the ordinary farm surroundings than an expensive building with all bare or semi-wild outside. A house should be in harmony with the situation. Just as a house and its surroundings exert its influence on the family and neighboring inhabitants, just so the lay of the country and the scenery should exert its influence, so the buildings may harmonize. For instance, where there are sharp hills, ravines, bluffs, broken rocks or mountains, flat roofs, horizontal lines and broad verandas would be out of place. There should be gables and steep roofs to harmonize. In other words, the architectural features of the buildings should be broken to harmonize. There lofty turrets, steep gables and grouped chimneys may mark the dwelling of the man of wealth, while his less plethoric (in purse) neighbors may profit by the example in his modest cottage. On a level plain or in a gently undulating country, such as is characteristic of the greater part of the west, this style of architecture would be out of place. The summers are torrid and the winters often arctic. There are often sweeping winds. Hence these must be provided for. The roof should be steep enough to quickly carry off drenching rains. There should be caps to the windows for shade. There must be stability to the whole. Thus the square form, or nearly so, will not only be economical, but at the same time in good taste with the surroundings. A cottage, with honeysuckles and morning-glories climbing over the porch and windows, or the log cabin in the woods with vines nestling around it, is more truly beautiful than the pretentious mansion with bare walls, weeds and rank grass, muddy or dusty walks and roadways, with, perhaps, a Virginia fence in front to keep out the pigs. In building, always have the best possible cellar the situation will allow. In very many country residences, a fatal mistake is made in having the walls of the rooms too low. Nine feet below stairs and seven and a half for the chambers is little enough. Ten feet below stairs and eight feet walls for the chambers would be better. Use large glass for the windows, and have them to slide top and bottom by means of cords and pulleys. Do not build a bracketed house. Use good sheathing, felting paper and the best siding. If the walls are to be of sound brick, so much the better. Never build a large, inferior house. It is better to build smaller and substantial. Do not forget the porches and verandas. They are most comfortable in summer, and give stability to the whole building. Provide, also, double or storm windows for the entire lower part of the house. The extra expense will be repaid the first hard winter. In the spring, these may be taken down and placed where they may be kept dry. The same may be said of the cellar, one of the most important parts of the farm dwelling. This should always have double windows, and also be furnished with blinds to darken it at will. If large, it should be divided into compartments, and for the reason that some portions of the cellar are required to be kept warmer than others. When hardy vegetables are to be kept, and canned fruits and vegetables, the temperature should be just above freezing. Squashes, sweet potatoes, pumpkins, and half-hardy plants, bulbs and tubers, must be kept where the temperature is dry and of about 50° Fahrenheit. Other apartments in the cellar may be kept down to the freezing point. Thus, by having the cellar divided as we have shown, convenience and economy may be both preserved.

ARCHITRAVE. The chief beam or structure resting immediately upon the columns of an edifice; the lowest number of the entablature.

ARECA. An East Indian palm, the nut of which is chewed with the betel.

ARENACEOUS. Sandy; relating to sand, as arenaceous soils.

AREOLÆ. In entomology, the small spaces between the nervures of the wings.

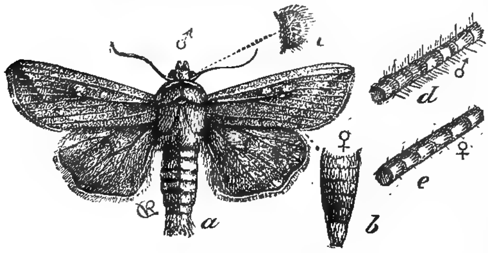
AREOMETER. An instrument for taking specific gravities. (See Hydrometer.)

ARGILLACEOUS. Clay; clayey.

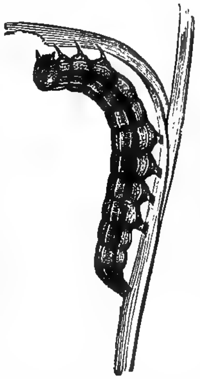
ARILLA, ARIL, ARIEL. A membranous prolongation of the placenta over a seed, as the mace of the nutmeg.

ARM OF A HORSE. The upper part of the fore legs.

ARMY-WORM. *Leucania* (*Heliophila*) *unipuncta.* Of this insect, Dr. Riley, in his Ninth Missouri Entomological Report, says it is with us every year. In ordinary seasons, when it is not excessively numerous, it is seldom noticed: 1, because the moths are low, swift fliers, and nocturnal in habit; 2, because the worms, when young, have protective coloring, and, when mature, hide during the day at the base of meadows. In years of great abundance the worms are generally unnoticed during early life, and attract attention only when, from crowding too much on each other, or from having exhausted the food supply in the fields in which they hatched, they are forced, from necessity, to migrate to fresh pastures in great bodies. The earliest attain full growth and commence to travel in armies, to devastate our fields, and to attract attention, about the time that winter wheat is in the milk—this period being two months later in Maine than in Southern Missouri; and they soon afterwards descend into the ground, and thus suddenly disappear, to issue again two or three weeks later as moths. In the latitude of St. Louis the bulk of these moths lay eggs, from which are produced a second generation of worms, which become moths again late in July or early in August. Exceptionally a third generation of worms may be produced from these. Further north there is but one generation annually. The moths hibernate, and oviposit soon after vegetation starts in spring. The chrysalides may also hibernate, and probably do so to a large extent in the more northern States. The eggs are inserted between the sheath and stalk, or secreted in the folds of a blade; and mature and perennial grasses are preferred for this purpose The worms abound in wet springs preceded by one or more very dry years. They are preyed upon by numerous enemies, which so effectually check their increase, whenever they unusually abound, that the second brood, when it occurs, is seldom noticed; and two great army-worm years have never followed each other, and are not likely to do so. They may be prevented from invading a field by judicious ditching; and the burning over of a field, in winter or early spring, effectually prevents their hatching in such field. It has numerous natural enemies, among which may be noticed, some parasites, the Red-Tailed Tachina Fly, the Yellow-Tailed Tachina Fly, also Ichneumon flies. Various predaceous beetles and their larva also prey upon it.



NORTHERN ARMY-WORM.



NORTHERN ARMY-WORM.

ARRACACHA. The South American name for an umbelliferous plant (the *Arracacia esculenta* of botanists) whose fleshy sweet roots are cultivated in Colombia and Jamaica, in the mountainous parts of those countries, in the same way as parsnips and carrots in Europe. The roots are of large size, and in quality are, when cooked, between a sweet chestnut and a parsnip. Attempts to introduce it into common European cultivation have uniformly failed; so says Dr. Brande.

ARROW-GRASS. The genus *Triglochin*. They are small marsh grasses, perennial, and flowering in July; some grow on salt marsh. They are eaten by cattle.

ARROW-HEAD. *Sagittaria sagittifolia.* A common indigenous, perennial, tuberose plant, with arrow-shaped leaves, growing in brooks. It is cultivated by the Chinese for its roots, which are mealy.

ARROW-ROOT. *Maranta arundinacea.* A herbaceous plant of the family Cannæ, with fleshy perennial roots, readily propagated by root-cuttings. It is cultivated in Bermuda, the West Indies and Florida. Arrow-root is a nearly pure starch, of agreeable flavor, but little nutrition. Good potatoes, rasped into a pulp and treated in the same way, produce a starch, which is often used to adulterate the genuine article.

ARSENIC. Arsenious acid; white oxide of arsenic; a violent and irritant poison. The safest antidote is the recently prepared hydrated oxide of iron; by precipitating a solution of per-nitrate of iron by solution of potash. Lime water is much less certain.

ARTEMISIA. The genus of wormwoods.

ARTERIOTOMY. The opening of an artery to let blood.

ARTERY. The vessels which convey red blood are so called.

ARTESIAN WELLS, or fountains, are those springs or wells which constantly overflow their summits. In many parts of the country streams are reached at various depths, which, being tubed, continue to give a full flow at the surface from year to year.

ARTICHOKE. The true Artichoke (*Cynara scolymus*), an herbaceous annual plant as to its top. with a perennial root. The plant is three to five feet or more high, with large, entire or lobed and spinose (spined) leaves; the thick receptacle, together with the fleshy bases of the scales of the flower head, being the parts usually eaten. It is nearly allied to the Cardoon, *C. carduncculus.* The plant usually cultivated under the name of artichoke is a true sunflower, *Helianthus.* The tuberous variety is called Jerusalem Artichoke, a corruption of the Italian name Girasol. There are several wild varieties in the West, found growing generally in rich valleys and river bottoms, the roots or tubers of which are eagerly sought in the autumn and spring by swine. The variety usually cultivated is a native of Brazil, and has many valuable qualities aside from its well known hardiness, standing, as it does, our coldest western winters perfectly. As food for hogs, it should be cultivated extensively, since its tubers are eagerly eaten and are highly conducive to the health of swine. It has usually been considered a watery, innutritious tuber. It is, however, quite as nutritious as the potato, as the following analysis of the artichoke and potato will show: 1. Proximate analysis of the tubers of the Jerusalem Artichoke, by Braconnot:

Uncrystalized sugar	14.80
Inuline	3.00
Gum	1.22
Albumen	1.00
Fatty matter	0.09
Citrates of potash and lime	1.15
Phosphates of potash and lime	0.20
Sulphate of potash	0.12
Chloride of potassium	0.08
Malates and tartrates of potash and lime	0.05
Woody fibre	1.22
Silica	0.03
Water	77.05

M. Payen found a larger proportion of sugar in this tuber than that stated above, and he ascertained that the fatty matter consists of stearine and elaine. Boussingault found: Of dry matter, 20.8; water, 79.2. 2. Proximate analysis of the potato in a fresh state, by Johnston:

Water	75.52
Starch	15 72
Dextrine	0 55
Sugar	3 30
Albumen, casein, gluten	1.41
Fat	0.24
Fibre	3.26

The cultivation of the artichoke is exceedingly simple. Furrow the ground—a well drained soil—four feet apart, and plant the tubers an inch below the surface and about ten inches apart, covering about two inches. Keep free from weeds with the ordinary two-horse corn cultivator. Dig in the fall, and leave the tubers to be rooted out by the hogs in the autumn, winter and spring. They bear great heat and drouth, and are excellent food for horses, cows and sheep in winter, if used in connection with dry food and salt.

ARTICULATA, ARTICULATES. A term applied by Cuvier to a primary division of the animal kingdom, characterized by an external skeleton in the form of a series of rings articulated together and surrounding the body; by an internal gangliated nervous system, the ganglions being arranged symmetrically along the middle line of the body, and by having distinct respiratory organs. Insects and various worms are of this order.

ARTICULATED. Jointed In botany it signifies a slight connexion, such as that of the leaf with the stem in exogens, which allows them to fall off when dead.

ARTICULATION. The connexion of the bones of the skeleton by joints.

ARUM. The genus of the Indian turnip.

ARUNDO. The reed plants. Several species, growing on sand, bind it together; arundinaceous, reed-like.

ARVICOLA. The genus of field-mice.

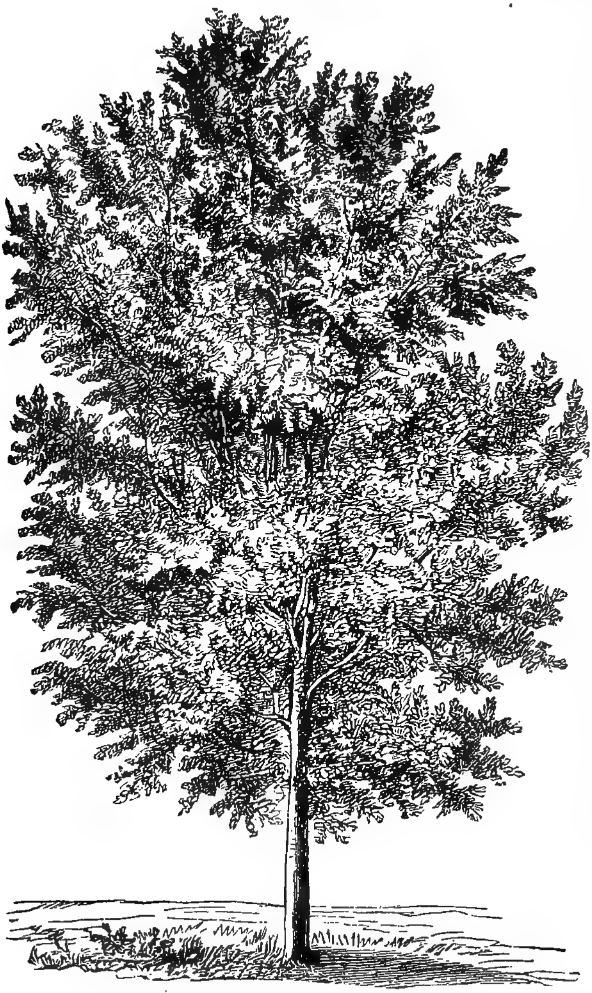
ASAFŒTIDA. A fetid gum resin obtained from the root of the *Ferula asafœtida,* whence it exudes, by incision, in the form of a milky juice, which, when dried by exposure to the sun, acquires a mottled appearance and pink color. It is a native of the south of Persia, and is used in medicine as a stimulant and anti-spasmodic in hysteric and nervous disorders, and in spasmodic cough, asthma, and flatulent colic

ASCARIS, ASCARIDES. Intestinal worms.

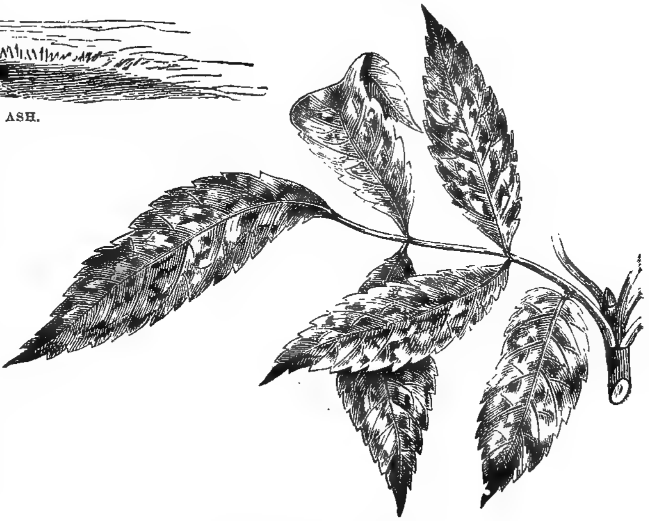
ASCI. Little membranous bags containing sporules; *Ascidium,* the Leaf-pitcher.

ASCITES. Dropsy of the belly.

ASH. The ash (*Fraxinus Americana*) contains five well known species: White Ash, Blue Ash, Black Ash, Red Ash and Green Ash. They occupy an important rank as timber trees of value, and thrive on a variety of soils—a cool deep moist soil being congenial to the most of the species. White Ash will thrive on rather poor soil. Blue Ash is found on rich river bottoms. Black Ash grows in swamps. Red Ash on river banks, and other rich soils, like the White Ash. The same situation suits the Green Ash. A European species (*F. excelsior*) has been introduced. but is inferior to our White and Blue Ash. The Acuba-leaved Ash is one of the most ornamental varieties. The cut, page 72, shows leaves one quarter the natural size. The White Ash is quite commonly known as the American Ash. Of it Arthur Bryant, Sr., says: Branchlets and petioles, smooth; leaflets, seven to nine, ovate or lance-oblong, pointed, pale, smooth or pubescent underneath, somewhat toothed or entire; fruit, terete, and marginless below; above, extended into a lanceolate, oblanceolate, or wedge linear wing. Among the American species of ash, the White Ash is one of the most valuable and worthy of culture, for the qualities of its wood and the rapidity of its growth. When full grown, it is one of the largest trees of our forests. I well recollect trees, in Western Massachusetts, three feet in diameter, with a straight shaft free from branches to the height of forty feet or more, but such are no longer to be found in the thickly settled parts of the country. The largest ash tree I ever met with was one near my native place, which was felled more than forty years since for the manufacture of scythe snathes. The trunk was five feet in diameter, and perfectly sound. The tree was not lofty, the top having been broken off by a tornado many years before. The White Ash abounds in the Provinces of the Dominion, in most parts of New England, New York, and the northern States generally, but is fast becoming scarce. It is common, but not abundant, in Northern Illinois and Iowa, and becomes less frequent in proceeding southward. A cold climate appears to suit it best. I have never met with very large trees of the ash in the vicinity of the prairies of Illinois and Iowa, although the soil is well suited to its growth; but this may readily be accounted for from the fact that it is one of the trees most easily destroyed by the fires which annually ravaged these countries previous to their settlement. I have been informed that in Southern Kansas the White Ash is small, crooked, and worthless for any purpose except fuel. The White Ash will not thrive in very poor, dry lands. A cool, deep, moist soil seems most congenial to its growth. The trees which have grown most rapidly afford the best timber; that taken from stunted, slow-growing trees, is comparatively weak and brittle. The prairie soils of Iowa and Northern and Central Illinois are well adapted to the growth of the White Ash. Other species would, perhaps, be of more value further south. Besides its employment in the manufacture of agricultural implements, ash timber is extensively used in the construction of carriages and furniture. It is esteemed for fire-wood. The supply is fast diminishing, and the demand increasing, and those who propose to engage in tree planting can not be too soon in taking measures to meet it. The American species of ash are diœcious, that is, the fertile and barren flowers are on different trees. Seed is produced by White Ash trees which grow in open ground. The seed are ripe by the first of October, and with the first sharp frosts. If sown in the fall, it should be thinly covered with earth, and straw or litter laid over it to prevent it from being washed out by heavy

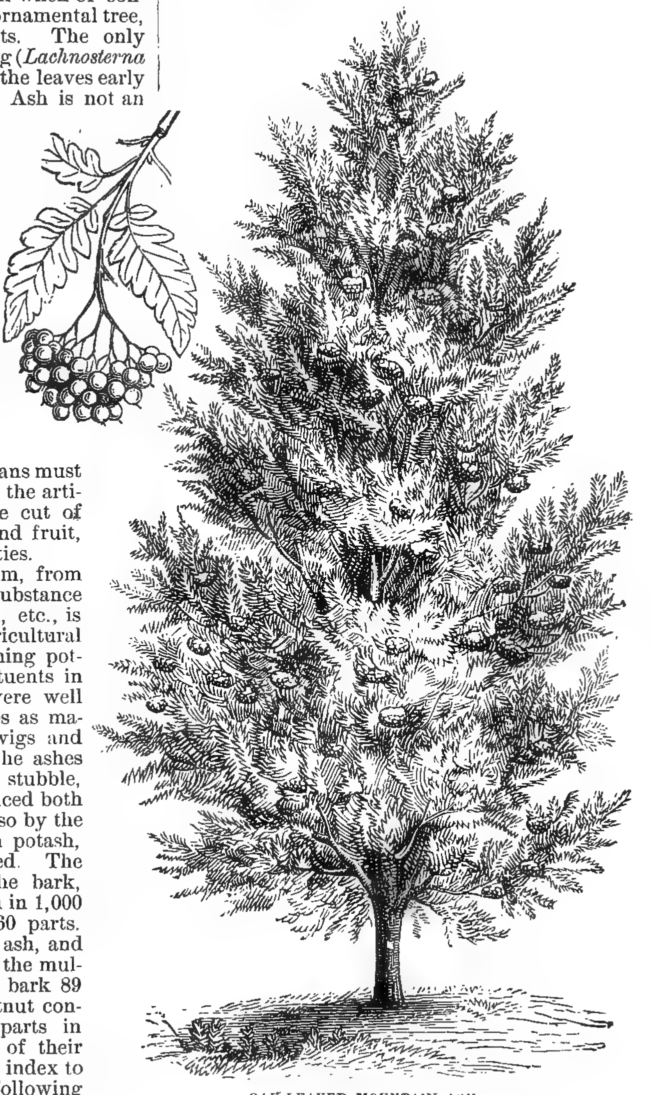


AMERICAN ASH.



LEAVES OF THE ACUBA-LEAVED ASH.

rains. The litter must be taken off in spring. If to be sown in spring, it should be mixed with moderately damp sand. If kept dry through the winter it is not likely to vegetate. The White Ash bears transplanting well, even when of considerable size. It is a handsome ornamental tree, and is rarely attacked by insects. The only exception I know of is the May-bug (*Lachnosterna fusca*), which sometimes devours the leaves early in the summer. The Mountain Ash is not an ash, but belongs to the apple (*Pyrus*) family. It is one of the most ornamental of our small trees, with its peculiar ash-like foliage, white flowers and its handsome red berries. The American species is *Pyrus Americana*, and the European species, *P. aucuparia*, also called Rowan Tree. The Mountain Ash scarcely requires pruning and never grows unshapely. The American Mountain Ash is sometimes used as a stock upon which to graft the apple, but can not be recommended. It is subject to the attacks of borers fully as much as the apple-tree, and the same means must be used for protection as given in the article, Apple-tree Borers We give cut of the Oak-leaved Mountain Ash, and fruit, one of the rarer ornamental varieties.



OAK-LEAVED MOUNTAIN ASH.

ASHES. The earthy residuum, from the combustion of any organic substance as vegetable matter, wood, coal, etc., is termed ash or ashes. In an agricultural sense they are valuable as containing potash, one of the important constituents in all fertile soils. The ancients were well acquainted with the use of ashes as manure, even to the burning of twigs and dry branches, for the sake of the ashes they contained. The burning of stubble, for the same purpose, was practiced both by the Jews and Romans, and also by the ancient Britons. Ashes vary in potash, according to the wood employed. The wood of the oak, divested of the bark, contains but about 2 parts of ash in 1,000 parts, while the bark contains 60 parts. Poplar wood contains 8 parts of ash, and the bark 72 parts. The wood of the mulberry 7 parts in 1,000, and the bark 89 parts. The wood of horse chestnut contains 35, and wheat straw 43 parts in 1,000. Yet this is no criterion of their value as manure, since it is no index to the potash they contain. The following table will show the potash (parts) contained in 10,000 parts of some well known substances, compiled by Davy, as follows:

Poplar,	10,000 parts	produced	7
Beech,	"	"	12
Oak,	"	"	15
Elm,	"	"	39
Vine,	"	"	55
Thistle,	"	"	53
Fern,	"	"	62
Cow Thistle,	"	"	196
Beans,	"	"	200
Vetches,	"	"	275
Wormwood,	"	"	730
Fumitory,	"	"	790

Corn-cobs are so rich, that the ash has been used as a substitute for saleratus, for raising bread, and the ashes are now carefully saved in many of the great corn regions of the West, as a manure for the land. Coal ashes contains but little potash—the constituents of value being lime and gypsum, about two per cent in a hundred of each. They are valuable, however, as a divisor of the soil, and on stiff clays may be used until it composes about one quarter of the soil. (See articles, Alkali and Potash.)

ASPARAGIN. The white crystalline principle found in the juice of the asparagus. It is resolved by boiling in water with magnesia, into ammonia and aspartic acid.

ASPARAGUS. A well known garden plant, a hardy perennial, maratime species, cultivated for its young tender stalks. Its cultivation is exceedingly easy, but to secure large succulent shoots the ground must be deeply trenched and made exceeding rich, at least four inches of manure being incorporated with the soil. Plant one year old roots in deep furrows, covering fully five inches, the rows three feet apart, and the plants twelve inches in the row. Keep clear of weeds for two years, digging in lightly, annually a top dressing of manure. The third year the shoots may be cut, and thereafter annually for many years.

ASPARAGUS STONE. A variety of apatite.

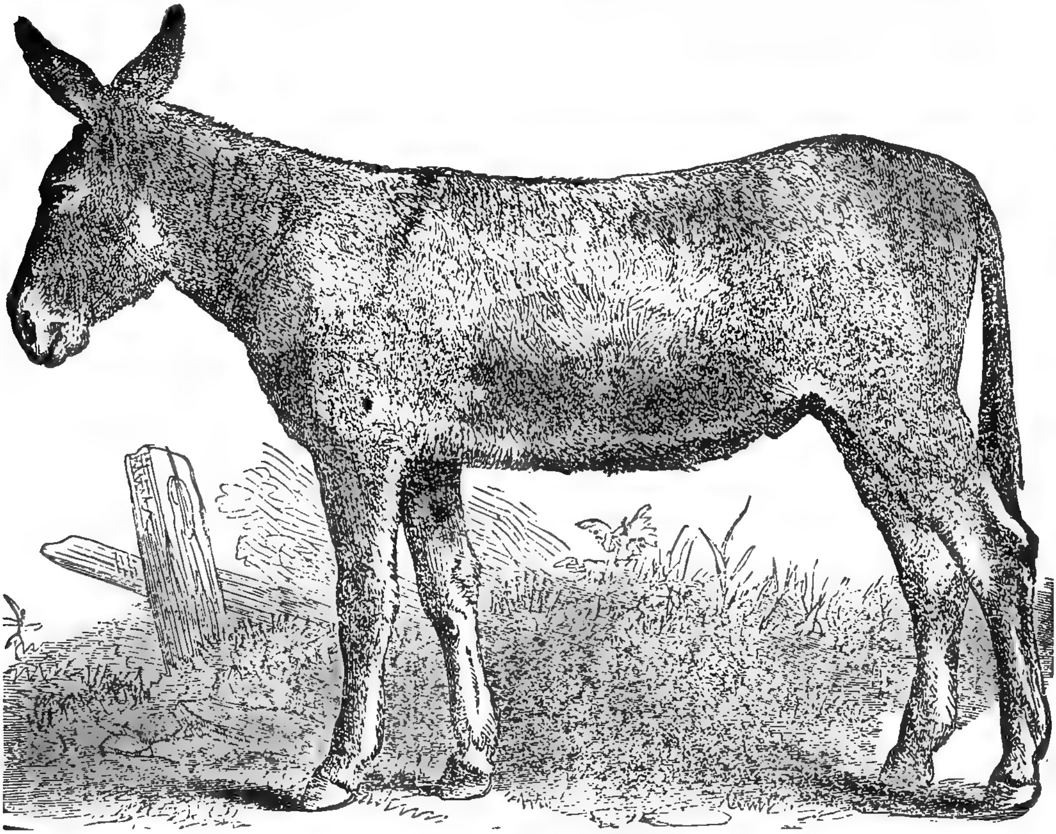
ASPEN. *Populus tremula* and *Tremuloides.* Species of the great genus of poplars, remarkable for their lightness and shade. The timber is white, soft, and readily decays.

ASPERGILLUM. One of the commonest mildew plants. (See Fungus.)

ASPHODELEÆ. The family of plants to which the onion belongs.

ASPIDIOTUS. A genus of insects resembling the bark-lice, or scale insects, and of the same habits and family. They are found on the oleander, rose, bay, cactus and other plants.

ASS. *Equus asinus.* An animal considered the humblest member of the horse family, but really second only in value to man, when we take into consideration the important place he occupies as a beast of burthen, among the poorer classes in all parts of the civilized world, and also the importance of the mule, the product of the male ass and the mare. The ass was undoubtedly domesticated before the horse. The first mention of the ass in the Scriptures is when Abraham went into Egypt at the time of a great famine in Palestine. Wild asses are still found in the mountains of Syria and adjacent countries, so fleet that the swiftest horses can not overtake them. The usual color of the ass in domestication is gray, mouse-color or black. The teeth of the ass assimilates to that of the horse, and the age is indicated as in the horse by the changes in growth of the teeth. The male is capable of propagating at the age of two years, and the female somewhat sooner; like the mare the female carries her young eleven months. The hybrid obtained between the male ass and mare is called a mule, and that between the stallion and the female ass a hinny. Although the word mule is correct, as applying to a hybrid of any two species, yet the word mule has now come, by common usage, to be applied distinctively to the produce between the "jack" and mare. The ass is but little used in the United States except for service in producing mules. These are bred more or less, in all the western and southern States, but principally in Texas, Kentucky, Tennessee, Ohio, Indiana, Illinois and Missouri, forming an industry of great value, and upon which large sums are yearly spent for superior jacks. These have, from time to time, been imported, until now it is probable no country possesses finer



SPANISH JACK.

jacks or more able mules. The raising of mules in the United States is principally confined to the States of Tennessee, Kentucky, Ohio, Indiana, Illinois, Missouri, Southern Kansas and Texas, although more or less are raised in nearly every State in the Union, and, as a rule, they sell about twenty-five per cent. higher than the ordinary horse stock of the country.

ASSOCIATION, FARMERS. (See Grange and Fairs.)

ASTER. The China-aster has always been a favorite in the garden. Of late years, the German Asters, produced by hybridization and careful culture, are among the most beautiful of garden flowers. The seed is better sown in a slight hot-bed, in March, and pricked out three inches apart in another frame when large enough. About the middle of May, or when corn is fairly growing, they may be transplanted in beds, at a distance of twelve inches apart, where they will bloom profusely from the middle of summer until frost. The cut shows the flower, and also the plant in bloom. The Cape Aster is a pretty and showy plant for stand or window. The whole genus is easy of culture, hybridize freely with each other, and are held in general estimation. They are nearly hardy, but are always grown in pots, as they flower so early that in the open ground the buds would be liable to be nipped by the frost. They are grown in light, rich soil, and only require ordinary care in watering. This plant is propagated by dividing the roots in August by cuttings struck in autumn, or by seeds which they ripen in abundance. The seed should be sown in May, on a slight hot-bed, and the young plants pricked out into small pots and shifted frequently during the summer. If they are wanted to flower in December, they should be kept in the green-house all the year and will begin to throw up their flower stalks in October; but if flowers are not wanted before April, the usual time, they may stand in the open air, and be re-potted two or three times during the summer. In October, they may be put in a cold pit, where they must remain just protected from the frost till March, when they will begin to send up their flower stalks.

ASTER FLOWER.

ASTER PLANT IN BLOOM.

ASTHMA. Heaves or broken wind are emphysematous asthma. The cause is rupture of the small cells of the lungs, occasioned by hard work and insufficent, musty or coarse food, and hereditary predisposition. Thus, the animal can not expel the air drawn into the lungs without a distinct double effort. The cough attending this disability is peculiar, a hollow, muffled sound, easily brought on by pressing on the upper part of the windpipe. A cure is impossible, but relief may be obtained by placing the animal on clean short grass, or better, a summer on the prairie where resin weed grows. Such horses should be fed on light nutritious food. Indigestion is always an accompaniment of this disease. This should be improved by tonics, and the bowels should be kept regular, if constipated, by light purgatives. Prof. Law recommends, as most useful in this desease, the following: One ounce Fowler's solution of arsenic, one drachm extract belladonna, half drachm tincture of ginger; mix with a pint of water and give as a drench daily, in the morning, for one or two months. Heaves are incurable and constitute unsoundness.

ASTRINGENT. In farriery, a term applied to such remedies as have the property of constringing, or binding the parts, as oak bark, sugar of lead, etc.

ATMOSPHERE. From two Greek words, signifying vapor and a sphere, is the body of air which surrounds the globe, and besides being necessary to the life of all terrestrial animals, is of special importance to the agriculturist, since upon its condition are we dependent for rain, the motion of the air tempering the heat of summer, and various meteorological conditions, without which, the labors of the farmer would be void. The air is in fact the great reservoir of the fertility of the earth. Elements noxious to animal life are constantly being poured into it, from various sources of contaminations; from all decaying bodies, whether animal or vegetable; from the lungs of all animals in breathing; from the miasma of marshes; from volcanoes, and the various other sources of contamination. On the other hand, living vegetation is constantly giving forth by day, during the growing season, fresh supplies of oxygen to keep it up to its normal state, else the oxygen consumed by animals in breathing would at length exhaust the air of this very necessary element. Upon some of the phenomena of the atmosphere, Appleton's New American Encyclopædia says: Air consists essentially of two gases, oxygen and nitrogen, in a state of mechanical mixture. But with these are always present a small proportion of carbonic acid gas and aqueous vapor. In the vicinity of large cities, ammonia is found too, in small quantity; and nitric acid is generated in thunderstorms by the chemical combination of nitrogen and oxygen induced by the electrical shock. These, which may be regarded as accidental impurities, are soon dissipated in the great bulk of the atmosphere, or they enter into new combinations, and are precipitated upon the earth, or are washed down by the rain. The proportions of the two elements of the air hardly vary—whether this is taken from the summits of the highest mountains, from extensive plains, from thickly populated cities, or from crowded hospitals—nor are they affected by season, climate, or weather. In closely confined places exposed to putrescent exhalations, the purity of the air is necessarily much affected; the proportion of oxygen diminishes, and nuphitic gases, as sulphuretted hydrogen and carbonic acid are introduced. Prof. Nicol gives an analysis of air collected in a filthy lane in Paris, in which the oxygen constitutes 13.79 per cent. only, instead of 23 per cent., its usual proportion; nitrogen was present to the amount of 81.24 per cent., carbonic acid 2.01; and sulphuretted hydrogen 2.90 per cent. Carbonic acid gas and aqueous vapor are more variable in their proportions, and the former, though found in the highest altitudes, has sometimes escaped detection in air collected at sea. Its composition is:

Name.	Measure.	Weight.
Nitrogen	77.50	75.55
Oxygen	21.00	23.32
Aqueous vapor	1.42	1.03
Carbonic acid	0.08	0.10
	100.00	100.00

Regnault calculates, from numerous analyses, that it is by measure oxygen 20.90, and nitrogen 79.10; and the article Atmosphere, in the Encyclopædia Britannica, gives as the mean of ten careful trials a proportion by volume of 79.9735 parts of nitrogen, and 20 0265 of oxygen. The near approach of these two gases to the number 80 of the one and 20 of the other, cannot fail to strike the attention of those who study the analyses made by Cavendish, Davy, Gay, Lussac, Humboldt and others. And as a volume of nitrogen is equivalent to one atom, the inclination is very strong to consider air as a compound of these gases in the equivalent proportions of two atoms of nitrogen and one atom of oxygen. But the differences of specific gravity, of temperature, structure or form, which usually accompany the change by chemical combination are here wanting; and, moreover, air is recomposed by simple mixture of its elements, with no evidence of any chemical change taking place. The phenomena of refraction are such as indicate a mixture; and a still more conclusive proof is that air held in solution in water does not consist of the same proportions of its elements; but from the greater solubility of oxygen, it contains of this about thirty-two per cent, and of nitrogen sixty-eight per cent. We are therefore not authorized in the conclusion that air can be otherwise than a mechanical mixture of its elements. Carbonic acid gas, increased to the proportion of five to six per cent., renders air unfit for sustaining animal life. A candle ceases to burn when it contains three per cent. of this gas. One may live, however, in an atmosphere containing thirty per cent of it for a short time, but not without suffering. But if carbonic oxide, which has only one atom of oxygen, instead of two atoms to one of carbon, is present, even in the small proportion of one per cent., it may prove instantly fatal. This poisonous gas is generated by the combustion of charcoal in confined places. Carbonic acid is generated by combustion of carbonaceous substances; with free access of air, and by the analogous process of the breathing of animals, an atom of carbon unites with two atoms of oxygen, and the solid matter takes the form of this invisible gas. By several processes it may be restored to a fixed or tangible shape. Man requires from 212 to 353 cubic feet of air per hour. In breathing, the oxygen in part unites with carbon in the system, and the air expired contains four and a half per cent. of carbonic acid gas. This is immediately dispursed through the atmosphere by the property of diffusibility, possessed in such a remarkable degree by the gases; but if confined in close places it soon accumulates and contaminates the air. Though this is the heaviest of the gases, and is generated near the surface, it is found in larger proportion in the air of elevated places, than in that below. The reason ascribed is, that this is owing to the plants absorbing it in the lower strata, and is not satisfactory, as it is in these strata produced. Growing plants are the compensating agents, that counteract the noxious influences of combustion and the breathing of animals; as in the ocean the coralline insects as quietly perform their great office of separating from the water the soluble contaminating ingredients, poured in from the innumerable rivers that feed it. Plants as well as animals breathe the air, but the effect of this respiration is just the reverse of that of animals. The carbonic acid gas is decomposed in the laboratory of their vessels, the solid carbon is added to their structure, and the pure oxygen is expired. It is true the process is reversed in the night, but with much less effect. This change in the action of plants at night is the reason why they should not be kept in sleeping apartments. Oxygen thus appears to be the life-sustaining element of the air for animals, while nitrogen has the negative duty of restraining, by its bulky proportions, the too active influence of its fiery partner. Oxygen is diluted with it, as strong food is with water, to make it wholesome. Both the weaker elements, however, have some other uses, being found as constituents of vegetable and animal substances. Water, moreover, in the form of vapor, manifests its presence by condensing in visible moisture and drops upon cold surfaces. When the air is warm, its capacity of holding water is great; as it becomes cool this capacity diminishes, and the water that is now in excess appears as dew, or mist, or rain. The atmosphere is said to be dry when it has not so much moisture in it as it is capable of holding at its temperature; evaporation then takes place. But let the temperature fall, and the same air that was called dry is now damp. The absolute quantity of vapor has not changed, but the relative quantity of what the air is capable of holding, and that actually in it. As the air becomes cool, and reaches a degree at which it is saturated with the water it contains, and this begins to condense upon cold surfaces, this degree of temperature is called the dew-point. If it is high, the absolute quantity of vapor in the air was great; if low, there was little vapor in the air. The relative quantity was the same in both instances, as it always must be at the dew-point. As the hot airs of the tropics are swept over the Atlantic in the trade winds they suck up the moisture like a dry sponge. Saturated with it, as they pass over the snowy summits of the Cordilleras, and their particles are compressed together with the cold, they shed it, like the same sponge squeezed in the hand. Thus does the atmosphere fill its office as a compensating agent, carrying away the excess of waters of the ocean, that, though all the rivers flow into it, it shall never be full, feeding, too, the dry places of the earth, that its wells and springs shall never lack its supplies. Air being a material substance, though invisible, possesses many of the physical properties of the solid and liquid bodies, as weight, inertia, elasticity, impenetrability, capacity for heat, etc. A vessel exhausted of air is found to weigh less than when filled with it; and in this manner it has been ascertained that 100 cubic inches of pure and dry air, at a temperature of 60°, and under a pressure of thirty inches of the barometer, weigh 31.0117 grains. Other gases are referred to air at this temperature for the expression of their comparative weight. Water is 815 times heavier than air; but at the freezing point the difference is as 770 to 1. From its weight result its inertia and the pressure of the atmosphere. It can not be set in motion without exertion of force, nor in motion be retarded without opposition of force. Its momentum, as with other bodies, is its weight multiplied by its velocity. Air in motion is a mechanical force, applied to propelling ships and wind-mills. The pressure of the atmosphere is the weight of the column of air. If this were alike dense throughout its height, the upper limit of the atmosphere would be easily calculated from the weight of a cubic inch, and the pressure of 14.6 pounds upon the square inch. It would be about five and one-fourth miles. But from the property possessed by the gaseous bodies of expanding in bulk or becoming more rare, in proportion as the force that confines them is removed, the weight of a column of air is not directly proportional to its height. This tendency of the particles of air to separate from each other, as the pressure that confines them is taken off, is called the elasticity of the air Its effect is, that every successive layer of air of any given thickness is of less density and weight than the layer of the same thickness beneath it. The rate of this decrease of weight may be thus expressed: When the height increases in an arithmetical ratio, the volume increases in a geometrical ratio and the weight diminishes in the same. For example, at the level of the sea, calling the volume one, and the density or weight one; at the height of 2.705 miles, the volume is two and the density one-half; at twice the height, the volume is four and the density one-fourth; at three times the height, the volume is eight and the density one-eighth. But notwithstanding this tendency of expansion, the atmosphere is proved by calculations based on its refractive properties to find somewhere a limit, and this appears to be not far from forty-five miles above the surface. The pressure of the atmosphere is made apparent by removing the air from any tube, the lower end of which is immersed in water or any other fluid. This fluid will be pressed up the tube to a height corresponding to the pressure upon its surface. If this be at the level of the sea, where the pressure is 14.6 pounds on the square inch, water will rise thirty-three feet and mercury twenty-nine inches. At any greater elevation, the pressure being less, a less height of the fluid will balance it. Such an instrument as this tube is the barometer, by which the difference of elevation is determined by the different heights of the column of mercury, the calculation being made on the principal above described, and corrected for temperature and the latitude of the place. There is another instrument used for the same purpose, based on the property of water boiling at less temperature, as the pressure of air upon its surface is taken off. For every 549½ feet increase of elevation, it is found that the boiling point is one degree less. Correction is in this case also to be made for the temperature of the air. Well constructed instruments of this kind have been made to produce very fair results in experienced hands. Familiar illustrations of the pressure of the air are afforded by the common pump, which is but such a tube as has been already referred to, furnished merely with a proper valve for lifting out the air, and then the water which follows it. The power applied to lift the air is equal to its pressure at the place multiplied by the height it is raised, or to the weight of the column of water. There can, therefore, be no expedients that will lessen the power required to work a pump, unless they can present some form more simple, and which involves less friction than the ordinary form of the pump, and this seems hardly possible. The pressure of the air is also well illustrated by the common leather "sucker," which the boys make for a toy—a mere disk of soft leather with a string knotted at one end passed through the centre. When moistened and applied to any smooth surface, care being taken to expel the intervening air, it is attracted to it by the external pressure. By the same principle insects walk upon the ceiling, and the patella or limpet, and some other shell fish, hold fast upon the smooth rock. So great is this pressure, that the force exerted upon the body of a moderately sized man is estimated at about fifteen tons, sufficient to crush him, as it inevitably would, if applied to only a portion of the body; but quite harmless when pressing with perfect elasticity everywhere alike—from the external parts inwardly, and from those within outward. Let the pressure be taken off from any portion, as by the cupping instrument, and one is immediately sensible of the power that is exerted upon the parts around, painfully pressing them into the vacant space of the instrument. Elasticity is possessed in a remarkable degree by gaseous bodies. If the pressure is removed from them their particles repel each other, and the tendency is to expand indefinitely. This force, as expressed by the law of Mariotte, its discoverer varies in exactly the same proportion as the density of the air. But as air has been made to expand to more than 2,000 times its usual bulk, and been compressed into less than one-thousandth—and at these extreme degrees of rarefaction and condensation it is difficult to determine its elasticity with vigor. From the freezing point upward air expands 1.493 of its bulk for every degree of its temperature. This is easily exemplified by heating air confined in a bladder. Its expansion soon swells the bladder and causes it to burst. As the bulk increases, its density or weight diminishes. The colder and heavier air presses through it, and the more buoyant fluid is lifted up. On this principle were constructed the first balloons. It is this principle that gives rise to the currents of air or wind, the colder bodies flowing along the surface to fill the space left by the ascending columns. Thus the trade winds blow from the temperate regions toward the torrid equatorial belt. The whirling tornado, and all the phenomena of the winds, owe their origin to local heating and rarefaction of the atmosphere. The rays of the sun pass through the upper strata of the atmosphere, imparting to them no heat. This the air receives only near the surface. As we ascend the temperature diminishes one degree for every 352 feet. Near the equator perpetual snow covers the mountains at a height of 15,207 feet; in latitude 60° it is found at 3,818 feet; and in 75° at 1,016 feet. Did the sun's rays impart no effect to the atmosphere, the great body of it would be seen as blank darkness; but a partial absorption of a portion of the rays takes place, and reflection of the blue rays. This gives the color to the sky, while that of the clouds and the rainbow comes from the effect of the light upon the particles of vapor floating in the atmosphere. These colors are too faint to be perceived in any small quantity of air. It is only by looking into the great depths of the atmosphere that they may become visible, as the color of the ocean is only apparent when the waters are seen in a mass.

ATMOSPHERE, GASES AND VAPOR OF. The invisible fluid surrounding the earth is termed the atmosphere. It is composed of oxygen 20.84 and nitrogen 79.16, in 100 parts water, in the form of vapor, and carbonic acid gas is also held mechanically, the former averaging one per cent., but varying with temperature, etc., and other meteorological conditions; and the carbonic acid gas forming 0.1 per cent., or by weight as compared with a volume of an one-thousandth part. In relation to the effects of vapor on the atmosphere, it is stated that, on the supposition that the vapor is uniformly distributed through the atmosphere, which will not be far from the truth if considered with reference to the principal zones of the earth, we can calculate the whole weight of water contained. Thus we find, if the water were at the boiling point, its elastic tension or pressure would be equal to the pressure of the atmosphere, and in this case it would support thirty inches of mercury, or its equivalent, 407.4 inches of water; and since transparent vapor observes the same law of expansion and contraction by variations of pressure and temperature that dry air does, it is clear that we shall have the following relation for any other temperature, namely, as thirty inches is to the quantity of mercury expressing the elasticity of the air at any temperature, so is 407.4 inches of water to the whole weight of the aqueous vapor, provided the weight of vapor is the same as that of the air. It has, however, been proved that vapor is only five-eighths of the density of air, and therefore, the quantity found by the foregoing relation must be reduced in this ratio. If we assume that the dew-point is on an average of 6° below the temperature of the air, and allowing the temperature of the tropical regions to be 82°, we shall have the following proportion: 30 : 0.897 : : 407.4 : 12.81. This last number must, however, be multiplied by $\frac{5}{8}$, and this will give us 7.61 inches. From this it will appear that if the atmospheric columns at the equator were to discharge their whole watery store, the moisture precipitated would cover the the earth to the small depth of 7.61 inches; and from a similar calculation we find that, if the columns of air resting upon the city of Washington were to precipitate at once all their moisture, the quantity of water would be indicated by about three inches of the gauge. To supply, therefore, thirty or forty inches of rain in the course of a year it is necessary that the vapor contained in the atmosphere should be very frequently renewed, and that, consequently, localities which can not be reached by moist winds must be abnormally dry.

ATOM. In chemistry, the ultimate part of a body which combines with other atoms. Theoretically, these are of a determinate magnitude in every case. Atoms are simple or elementary when they can not be separated by chemical forces, and compound when they are liable to decomposition. Chemical compounds consist of a definite number of atoms, bound together by chemical force or affinity; but the value of this force is different in different compounds. In consequence, however, of the union of atoms in invariable weights, determined by experiment, each chemical body has attached to it a distinct proportional weight, termed its atomic weight, equivalent, or combining number. The study of these is the essential of all chemical inquiries; it is this remarkable adherence to a precise quantity in all cases of combination which gives exactness to our investigations, and forms the difference between a mere mixture and chemical union. The following are the atomic weights or proportionals of various elementary bodies interesting to agriculture, and their initial equivalent or contraction:

Hydrogen (H.).........	1.	Potassium (K.).........	39.
Oxygen (O)............	8.	Sodium (Na.)...........	23.
Nitrogen (N.)...........	14.	Calcium (Ca.)...........	20.5
Carbon (C)............	6.	Magnesium (Mg.).......	12.7
Sulphur (S.)............	16.	Aluminium (Al.)......	13.7
Phosphorus (P.).......	31.	Iron (Fe.)...............	27.
Chlorine (Cl.)..........	35.5	Maganese (Mn.)........	27.7
Silicon (Si.)............	22.		

These are on the basis that hydrogen is 1., and may be understood by the following case: Water is a compound of one atom of hydrogen and one atom of oxygen; and, supposing a given quantity weighs nine grains, we know, by the laws of chemical combinations, that it contains one grain of hydrogen and eight grains of oxygen; or, if the weight of water be other than nine grains, these constituents are united in the rigorous proportion of one to eight Atomic theory is the theory of Dr. Dalton, that chemical union takes place only in definite atoms. Atomic weight is the equivalent or combining weight.

ATROPY. In farriery, a morbid wasting and emaciation, attended with a great loss of strength in animals.

ATROPIA. The poisonous alkaloid of the deadly Night-shade.

AUCHENIA. The region of the neck, in mammals, below the nape.

AURALIA, AURELIAN. Pupa or nymph of the higher insects.

AURICLE. The external ear; the venous chambers of the heart.

AURICULAR. Appertaining to the ear.

AURICULATE. When the base of a leaf is lobed on each side the midrib.

AUSCULTATION. The examination of the sounds within the body to detect diseases, etc.

AUTOPSY. Examination by the eye. It is generally used to designate examinations of the body after death, for the discovery of the causes of disease.

AVENA. The generic name of a family of grasses, of which the *A. sativa* (oats) and *A. elatior* (Andes Grass) are best known. Several species, as the *A. flavescens* and *pubescens*, are found in English meadows, and the latter is well worthy of cultivation; it is the downy oat-grass of agriculture.

AVENUE. Any broad, gravelled, or properly made road, bordered by trees; a side road, or approach to a house.

AVERSE, AVERSUS. Turned back.

AVIARY. A place to keep birds in.

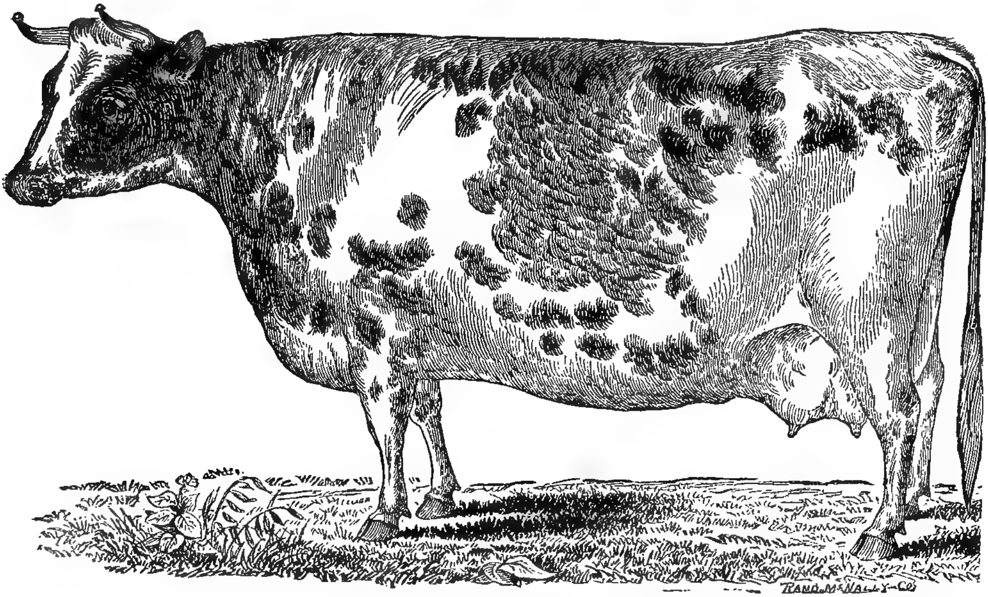
AWN. The stiff beard or bristle of some grasses, *Arista.*

AWNING. A covering of some kind of cloth, to protect plants, etc., from sun or rain.

AXIL, AXILLA. The armpit; the angle between the leaf and the stem; buds placed here are termed axillary.

AXIS, AXLE-TREE. The spindle or central rod around which parts of machinery, etc., revolve or are developed.

AYRSHIRE CATTLE. The Aryshire are undoubtedly a composit breed and of comparatively modern date, originating in the county of Ayr, Scotland, whence their name, and within the last sixty or seventy years disseminated generally throughout England and Ireland, where they are generally esteemed for their superior milking qualities. Importations were made into the United States over forty years ago. Of late years superior specimens have been introduced over the East and West, and where handled, they have given general satisfaction. Their history and characteristics is as follows: Aiton, in his Dairy Husbandry, speaks of the cattle which occupied Ayrshire fifty years before the time, when he wrote (1806) as follows: The cows kept in the districts of Kyle and Cunningham (districts of Ayrshire) were of a diminutive size, ill-fed, ill-shaped, and yielded but a scanty return in milk; they were mostly of a black color, with stripes of white along the chine or ridge of their backs, about their flanks, and on their faces; their horns were high and crooked; their pile (hair) was coarse and open, and few of them yielded more than three or four Scotch pints (six to eight wine quarts) of milk a day. A comparison of these points with those presented by the present breed of Ayrshire cattle renders probable the conclusion of Youatt, that the stock of that day could not have arisen entirely from the old. It follows, therefore, that the modern breed, like various other valuable breeds of domestic animals, originated in crossing. The question as to the breeds from which it was derived will be briefly considered. Various accounts represent that the Earl of Marchmont, sometime between 1724 and 1740, introduced to his estates in Berwickshire some cattle, conjectured (their history was not positively known) to be of the Holderness or Teeswater breed, and that not long afterwards some of the stock was carried to estates belonging to the same nobleman in that part of Ayrshire called Kyle. But it is not improbable that the chief nucleus of the improved breed was the "Dunlop stock," so called, which appears to have been possessed by a distinguished family by the name of Dunlop, in the Cunningham district of Ayrshire, as early as 1780. This stock was derived, at least in part, from animals imported from Holland. The Dunlop cows soon became noted. Rawlin (as quoted by Youatt), who wrote in 1794, speaking of the cattle of Ayrshire, says: They have another breed, called the Dunlop, which are allowed to be the best race for yielding milk in Great Britain or Ireland, not only for large quantities, but also for richness and quality. This, though perhaps extravagant praise, shows that the stock possessed remarkable properties at that early day. It was, indeed, held in great esteem still earlier. In Youatt's Treatise it is mentioned, when speaking of the cattle of Dumfriesshire, that the poet Burns, when he occupied a farm near the city of Dumfries, not content with the Galloway breed, introduced some of the west country cows, which he thought would produce more milk. In the poet's published correspondence allusion is made, in a letter dated November 13, 1788, to a heifer which had been presented to him by the proprietor of Dunlop house as "the finest quey in Ayrshire." Mrs. Dunlop, it will be recollected, was a special friend and correspondent of the poet. As a further explanation of the preference given by Burns for the west country cows, it may be mentioned that the writer, when visiting Scotland for the purchase of Ayrshire cattle in the year 1858, had several interviews with the poet's sister, the late Mrs. Begg, of Ayr, in one of which she stated that her brother, during his occupancy of the farm of Ellisland, near Dumfries, kept a dairy and made considerable of cheese. His efforts to procure the Aryshire cows show that they had, even at that time, a high reputation for this object. Colonel Le Couteur, in a paper on the Jersey or Alderney cow, published in the Journal of the Royal Agricultural Society of England, refers to a statement by Quayle, that the Ayrshire was a cross of the Short-horn and Alderney, and adds, himself, that there is considerable affinity between the two breeds, meaning the Ayrshire and Alderney. Rawlin also says, in reference to the Ayrshire breed: It is said to be a mixture by bulls brought from the Island of Alderney with their own, or the old race of cows. Martin says: At some period or other there has evidently been a cross with the Durham or Holderness, and perhaps, also, with the Alderney breed. Prof. Low, in his Illustrations of British Quadrupeds, says: From the evidence of which, in the absence of authentic documents, the case admits, the dairy breed of Ayrshire cows owes the characteristics which distinguish it from the older race, to a mixture of the blood of the races of the continent, and of the dairy breed of Alderney. In addition to the foregoing evidence respecting the origin of the Ayrshire cattle, it should be stated that the present leading type of the breed was formed, in part, by an infusion of the blood of the Kyloe or West Highland breed. This appeared in the first instance, probably, in what has been called the Swinley variety. The facts, as authentically obtained in Scotland, on this point, are substantially as follows: Theophilus Parton, of Swinley Farm, near Dalry, Ayrshire, took great pains to establish a herd of what were deemed the best Ayrshire cattle, into which he infused a strain of the West Highland blood, the particular degree of which is not publicly or generally known. The Swinley stock differs from the older Ayrshire cattle in having a shorter head, with more breadth across the eyes, more upright and spreading horns, more hair, and that of a more mossy character, and generally better constitutions. They are also somewhat smaller boned than old stock, though from their superior symmetry and greater tendency to fatten they are fully equal to the former in weight of carcass when slaughtered. The following points given by the Ayrshire Agricultural Association in 1853, as indicating superior quality, will give an idea of the standard of Ayrshire cattle as recognized by the leading breeders: Head short; forehead wide; nose fine, between the muzzle and the eyes; muzzle moderately large; eyes full and lively; horns widely set on, inclining upwards, and curving slightly inwards; neck long and straight from the head to the top of the shoulders, free from loose skin in the underside, fine at its junction with the head, and the muscles symmetrically enlarging towards the shoulders; shoulders thin at the top; brisket light; the whole fore-quarter thin in front, and gradually increasing in depth and width backwards; back short and straight; spine well defined, especially at the shoulders; short ribs arched; the body deep at the flanks, and the milk veins well developed; pelvis broad and straight; hook (or hip) bones wide apart, and not much overlaid with fat; thighs deep and broad; tail long and slender, and set on a level with the back; milk vessels (udder) capacious, and extending well forward; hinder-part broad, and firmly attached to the body; the sole or under surface nearly level; the teats from two to two and a half inches in length, equal in thickness, and hanging perpendicularly; their distance apart at the sides should be equal to about one-third the length of the vessel, and across to about one-half of the breadth; legs short, the bones fine, and the joints firm; skin soft and elastic, covered with soft, close, and woolly hair; the colors preferred are brown, or brown and white, the colors being distinctly defined; weight of the animal when fattened about forty imperial stones (that is 560 pounds), sinking the offal. As to the annual returns of Ayrshire cows in dairy produce, Prof Low says: Healthy cows in good pastures give 800 to 900 gallons of milk in a year. Aiton says 600 gallons a year may be deemed about an average of this breed. And the author of British Husbandry says, in reference to this yield: If equalled, we believe it will not be found excelled by any other breed in the kingdom. Martin says: The milk of a good Ayrshire cow will afford 250 pounds of butter, or 500 pounds of cheese annually. Milburn's estimate is, that cows of this breed will give from 600 to 800 gallons of milk in the course of the year, and as much as 260 pounds of butter. Haxton cites many statistics, from which it appears that in one dairy of thirty cows the average annual yield of milk was 632 gallons; that nine and a quarter quarts afforded a pound of butter, amounting to an aggregate of 274 pounds in a year. He adds: From these data, it appears that the milk of the Ayrshire breed of cows is not only abundant in quantity, but also rich in those substances which constitute excellence of quality, and when with these qualities is considered the small amount of food consumed the result is so favorable to this breed that few thoroughly acquainted with the subject will refuse to rank the Ayrshire cow among the most valuable for dairy purposes in the United Kingdom: In the competition at Ayr in 1861, for a prize offered by the Duke of Athol, the average weight of milk per day, for two days, from six cows, was about fifty pounds, the cows being milked twice a day. The cow which took the first prize gave an average of fifty-seven pounds per day. On this occasion, the Duke of Athol stated that the cow (then in his possession) which received the first prize at the previous year had given an average of upwards of twelve quarts of milk per day for a year, actual measurement having shown a product of 1,110½ gallons in something less than twelve months. Comparatively few accurate trials have been made with specimens of the breed in this country. One of four imported Ayrshire cows, owned several years since by the late J. P. Cushing, of Watertown (now Belmont), Mass., gave in one year 3,864 quarts of milk, beer measure. One of the cows, imported by the Massachusetts Society for Promoting Agriculture, in 1837, while kept by the late E Phinney, Esq., of Lexington, Mass., was said to have afforded sixteen pounds of butter per week, for several weeks in succession. The imported cow, Jean Armour, owned by H. H. Peters, of Southboro', Mass., in 1862, gave an average of forty-nine pounds of milk a day for 114 days, commencing June 1; and for the month of July her average was fifty-one pounds thirteen ounces per day. Her milk for three days in July yielded six pounds of butter. Her live weight at the close of the trial was 967 pounds. It will be understood, from what has already been said, that the dairy is the leading object with the breeders of Ayrshire cattle. At the same time the important fact has not been overlooked, that to breed and perpetuate a profitable dairy-stock regard must be had to hardiness and strength of constitution, and also to such fattening tendencies as will insure a profitable return from calves fattened for veal, from steers reared for beef, and from cows, which, having served their turn in the dairy, are at last dried of their milk and prepared for the shambles The importance of these properties is not sufficiently regarded by keepers of dairy stock in this country. Even if milk were the sole object, it would be impossible to preserve a breed possessing superior qualities in this respect, without giving attention to those points of form which denote strength of constitution. It has been well observed by Magne that in the breeding of dairy stock we should make choice only of animals possessing the two-fold character of general vigor and activity of the mammary system. These principles have been followed to a considerable extent by the leading breeders of Ayrshire in Scotland. Hence they claim a high rank for the breed in reference to general usefulness. Aiton, in speaking of what the Ayshire cow will do, says she yields much milk, and that of an oily or butyraceous, or caseous nature, and after she has yielded very large quantities of milk for several years she shall be as valuable for beef as any other breed of cows known; her fat shall be much more mixed through the flesh, and she shall fatten faster than any other. Whatever may be said in regard to the extent of these claims, it will be admitted that they indicate the confidence which was long ago placed in the breed in regard to the properties mentioned. Youatt, who wrote twenty-five years after Aiton, says: The breed has been much improved since Mr. Aiton described it. In the early part of the century Mr. Youatt made this remark, and since that time the breed has been still further improved in reference to general usefulness. It is the unanimous testimony of the most experienced breeders in Scotland, that while nothing has been lost on the score of dairy properties, considerable has been gained in hardiness and thrift, and in the faculty of giving a greater return both in milk and flesh, for the food consumed. The common course in Scotland with calves of the Ayrshire breed that are not wanted for keeping up the dairy stock, is to fatten them for veal, or turn them for beef at an early age. The larger portion, perhaps, of the males are killed for veal. In some districts the fattening of calves is an object of considerable importance, and the superiority of Ayrshire cows for producing the best quality of veal is acknowledged. Thus Haxton observes, for all medium soils and climates throughout the United Kingdom, there is no breed equal to the Ayrshire for profit, whether the produce is converted into cheese, butter or veal. Scotch farmers, who are in the practice of fattening stock of various breeds, state that Ayrshire steers at the age of three to three and a half years fatten to as much profit as any, reaching the weight of 700 to 800 pounds (the four quarters), and affording beef excelled in quality only by the West Highlanders and Galloways; two of the most superior for beef of any in England, quality being the test. Among the better class of Ayrshire breeders any animal showing a disposition to feed instead of to milk is immediately disposed of, and even those bulls are preferred having the most feminine character about the head. The system of keeping and rearing also conduces to increase their disposition to milk. The calves are never allowed to suck their dams, but are fed new milk for five or six weeks, at the end of that time it is gradually diminished for two or three weeks longer, when the calf is left to shift for itself. After the first year the heifers are generally turned upon the poorest, coarsest pasture on the moor-edge where the sedgy grass contains so little nutriment that to satisfy their hunger they are obliged to consume a large quantity of it; this bulk of food, of course, enlarges the paunch, distending its walls and the belly plates of the young animal, and producing the large belly the Ayrshire farmer so values. The heifers usually calve at two and a half to three years old, though some are in milk at two years old. The usual yield of the cow is from thirty to fifty pounds of milk per day, producing in the season about 150 pounds of butter, or her own weight in cheese, as the phrase is; though we think 375 to 400 pounds would be nearer the average. (These are good results, and would be even to-day.)



MODEL AYRSHIRE COW.

Youatt, in his account of the Ayrshires, gives much greater products as being obtained, and no doubt instances are found of such extraordinary yields. We quote a few of his figures: An Ayrshire cow may be reckoned to yield two hundred and fifty-seven pounds of butter per annum, or five pounds per week, all the year round. Six hundred and fifty gallons of milk is called an average yield of a cow, making four hundred and thirty pounds of cheese, or one hundred and seventy-five pounds of butter. This was the average of a herd kept near a town, and highly fed and well cared for, and this would, no doubt, exceed the average of dairies. Thirty-six quarts per day have been milked from a cow, and twenty-eight quarts from a three-year-old heifer, and this last for six weeks after calving. Though this breed are chiefly celebrated for the dairy, the oxen work kindly, and the steers can be turned off at three years old, weighing seven or eight hundred pounds. Curiously enough, there seems a lurking tendency in them to fatten, whether resulting from the short-horn cross, or from their natural vigor, it is impossible to say, but it is certain that when transferred to the fertile pastures of England or of America, they are apt to lose, in a degree, their extraordinary milking property, and begin to lay on flesh, and the time of their remaining in milk is shortened when removed from their native pastures. The illustration we give of a mature Ayrshire cow will not only show the form of this breed, but that of deep milking cows generally. It will be a good place here to notice in relation to milking qualities some general characteristics, which will apply to all dairy cows. Thus we find that the usefulness of any dairy cow is in her udder, and toward the udder, its shape and its yield, all the capabilities of the cow should be directed. This will apply to all milk breeds. Viewed as a reservoir for the milk, it must be large and capacious, with broad foundations, extending well behind and well forward, with distant attachments; broad and square, viewed from behind; the sole level and broad; the lobes even-sized, and teats evenly distributed; the whole udder firmly attached, with skin loose and elastic. Such a form gives great space for the secreted milk, and for the lodgment of the glands, while allowing the changes from an empty to a full vessel. The glands should be free from lumps of fat and muscle, well set up in the body when the cow is dry, and loosely covered with the soft and elastic skin, without trace of flabbiness. Such a covering allows for extension when the animal is in milk, while the glands are kept in proximity with the blood-vessels that supply them. The necessities of the lacteal glands are larger supplies of blood from which milk can be secreted, and this harmonizes with the demands of the udder as a store-house For broad attachments means broad belly or abundance of space for the digestive organs, from which all nutriment must originate. The blood is furnished to the glands of the udder by large and numerous arteries. As secretion is dependent on the freedom of supply of blood to the part, and a copious flow, we find branches coming from different arterial trunks and freely anastomosing with each other. Although these arteries are internal and out of sight, yet fortunately the veins which carry the blood from the udder pass along the surface, and from their size and other characteristics indicate not only the quantity of blood which they carry away, but which must have passed through the glands from the arteries. These return veins pass both backward and forward. Those passing forward are known as the milk veins, and the size of these superficial veins on either side of the belly, and the size of the orifices into which they disappear, are excellent points to determine the milking probability of the cow. Still better is it to find, in addition, the veins in the perineum, which also return from the udder, prominent and circuitous. The escutcheon is now generally conceded to be a good indication of milk in the cow. This mark is sufficiently well known not to require description in detail. I think the broad escutcheon is full as good a sign as a long one; that quantity or quality means more than shape, yet I will not discard the shape entirely. One error must, however, be avoided. It may be well to compare the size of escutcheon of cows of one breed, but never to compare the size of escutcheon in cows of different breeds. I think this point means more relative to size in the Ayrshire than in the Holstein or Dutch; and I am certain that, while it may be safe to follow it in the Ayrshire in the majority of instances, it would be equally unsafe to adopt it in selecting a Short-horn, for the obvious reason that that breed has been bred for generations for other puposes than the dairy. The udder and its dependencies, the milk vein and the escutcheon mark, may be considered the foundation of the Ayrshire cow. These notably influence profit, as they also do the shape of the body and the form of the animal. The milk vessel is placed in the pubic region of the cow, and is protected on either side by the hind limbs. The breadth of its attachments secures breadth of the body, and the weight requires also a depth of quarter and of flanks. The breadth below requires breadth of hip above, and length of bone here appears related to length of pelvis. So much for the physical portion. The physiological functions of milk-producing demands a great and continuous flow of blood, for it must not be forgotten that milk is blood, so to speak. This flow is dependent on the supply of food, and on the facilities of digestion. To gain this a large body is required in order to hold the suitable digestive organs. To gain further room for these, we desire to see arched ribs, depth, yet no heaviness of flank, and the breadth of hips which we see was also required for the broad udder. To sustain this body, a strong, firm back is needed. To gain the most of our blood after it has absorbed the chyle from the digestive organs, reason shows that it should find its way freely and speedily through the system on its labors of supply and removal, cleanse itself in the lungs, and again pass on to its duties. All this points to a healthy heart, not cramped, and lungs of sufficient capacity; for the yield of milk drains much nutriment from the system, and the constitution must needs have the vigor given by healthy and active heart and lungs. In this way, then, the chest is correlated with the udder. The reproductive functions require hook bones of good size, and a broad pelvis desirable, as underlying which are the generative organs. Thus the necessities of the body of a good milking cow require the wedge shape, and this not only from the flank, but also when it is viewed from above.

To sum up the points of a good dairy cow, we should find the whole fore quarters thin in front, and gradually increasing in depth and width backward, yet being of sufficient breadth and roundness to insure constitution. The back should be straight, the loins wide, the hips high and well spread; pelvis roomy, long, broad and straight, hook bones wide apart; quarters long, tolerably muscular, and full in their upper portion, but moulding into the thighs below, which should have a degree of flatness, thus affording more space for a full udder; the flanks well let down, but not heavy; ribs, behind, springing out very round and full, affording space for a large udder—the whole carcass thus acquiring increased volume towards its posterior portion. The points as given are those of utility, and we see the udder points and body points are correlated. In connection with the body and the udder, the skin is of great value in assisting our judgment. Between that portion of the external covering used for leather and the muscle, there occurs a layer of cellular tissue, which contains a larger or smaller amount of fat cells, and the mellow handling caused by these cells indicates a free circulation throughout this meshwork. The skin varies from a thin, papery hide, covered with silky hair, to a thick, supple, elastic hide, well coated with hair, on the one hand, and a similar variation, with harsh hair and coarseness, on the other. The thin, papery hide indicates quick fattening and a delicate constitution; the thick, elastic hide cushioned on fat, and which, on the flank, comes into the hand almost without grasping, indicates the height of vigor, accompanied by the fattening tendency, and the possessor of this handling endures climatic changes, low quality in his food, and neglect, with remarkable hardihood, and quickly responds to full feed and good care. The harsh handler is a dull feeder, consumes much food, and generally contains more than a just proportion of offal or waste. In the Ayrshire cow we desire neither of these extremes, for it is in the milk product that we wish the food to be utilized, and it is almost an unchanging law of nature that deficiency in one direction must be compensated for by excess in another direction, and vice versa. At any rate, the cow that lays on fat too quickly is seldom a first-class milker, and how well known is it that the cow of large yield milks down her condition. A cow that has a moderately thin, loose skin, of sufficient elasticity and suppleness of touch, without being fat-cushioned, as it were, with hair soft and mossy, or woolly, if of correct form otherwise, will usually milk a large quantity, and when she becomes dry, will rapidly come into condition. In truth, the handling of the Ayrshire cow must be good; it can not be too good; but it must not be of exactly that quality sought for in the grazing breeds. There, as everywhere, the dairyman must keep to his line; milk, not fat, is his profit; and in seeking excess of both, he will be liable to fall below the average of either. It is an axiom of breeders to diminish the useless parts of an animal as much as possible; or, in other words, reduce the proportion of those parts not conducive to profit to as great extent as possible. Applying this rule to a dairy breed, we should desire a small neck, sharp shoulders, small brisket and small bone. Moreover, small bone usually accompanies thrift, and is universally found in improved breeds. We thus have a reason for these other points, which are here quoted: Shoulders lying snugly to the body, thin at their tops, small at their points, not long in the blade, nor loaded with muscle; brisket light; neck of medium length, clean in the throat, very light throughout, and tapering to the head; tail long and slender; legs short, bones fine, joints firm. If the dairyman's policy were otherwise, he would have to supply extra food for the supports of parts useless to him, and whose larger development is of no especial value. The head should be small, in shape either long and narrow, or broad in the forehead and short, according to the type of the animal preferred by the breeder, generally preferred somewhat dishing; the nose tapering to an expanded muzzle, with good, clean nostrils. Opinions differ as to the general shape of the head. A broad forehead and short face occurs more frequently in bulls, and is generally esteemed a masculine characteristic; a more elongated face is called feminine. Yet some families of well-bred and good milking Ayrshire cows have the broad and short head, and such were, at one time, if not now, the favorites in the show-yards in Scotland. The eye should be moderately full, lively yet placid-looking. The eye is a mirror of the disposition, and interprets the character of the cow; a fretful, irritable animal is seldom a quick fattener, and usually disappoints at the pail. It also gives expression to the features, and physiognomy aids our judgment. The ears should be of a good size, but thin, and their skin of rich yellow color. Coarse ears are usually found on ill-bred animals, and thus may be considered, to a certain extent, indicative of general coarseness. The color of the skin, as shown inside the ear, is usually considered indicative of the richness of the milk in butter. The horns should be of medium size, of fine texture, with an outward and upward turn, or inclining upwards and coming slightly inwards, according to the taste of the breeder. They should be set on rather widely apart. A coarse horn may indicate a coarse and thick hide, as there seems an intimate relation between the composition of the horn, hair and hide; and the influence of climate on the horn and hair gives an appearance oftentimes of correlation between the two. The neck should be of medium length, very light throughout, and tapering to the throat, which should be free from loose, hanging skin. Yet a too thin neck is not desirable, as it usually indicates a delicate animal. A thick-set neck, well covered, yet not overladen with muscle, accompanies hardiness and vigor of constitution. The junction of the neck with the body and over the shoulders is called the crops; on a horse it would be called the withers A hollow behind this point is a never-failing sign of weakness. The crops should blend in easily with a thin shoulder, lying snugly to the body. This shoulder and a well-defined spine produce the sharpness of shoulder so much admired. The back should be straight, with spine well-defined, especially forward. The tail long, firm in the bone, and set on a level with the back, without depression or notch. A fine tail usually accompanies fine bone, and fine bone is not only decrease of offal over heavy limbs, but accompanies early maturity and a tendency to thrift. The limbs should be fine-boned, flat-boned, and with joints of moderate size. On the forward limbs the cow should stand low. Large joints and round bones are found very frequently on dull feeders and on animals of little profit. The teats should be of medium length, evenly set, and project slightly outward when the bag is full; of even thickness throughout; and of fine texture. They should be placed about one-third of the vessel apart in one direction, and about one-half the other. When the udder is not distended, they should hang perpendicularly. Large teats, however desirable to the milker, are usually accompanied by coarseness of build in the cow. They are seldom found on well-bred animals; yet exceptionally they so occur, and are much liked. A teat should be large enough to grasp, say from two to two and a half inches in length. A shorter one would be an objection; with larger I should fear coarseness. To return to Ayrshires: In color they vary greatly. Brown red and white appears to good advantage, and is fashionable. A good quantity of white, well distributed, adds style and showiness to the animal. Yellow and white is frequently seen, yet while this color is sometimes stated as indicating lack of hardiness, I am not aware of any proofs or argument having been brought forward to support this view. Color is as yet a matter of taste, for its correlations are hardly guessed at; and from almost pure black, through the reds to almost pure white, are colors found on the best cows. Black spots on the skin, barely perceptible through the hair, often occur on the best cattle. Strawberry-blotched and red and white are perhaps the more common colors. A self-colored animal, or a roan, or an animal with white on the ears, the writer has never yet seen among the Ayrshires in Scotland or in this country, when the pedigree was unquestionable. The carriage should be light and active, the head well-up, and the hind legs should not cross in walking. The condition should be neither fat or lean, but that average which a good cow holds when in good flesh at calving, and liberally fed while in milk.

AZALEA. A genus of small ornamental shrubs with large, trumpet-shaped flowers, allied to the Rhododendron. Choice varieties are cultivated under the name of Rhododendrons.

AZOREAN FENNEL. *Anethum azoricum.* A kind of fennel.

AZOTE. (See Nitrogen.)

B

BACCA. A berry.

BACCIFEROUS. Bearing berries, such as the currant.

BACK. The spine; also applied to those parts between the shoulders and rump.

BACK-RAKING. An operation in farriery, by which hardened fæces (dung) are withdrawn from the rectum.

BACK SINEWS, SPRAIN OF THE. Occasioned by the horse being overweighted, and then ridden far and fast, especially if his pasterns are long; but it may occur from a false step, or from the heels of the shoes being too much lowered. Sprain of the back sinews is detected by swelling and heat at the back of the lower part of the leg; puffiness along the course of the sinews; extreme tenderness, so far as the swelling and heat extend; and very great lameness To treat this disability local applications should be made to the back of the leg, in the form of fomentations of water sufficiently hot and frequently repeated. At the same time, as much strain as possible should be taken from the sinew by such appliances in the stable as will enable the animal to stand at ease. Absolute rest is necessary to insure a cure. (See Fomentation.)

BACK, SORE. A complaint common to young horses when first worked or ridden. To prevent it, their backs should be cooled every time they are rested, and at night, where the harness or saddle have pressed, the parts should be washed with warm water and wiped dry with a linen cloth. One drachm of sugar of lead with one pint each of vinegar and water is a good remedy for this disability.

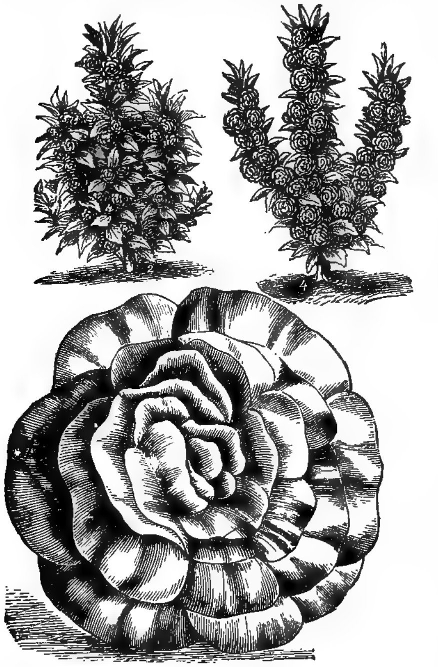
BACON, TO KEEP. Wash clean with soap-suds, wipe and then rub well with ground black pepper. Hang in a dry dark place, and smoke occasionally.

BALK. A piece of whole timber squared. In plowing, strips of unplowed land between furrows, or at the end of the field.

BALL. *Bolus.* In farriery, a well-known form of medicine, for horses or other animals, which may be passed at once into the stomach. They should be made of a long oval shape, and about the size of a small egg, being best conveyed over the root of the tongue by the hand. This method of administering medicines is preferable in most cases to that of drenches, but should never be given unless the actual necessity exists, since good nursing, and bran mashes will effect a cure in ordinary ailments. The recipes for a few forms of ball, are appended Mild physic ball—six drachms Barbadoes aloes, two drachms powdered ginger, two drachms castile soap, twenty drops oil of cloves; syrup of buckthorn sufficient to form a ball Strong physic ball—eight drachms Barbadoes aloes, two drachms powdered ginger, two drachms castile soap, twenty drops oil of cloves; syrup of buckthorn sufficient to form a ball. Calomel ball for a light horse—one drachm calomel, six drachms powdered aloes, two drachms powdered ginger, two drachms castile soap, twenty drops oil of cloves; syrup of buckthorn sufficient to make into a ball. Calomel ball for a heavy horse—eight drachms powdered aloes; otherwise same as the last. Diuretic ball—four ounces castile soap, two ounces powdered nitre, two ounces powdered rosin, half ounce oil of juniper; anise-seed powder and treacle sufficient to make into eight balls. Cordial ball—four ounces powdered cummin seed, four ounces powdered anise-seed, four ounces powdered caraway seed, four ounces liquorice powder, two ounces powdered ginger; honey sufficient to make into balls the size of a hen's egg. To give a ball properly, a balling iron (a ring sufficiently large to admit the hand, and with cheek pieces) should be used. Have the horses head held well up, pull out the tongue, but do not pull on it strongly. Introduce the ball well back at the root of the tongue, withdraw the hand, return the tongue to the mouth, close the jaws and hold the head for a short time or until the ball is swallowed. This may be facilitated by gently stroking the throat between the jaws, or by slightly pinching the throat, or, rather, by slight but direct pressure on the throat, under the jaws.

BALM. *Melissa officinalis.* A perennial plant, having a fragrant odor, the flowers of which are exceedingly attractive to bees. Hence its name, *Melissa,* from the Greek word signifying honey. It is propagated from seeds, by offsets from the roots, or by cuttings of the young shoots. Place them in a shady border to root, and, well rooted, transplant to a distance of ten inches apart, where they are to stand. A poor but friable soil is best suited to the plant. By distillation, balm yields a fragrant oil, which, diluted with water, is held to be beneficial in cases of fever, or to persons of a lax or debilitated habit. A strong infusion of the young shoots may be used for the same purpose. For drying, gather the stalks when the flowers are in bloom, and dry in the shade or in a cool oven.

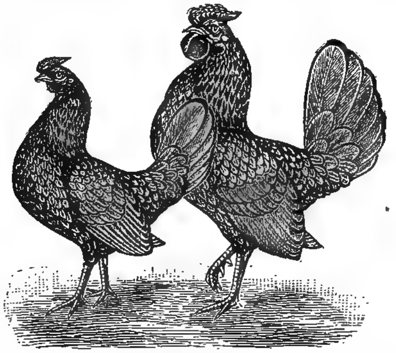
BALSAM. *Impatiens.* This common and pretty annual has long been cultivated in gardens for its variety of color and abundance of bloom.



DOUBLE BALSAM.

It is commonly known as Lady-slipper, and Touch-me-not, from the habit of the ripe pods suddenly flying open upon being touched, and casting their seeds to some distance. This plant must not be confounded with the stemless *Cypripedium*—a semi-aquatic plant, also called Lady-slipper. Many of the new varieties are quite beautiful. The plant is also attractive, especially when properly trained by pinching or pruning. The cut shows a double flower full size, also a plant in flower, pruned to three branches; and still another with the side branches shortened in by pinching back. The whole genus are killed with the slightest frost; hence the seeds should not be planted until about the time for planting cucumbers, or when Indian corn is up and growing. If bloom is wanted very early, sow the seeds in a gentle hot-bed about the time of sowing spring wheat, and transplant when the days and nights are warm. They transplant easily, but should be set so deep that a part of the stem is buried; thus they will make new roots along the buried stem. Several species of the genus are found in the United States. One of these, the Pale Impatiens, known by the popular names of Yellow Balsam, Snapweed, and Touch-me-not, is frequent in moist, shaded grounds, and along streams where its gamboge yellow flowers appear from July to September. The most common species, however, is the Fulvous or Tawney Impatiens, the flowers of which are of a deep orange color, with numerous reddish brown spots. The tender and succulent stems of this plant afford a domestic application to inflamed tumors, being bruised in the form of a poultice. It has sometimes been used for dying salmon-red.

BANTAM FOWLS. The smaller varieties of poultry are generally known under the name of bantams. They are not especially valuable, being kept entirely as pets or for ornament. Dwarf fowls have been known since the time of Pliny, who says of them: They are extraordinarily small, and yet fruitful. Aldovrandus describes a dwarf hen, and Willoughby, in 1678, says of bantams, that they are called trigs. Since the date mentioned, they have become common, and during the last century many new varieties have been originated, so that there are now bantams of all the principal breeds. Those in most repute, however, are the Game Bantam, the White, the Black, and the Seabright or Gold and Silver-laced Bantams. So there are bantams of the Asiatic fowls, Cuckoo Bantams and Japanese Bantams, the latter the most curious of all. The cut shows the Golden Seabright Bantam, the only difference between these and the Silver Bantams being, that the first is marked with yellow, while the latter is marked with white lacings. The Game Bantams are, without doubt, among the finest specimens of bantams, as they are the smallest; and yet a cockerel, not larger than a pigeon, will drive one of the large Asiatic breeds. The Game Bantams should be exact and diminutive representatives of the large breed of games they are to represent, whether Black-red, Brown-red, Duckwings or Pile Game Bantams. The smaller these are the better, and to reduce



SEABRIGHT BANTAMS.

the size it is usual to rear chickens from late fall broods. For competition, cocks must weigh less than twenty-four ounces, and hens less than twenty ounces each.

BARB. The horses of Barbary are called "Barbs." All that region, including Algiers, Fez, Morocco, Tripoli and Tunis, lying on the northern coast of Africa, west of Egypt, has long been celebrated for its superior horses. The Gadolphin Arabian was said to have been a fine Barb. Others that have exercised an influence in the make-up of the modern blood-horse were Burton's mare, Compton's, Croft's bay, Curwen's bay, Dodsworth's, Fairfax's Morocco, Greyhound, Harper's, Hutton's Gray, Layton's mare, Taffolet, Thoulouse, and Numidian. The true Barb is described by Beranger as follows: The forehead is long, slender and badly furnished with mane; but the neck rises distinctly and boldly out of the withers; the head is small and lean; ears of good size and well placed; shoulders light, obliquely sloping, and broad; withers thin and high; loins straight and short; flanks and ribs round and well developed; haunches strong; croup somewhat too long; quarters muscular and full; legs clean, and the tendons clearly marked and separate from the bone; pasterns somewhat too long and slanting; feet sound and of good shape. In size, they are lower than the Arabs, seldom measuring more than fourteen and a half hands, and they have not so much spirit, speed and endurance, although in external things they are, perhaps, superior.

BARB FENCE. (See Fencing.)

BARILLA. The ashes of sea-shore plants, containing about twenty per cent. of soda; used in the manufacture of hard soaps. The manufacture of soda from other sources now furnishes the soda of commerce. (See Alkali.)

BARK. The rind or covering of the woody parts of a tree. The bark of trees is composed of three distinct layers, of which the outermost is called the *epidermis*, and the next the *parenchyma*, and the innermost, or that in contact with the wood, the *cortical* layers. The epidermis is a thin, transparent, tough membrane; when rubbed off, it is gradually reproduced, and in some trees it cracks and decays, and a fresh epidermis is formed, pushing outwards the old; hence the reason why so many aged trees have a rough surface. The parenchyma is tender, succulent, and of a dark green. The cortical layer, or *liber*, consists of thin membranes encircling each other, and these seem to increase with the age of the plant, The liber, or inner bark, is known by its whiteness, great flexibility, toughness and durability; the fibres in its structure are ligneous tubes. It is the part of the stem through which the juices descend, and the organ in which the generative sap from whence all the other parts originate, is received from the leaves. The alburnum is the white or softer wood between the bark or sapwood or duramen. The bark in its interstices contains cells which are filled with juices of very varying qualities; some, like that of the oak, remarkable for their astringency; others, like the cinnamon, abounding with an essential oil; others, as Peruvian Cinchona bark, containing an alkali; some mucilaginous; many resinous. Several of these barks have been analyzed by various chemists; they have found them to consist chiefly of carbon, oxygen and hydrogen, with various saline and earthy substances.

BARK-BOUND. Trees, the bark of which appears stretched over the wood, and which does not split off kindly, are said to be bark-bound. Cutting a slit through it from the branches to the root, relieves the tree, and when the wound is kept clean from insects, does good. Manuring and good cultivation, scraping the bark and washing, are the real remedies.

BARK CLEANING. Fruit trees sometimes become infested with lichens or moss; the rough bark offers a hiding place for various insects as a nidus for their eggs. To prevent these, the bark should be scraped in the spring, as far as rough bark is concerned, and afterwards washed with strong lye, brine, whale oil soap dissolved in water (one pound to three gallons), lime water, soft soap, or other alkaline wash.

BARKING IRONS. Instruments for removing the bark of oak and other trees, required for the tanner's use. They consist of a blade or knife for cutting the bark, while yet on the trunk, across at regular distances, and of chisels or spatulas of different lengths and breadths.

BARLEY. *Hardeum vulgare.* This grain, from the fact that it has been used from time immemorial in Oriental countries as food for horses, and to a great extent as food for man among barbarous people; and from its easy conversion into malt and thence into beer, ale and other spiritous liquors, it has acquired an importance not warranted as a food grain. It is far below Indian corn, wheat, or even oats, in money value to a country, except in certain climates where it may be easily cured bright for malting. When heavy, and perfectly bright, it commands high prices from maltsters, but when it is dark and discolored it hardly brings the price of good oats per bushel. In Europe, where barley is extensively raised as one of the crops of a rotation, it is much employed as food for horses after a hard day's work. It is given after having been boiled, in which condition it acts as a gentle aperient and sudorific, opening the system and softening the skin. In the United States there is a prejudice against the use of barley as food for horses. This is entirely unfounded. Six or seven pounds may be given at a feed without injury, and if soaked twenty-four hours before feeding, a horse may eat what he will naturally take at a meal, and without injury. Certain it is that in Oriental countries, where it forms the bulk of the grain fed, it agrees perfectly with the horses. The same may be said of its use in New Mexico, on the plains and in California. It is nutritious, and in every way adapted either to horses of fast or slow work In the great grain region of the United States, oats are more prolific and certain, and hence but little attention is paid to barley. Barley is less nutritious than wheat, but one-seventh more so than oats. The ancient Romans, besides using it as food for horses, considered it the best food for swine, especially after boiling, the flesh so made having been reckoned especially tender and sweet. The first record of barley sown in America, is at Martha's vineyard in 1602, and in Virginia in 1611. In the New England States it has long been held valuable as food for hogs, milch cows and poultry. There is no doubt that the only drawback to its use is the high price which bright grain brings for malting. Barley is held to contain less of the flesh and blood-making principles than wheat, hence its use as a demulcent and for invalids in febrile complaints, and as an emollient in inflammatory disorders; but from its well known tendency to act on the bowels, it should not be eaten by persons subject to diarrhœa, or when bowel complaints are prevalent. Barley contains of—

Flesh-forming principles	6.1
Heat and fat producing principles	69.3
Husk	13.8
Water	10.8
	100.0

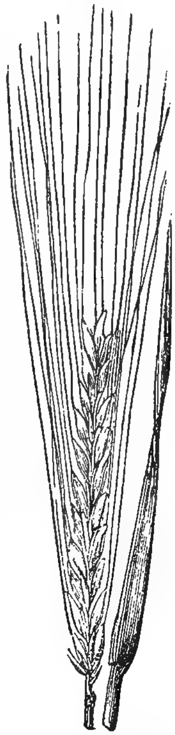
Or, according to another analysis:

Water	13.9
Gluten	13.0
Starch	47.5
Sugar	4.1
Gum	3.5
Fat	0.4
Fiber	13.4
Mineral matter	4.2
	100.0

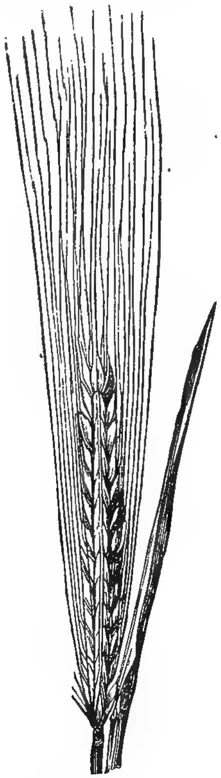
Or, economically:

Water	13.8
Flesh-formers	13.0
Fat-formers	52.0
Accessories	16.9
Mineral matter	4.2
	100.0

In Europe and the Oriental countries barley is extensively cultivated for fodder. In Germany and Russia it is extensively used for making bread. Scotland has long been celebrated for its barley meal, and its use is constantly extending in the form of mush with milk in all civilized countries. Barley grows best in a sandy soil and must have dry weather for ripening and curing. Hence the superior quality of the crop when grown on the plains of the far West and in California. In that State it is sown at any favorable time during the winter, or even to the end of March. In the West the crop is sown on newly plowed rich soil, reduced to a fine tilth in April or early in May, at the rate of about one and a half bushels drilled, or one quarter more sown broadcast; occasionally three or more bushels are sown. The varieties usually sown are the two-rowed (*Hordeum distichun*) and the six-rowed (*H. hexastichon*). The usual yield on fair soils is from twenty to twenty-five bushels, though under exceptional circumstances fifty and even sixty bushels per acre have been taken. Pot or hulled barley is barley denuded of its husk, in a mill, and is used in making mush, puddings, etc. Pearl or pearled barley is when all the integments are removed and the grain rounded and polished; in which form it is much used in soups. Pearled barley, ground into flour, is called patent barley. More care is required in harvesting barley than in any other of the grain crops. It should be allowed to become ripe, but not dead ripe. It is very apt to be destroyed on account of weather, causing germination of the grain, and the consequent depreciation of its value as malt. Hence it should not be stacked or put in the barn unless thoroughly dry. None should be put away when the dew is upon it, as, from the softness of the stem and the tendency of the ears to vegetate, it will be heated, the vitality may be destroyed, and maltsters will purchase it only for grinding, and then at greatly reduced rates. The English plan of harvesting is as follows: The grain must be ripe, but not dead-dry ripe, in order that it may germinate evenly. Wait until the red streaks which runs longitudinally on the ripening grain disappear, the head begins to hang down, and the straw assumes a golden hue. Then cut, and if sufficiently long tie up into small sheaves, in the event of bad weather. This will better protect it from staining than if lying loose. Barley stacked loose gets into better condition than when tied up; the sweating is more uniform and the sample a shade mellower. Still the evidence is in favor of tying. It is also recommended to avoid threshing with a machine, as the germinating "spear" is bruised, and is as much injured by it as if heated in the mow. It is likewise important, on account of the fineness of the texture of the chaff, that the grain should not be thrown in very large heaps without daily examination, to prevent heating and fermentation. The necessity for all these cautions will readily appear when the process of malting is understood. Among the new varieties introduced within the last few years are, Saxonian, Probstier, Chevalier barley. The latter, a pedigree sort, that is a variety obtained by careful selection and cultivation through a number of years. In the first half of the last decade the cultivation of barley received a strong impulse from the high prices obtained. Since that time its cultivation has presented fluctuations. In 1874–75, exports dropped to 91,118 bushels, the value of which was 67.4 cents per bushel as against 320,399 bushels the previous year, worth 65.8 cents per bushel. In 1875–76, exports reached 317,781 bushels, worth 66.3 cents per bushel. In 1876–77, it reached 1,186,129 bushels, worth 59.8 cents per bushel.

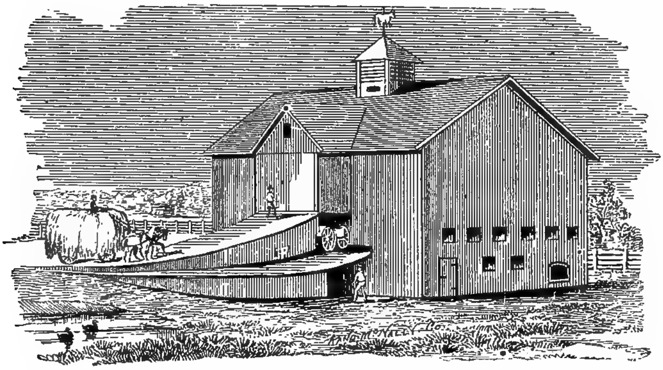


SPRING BARLEY.



WINTER BARLEY.

In 1877, the number of bushels of barley raised in the United States was 34,441,440, from 1,614,654 acres, valued at $22,028,644. The average yield per acre being 21.3 bushels, the average price 63.9 cents per bushel, and the average value being $13 64 per acre. In 1879 the acres in barley were, 1,680,700; bushels harvested, 40,283,100; and the value, $23,714,444—an average of $14.11 per acre, and an average yield of 24 bushels, nearly, per acre. Barley is subject to many disabilities, other than the most prevalent one of discoloration of the grain in curing. Those, during growth, are smut, blight and mildew. Those, during harvesting and succeeding harvesting, are germination in wet weather. Discoloration is produced by dew and damp weather during curing, and from heating in the stack. To obviate this in the United States, when little danger of rain and dew is feared, the grain is placed in windrows, set up in gavels without binding. Since the introduction of automatic binders, binding is again coming into favor, the shocks being carefully capped if rain is feared, and also at night to prevent the heads taking dew. On the great plains of the West, in the valleys between the Rocky mountains and the Sierra Nevada, and in California, where there is neither dew or rain during harvest, the brightest samples of barley are produced. There the grain is harvested, bound and shocked, and either threshed immediately from the shocks or else stacked and threshed after sweating, which always takes place in grain or hay when stacked. This sweating usually occcupies six weeks or two months, after which grain is usually dry enough for keeping in bulk or during transportation to distant markets. In threshing, there is an objection to that threshed with spiked cylinder machines. That threshed with the flails or tramped out by horses is less likely to have the germ broken, which injures it for malting or for seed. This, however, is too slow and tedious; hence machines, called beater machines, are preferred in threshing. The best soils for barley are rich sandy soils, or free loams, that is, loams not containing too much clay. All heavy (retentive) soils should be drained, else the outcome for barley or wheat need not be relied on to be remunerative. As a green crop for feeding, barley is better than rye. It should be fed sparingly to horses at first, as it is apt to purge them; but after a time the quantity may be increased without danger. For cattle, and especially for sheep, it is undoubtedly one of the best of forage crops. In the United States, however, it is but little sown except for its grain, and this almost exclusively for malting.



THREE-STORY BARN.

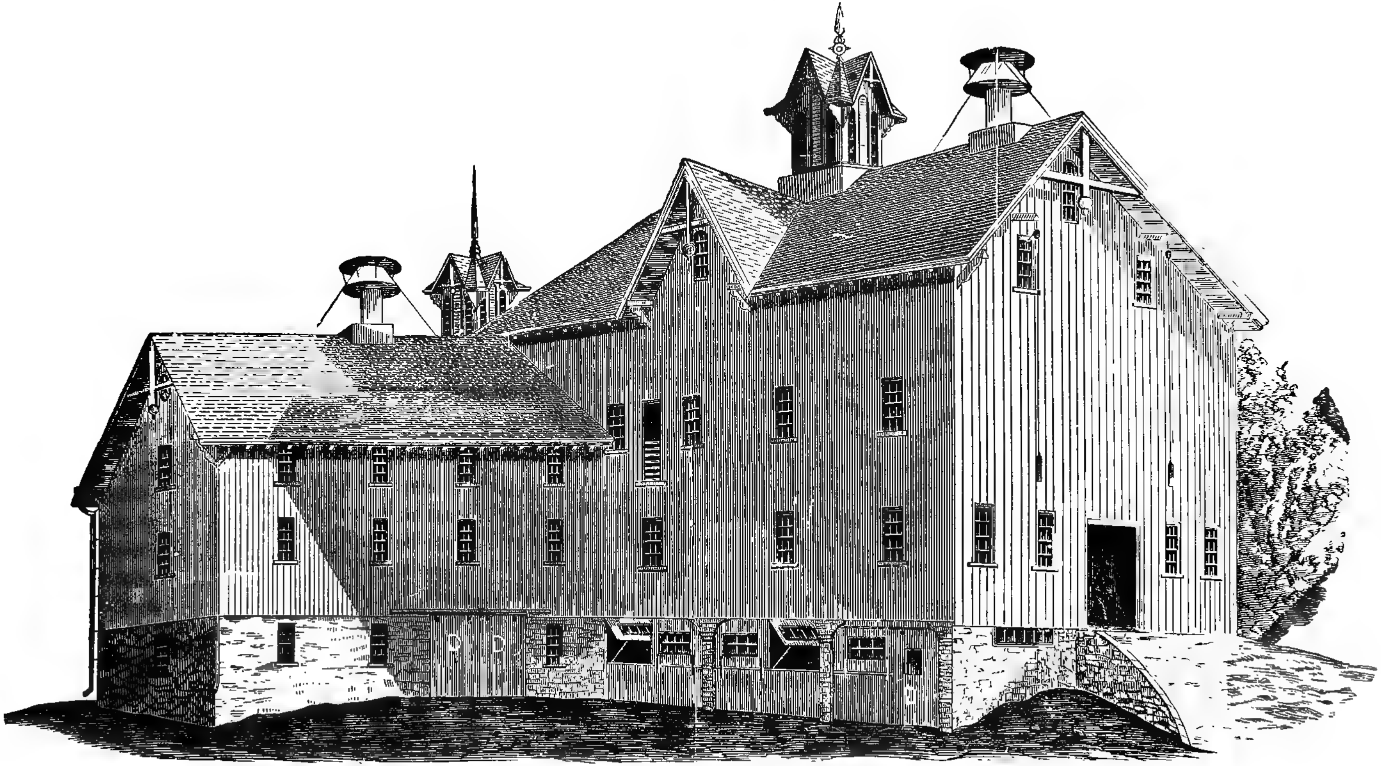
BARLEY GRASSES. Grasses of the genus *Hordeum*. They are coarse, and of little moment in agriculture. (See Grasses.)

BARLEY, PEARL. The small round kernel which remains after the skin and a portion of the barley have been ground off. (See Barley.)

BARM. Leaven; yeast.

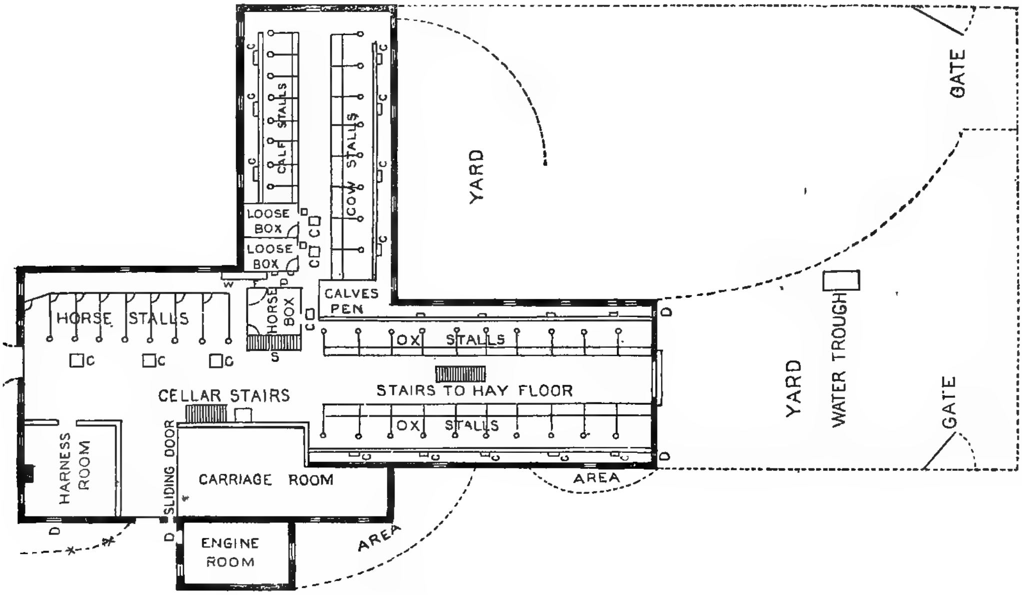
BARN OWL. The owls are all helps to the farmer, from their habits of destroying rats, mice, young rabbits and other verminous animals. (See Owl.)

BARN. Buildings for storing hay, grain in the straw, and fodder of various kinds. Have always been considered as among the most important in farm economy. Hence, in all old settled countries, the fertility of a farm, and the wealth of its owner, may be pretty accurately known by the completeness of its barns and other outbuildings. Of late years, however, barns are becoming more and more of a mixed character; that is, they are built with special reference to the sheltering of stock, and the storing and saving of hay and fodder, rather than for the storing of grain, since the practice of thatching allows the stacking of grain outside, and the modern facilities for warehousing and transportation of threshed grain, and modern systems of ventilation prevents damage thereto. Slighter structures, also barracks, skeleton barns, etc., allow the perfect saving of hay and fodder; hence, now-a-days the best barns are made of two and three stories, the lower being devoted to stalls and conveniences for keeping cattle, horses and sheep; a portion of the second floor to granaries, storing vehicles and implements, and the rest of the structure to hay, fodder, etc. (See illustration of model barn, and stock floor, accompanying this article.) Barns should be built on as dry a location as possible, or on one where the drainage may be made perfect, and also where the means for saving manure may be most economically carried out. Above all, a barn should never be shaded by trees, since dryness is one of the prime essentials. There are very few situations where a sufficient elevation may not be had to allow a basement partly under ground; that is, running into the bank. If the bank into which the barn is built be nine feet, by giving an elevation to the embankment of eight feet more, the second story may be reached without serious strain on the team. The illustration shows a three-story barn with platforms to each story. In building a barn, one should have as definite an idea of what it is to be used for, as in building a house. The principal objects sought are to store farm products and shelter stock; the saving of manure in cellars, once thought essential, being now exploded, as not economical except where special manures are to be prepared. In the planning of the more modern barns, it has been found to be

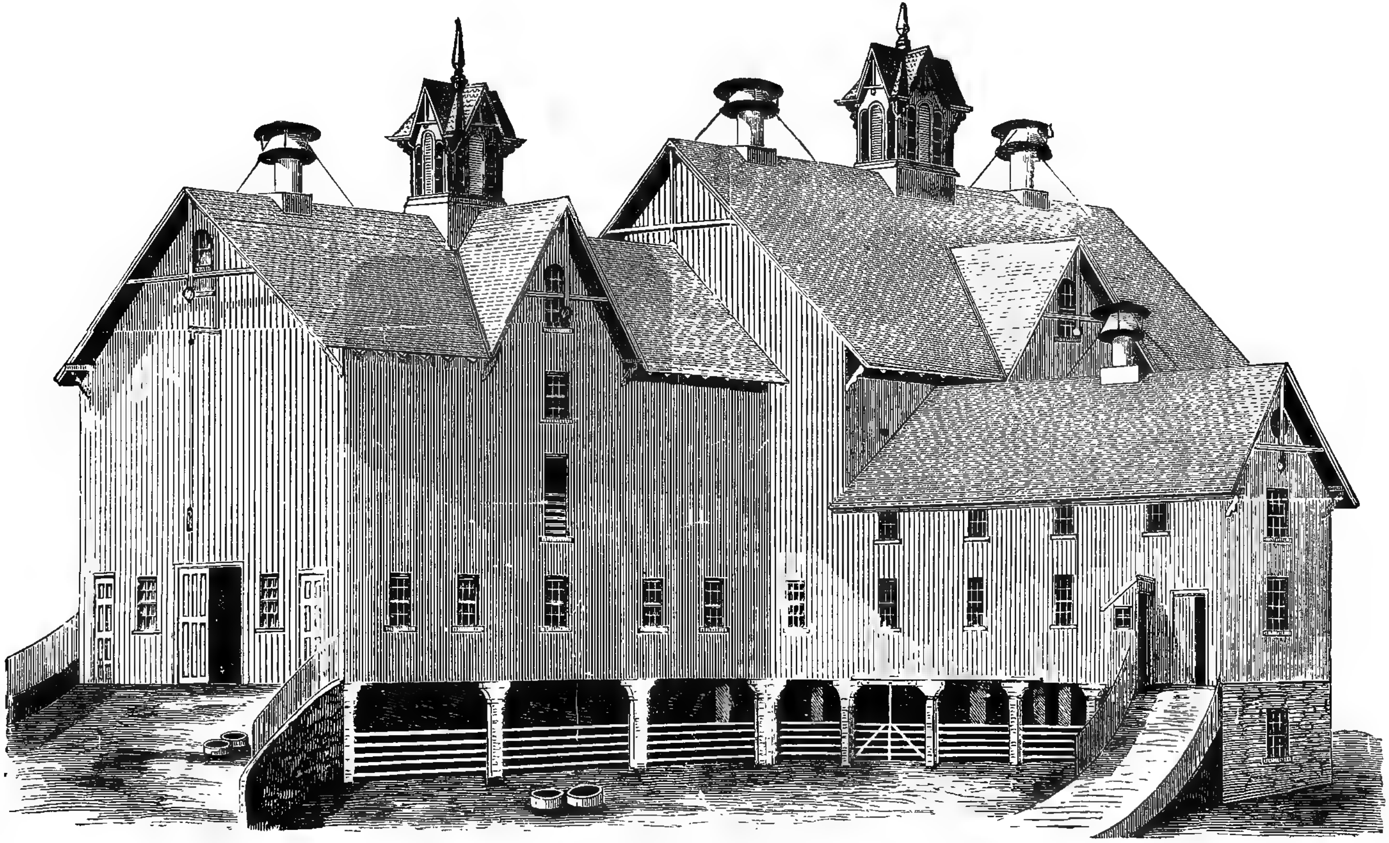


NORTHEAST VIEW, MODEL BARN.

economical to build high, since modern appliances for handling hay and grain allow it to be lifted, and carried by horse power to comparatively long distances. If the bank has sufficient elevation so the team can be driven upon the second floor, much valuable space may be utilized for storing machinery and implements, and also feed, on the floor above the stable and feeding floor. All above the second floor, and so much as may be deemed necessary above the first floor above the basement is to be used for hay and grain, except in particular cases where the nature of the case requires space for other purposes. When granaries are to be built in the barn, these should have sufficient elevation so the grain and other provender may be easily carried in chutes, and delivered from spouts, handy to where it is to be fed to the animals below. Hence the provender is stored one story above the stables. In relation to the height of modern built barns it should be remembered that a few feet additional, in height, costs but a trifle in comparison to the space gained; for the foundation answers, and the same roof covers all. To convey a more perfect idea of this important subject, we present illustrations showing a very complete barn adapted either to the East, West or South, from which a fair idea may be gained of the means to be used in economizing space. The subject will be again taken up when we come to treat of barns for special purposes as in the sheltering and feeding of live stock, in dairying and in stables used for various animals. The engravings on pages 89 and 91 give two views of the elevation, and also the feeding floor of a very complete barn. The first showing a northeast view. The next a southeast view, with yards attached. The northwest side of the barn contains the principal embankment for reaching the second floor, with room for power for raising and carrying fodder, and also the horse stable and entrance. The accompanying diagram shows plan of stock floor, yards, etc. The barn stands upon a side-hill sloping east. There are three distinct floors, and the barn consists of a main building and two wings, with dimensions as follows: Main building fifty-five by eighty feet: the east wing is fifty-six feet long and thirty-one and a half feet wide; the south wing is fifty-six feet long and thirty-five in width; total length from north to south, 136 feet. In the view from the northeast is shown the east wing and the cellar or basement wall, with the doors and windows communicating with the hog-pen, etc. The doors (D) are suspended upon rollers upon which they slide. The windows are suspended by hinges from the top, and swing open inside. The view from the southeast, shows the cattle yards, both wings, the cellar, etc. The approach to the cattle door of the east wing is not as steep as it appears in the drawing. Circular tanks of boiler iron are filled with constantly flowing water in each yard. The rail fence and gates shutting off the cellar from the yard are movable; the posts at either end being stepped into sockets, like mortices, left in the wide bases of the brick piers. Two men in a few minutes will remove them all and throw cellar and yard together, thus giving the cattle shelter in either winter or summer. Any portion of the cellar may, in the same way, be fenced off or opened to the yard. Horse power may be used for threshing and sawing, hay and stalk-cutting; but the plan is to employ steam power as the most economical, the waste of steam to be used for steaming hay and roots, and to this end the location of the engine-room, contiguous to and below the threshing floor, is exactly right. On the storage floor, all the hay, grain, straw, and stalks are stored. Two threshing floors, sixteen feet wide, cross the building, being entered from the west. On one of these is a hay scale, and there is abundant

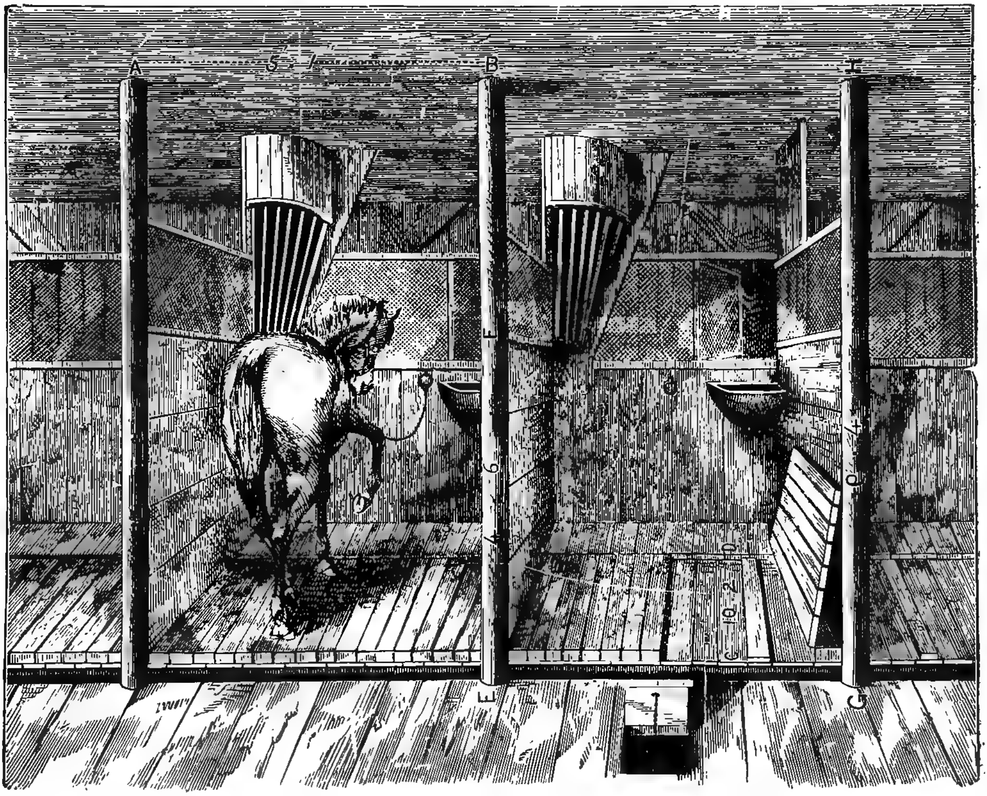


GROUND PLAN OF FEEDING FLOOR AND YARDS.



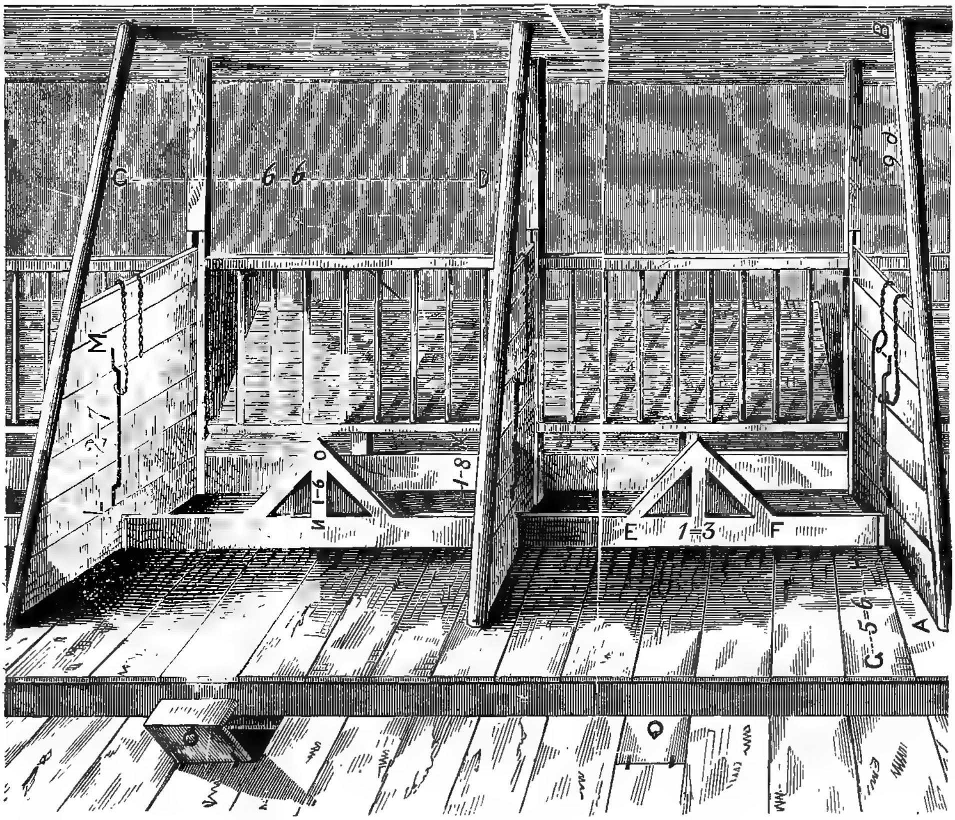
SOUTHEAST VIEW, MODEL BARN.

room upon the other for a horse power and hay cutter, by which most of the coarse fodder is chopped up before being delivered at the feed trough on the floor below. Each grain and meal bin communicates by a chute with the feeding floor, where its contents may be drawn off. The greater part of this floor is occupied by the immense hay mows through which pass the four great ventilators coming from the feeding floor. Doors open with the ventilating trunks at different heights, so, when desirable, hay, straw, oats in the sheaf, etc., may be thrown down to the stock. From this floor there are stairs which ascend to the cupola or observatory. The horse stables throughout the barn are airy and roomy. There are three loose boxes as shown in the ground plan (page 90), one twelve feet square, for horses, and two somewhat smaller, which are used for horses, or as lying-in stalls for cows. The horse-stalls are models of convenience and excellence. Each has the following dimensions: ten feet from front to rear, five feet one inch wide, nine feet four inches high. The stalls are separated by plank partitions four and a half feet high, surmounted by strong woven-wire cloth extending two feet higher. The same style of partition forms the front of the stalls. The hay rack is of iron, in one corner, and an iron feed box is in the opposite corner, accessible from the passage way in front of the stalls by a small door in the wire cloth. There are two floors, the lower one being laid of two-inch chestnut plank, with cleats, half an inch thick, covering the cracks between the planks. Upon this water-tight floor is another made in three parts; for two feet at the upper end the floor is of white oak plank nailed fast; the rest of the floor is formed of narrow oak plank fastened together by strong oak cleats let in flush so as to form two doors, as it were, hinged at either side, so as to be lifted and set up, as shown in right hand stall of the cut, for the perfect cleansing of the lower floor. A channel at the rear carries off the urine, and the solid manure is thrown into the cellar through the trap-door seen open in cut. Between the cattle-stalls in the south wing (page 93) there is a passage way ten feet wide, through which carts with green food, roots, etc., may be driven, making a complete system of soiling in summer practicable and convenient. The passage way through the east wing is not quite so wide, but might easily be used in the same way. All the cattle-stalls are made upon the same principle, though of different sizes, for fattening cattle, milch cows, and young stock. The cow-stalls are represented on page 93. The feeding boxes are two and a half feet wide, the floors five and a half feet from the feeding trough to the gutter, which is fourteen inches wide, and the passage in the rear is three feet, making in all about twelve feet for the stalls. The stalls are six and a half feet wide, arranged for two animals, which are fastened by a neck strap or chain



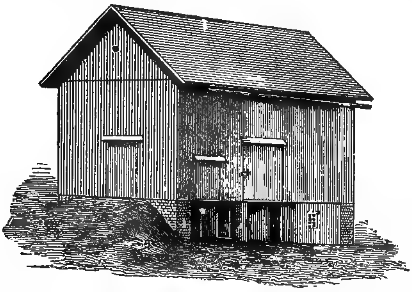
STALL, WITH HORSE.

attached to a short chain and ring, playing up and down upon a rod bolted to the partition between the stalls. A perpendicular rack is in front of the manger, and a shutter is hinged below it, and when open is held in an inclined position by a chain. This affords space below for a good forkful of hay between the shutter and the rack. Great economy of space is thus secured, for the encroachment upon the gangway is rarely of any inconvenience, and when carts are driven through it is easy to close the shutters. Light and air are abundantly provided for the stock, as one may see by a casual inspection of the plans. In fact, these are the first features that impress one. The ventilating trunks are four feet square, and rise from the feeding floor directly to the roof, where they terminate in ventilators of the largest size. The current of air caused by one of these is all times perceptible, and usually amounts to a considerable flow. The windows on the stock floor are numerous, and are each provided with two glazed sashes, hung by weights, so that any one, or all, may be opened to any degree desired, making the floors cool and airy in the closest weather. The yards open to the south and east, and are so arranged that the wash may be turned to flow into tanks for wetting down the manure in the cellar, which operation is frequently necessary, especially in summer. The water from the eaves is all conducted off, none going into the yard, and there is no necessity for husbanding it. The gables on the sides of the barn and south wing give great strength to the frame, afford light to the floor, and in summer give a splendid draft of air over the floor, to say nothing of the beauty added to the building. A cheap barn can be built on this general plan of, first, basement for stock cattle; second, floor for stock, wagons and tools; third, floor for hay, grain, hay-scales and other conveniences. To come to more simple barns, intended principally for storage of hay and grain, all that will be necessary to decide will be the size intended. In those localities where there is a lack of building stone for the foundation, it is better that there be no basement. A barn forty by eighty feet, or larger, should not have less than twenty-five feet posts, since with a horse fork and runways, hay may be carried easily and economically. Such a barn, to be built internally of timber and boards, should be sided vertically, and battened, or not, as the taste of the owner may suggest. For an average farm we present a cut of barn thirty-two by forty-four, with basement. This barn has eighteen feet posts, but we should prefer in a barn of this size that the posts should be twenty feet. The inside arrangement may be figured upon according to the special wants of the owner. By studying the plan of large barn, the fixtures may easily be



COW STALLS.

altered for smaller. In such a barn the entrance should be from the end, the doors being hung on iron rollers; the siding may be of rough boards, placed vertically, the floors of two-inch plank, planed and matched, with the shed and corn stables in the basement, and horse stables on the floor above.



A SMALL BANK BARN.

BAROMETER. The word is derived from two Greek words, which signify the measurer of weight. This, the most valuable instrument for meteorological observations in the farmer's possession, was invented about the middle of the 17th century, by Torricelli, an Italian philosopher. It was found by Torricelli, that a column of water of about thirty-two feet exactly balanced the weight of the atmosphere which surrounds our earth, and that this was equal to the weight of a column of mercury of about twenty-eight inches. This column of mercury under various forms is the barometer. As the pressure of the atmosphere commonly varies with approaching changes in the weather, the consequent rise or fall of the mercury merely marks its amount; one end of the mercurial tube is hermetically sealed and is void of air, so that the mercury rises or falls in it unresisted; but the other end of the tube is open, and the atmosphere forces the mercury through this, by pressure on the surface of the fluid mercury in the cistern. Thus, the atmosphere operates by its varying pressure. When, therefore, the mercury rises, the atmospheric pressure is increasing; when it falls, the pressure is diminishing. The more dense the atmosphere, the higher the mercury will rise in the instrument. It is a popular notion that the atmospheric pressure must be greater when the air is thick and cloudy. The term density, when applied to the condition of the atmosphere and its relations with the barometer, means specific weight, without reference to its clearness or cloudiness. Vapor or moisture in the air always lessens its weight, and the more vapor, whether this be invisible, or in the condensed states constituting fogs and clouds, the less the weight or density and pressure upon the barometer. It is more from this rising and falling of the barometer, observes Mr. Forster, that from its height or lowness, that we are to infer fair or foul weather. In very hot weather the falling of the mercury indicates thunder; in winter, the rising indicates frost; and in frosty weather, if the mercury falls three or four divisions, there will follow a thaw; but in a continued frost, if the mercury rises it will snow. When foul weather happens soon after the falling of the mercury, it will not continue; and, on the contrary, you may expect, if the weather becomes fair as soon as the mercury rises, that it will be of short duration. In foul weather, when the mercury rises much and high, and so continues for two or three days before the foul weather is quite over, then expect a continuance of fair weather to follow. There are many catch-penny, cheap barometers of late years. To buy them is money thrown away. If the farmer wishes a barometer, he had better get a mercurial instrument at once, since the first cost will be amply re-paid in the end.

BARRAS. The resin which flows from the bark of fir-trees.

BARREL. An English beer measure of thirty-four gallons. In the southern States, a measure of corn equal in the ear to ten bushels, or five bushels, shelled. A barrel of flour contains 196 pounds.

BARREN FLOWERS. Those which contain stamens only; they are easily known by the absence of the swelling under the (*ovarium*) flower. By high cultivation flowers become barren, and contain no stamens; when these bear fruit, it is without seeds; hence seedless varieties of orange, grape, etc. Thus entirely double flowers are seedless. These, botanically, are monstrosities, yet very beautiful to the eye.

BARRENNESS. Barrenness or sterility is produced by a variety of causes. High and stimulating food; want of exercise, fatty and sweet foods, lack of vigor, disease, over-milking and innutritious food are among the more common among the artificial causes. Natural causes, are a female twinned with a male; incomplete growth of the ovaries and incomplete genital organs are among the natural causes. If the male be old, diseased, very fat or very lean, or if his copulation has been excessive, the females coupled with him may not breed. The proper remedies will naturally suggest themselves. Malformation, of course, cannot be remedied.

BARRENS. A term applied in the West to sandy soils, sparsely covered with trees. They are not necessarily barren soils. Since those bearing bur oak are among the most productive soils in the West. Soils may be barren not always from the lack of fertility; excessive dryness and porosity may prevent fertility. Indurated clays may lack fertility because the roots cannot penetrate the soils. Others again are barren from the presence of tannin, metals, as iron, sulphur, etc., in combination with acids. Irrigation is necessary to the first named, deep tilth to the second, and the third class of soils are usually benefited by dressings of lime.

BARROW. In the United States, a pit or cave. In agriculture, a mound of earth, sometimes called camps, under which potatoes or other roots are stored for protection from frost. They are made by excavating the ground, when possible, which should be high and dry, about one foot and a half deep, from three to four wide, and of a length proportionable to the number of bushels to be stored. The earth dug out is thrown evenly on both sides of the trench. Before storing, a layer of straw is put down; but this is unnecessary; the roots, etc., are next piled up in a rounded form, with the greatest height of three or four feet in the middle of the mound; straw is laid over them, and dry earth of the excavation piled on from two to two and a half feet, and flattened with the spade. Around the barrow a ditch is dug, deeper than the floor within, to drain off water. What ever is stored should be sound, and previously well aired. They should be placed in a shaded place. When severe frost is expected one foot of earth is thrown on the first layer of straw, and another layer of straw is placed over this, and another foot of earth over all. The severest frosts will not enter a pit thus made. When the soil is too wet to be excavated, the roots may be placed directly on the surface, and a mound raised over the heap as before directed, but in this case it will require one-quarter more earth for covering than in the case of a pit.

BARS. In farriery, those portions of the crust or hoof of horses that are reflected inward, and from the arches situated between the heels and the frog.

BARS OF A HORSES MOUTH. The fleshy rows that run across the upper part of the mouth, and reach almost to the palate; they form that part of the mouth on which the bit should rest, and have its effect; the tongue of the curb bit, pressing directly thereon, when pulled upon by the reins.

BAR-SHOE. A particular kind of shoe, which is sometimes of necessity used to protect a tender frog from injury, the hinder part of the shoe being thickened and hollowed over the frog; but unless it is made exceedingly heavy it will soon be flattened down, and press injuriously upon the heels.

BARYTA. The oxide of barium, an alkaline earth closely resembling lime, but not very abundant. Many of its salts are isomorphous with those of lime.

BASALT. A rock of great hardness, containing iron, lime and sand. It does not differ from trap except in color, and occasionally in putting on the columnar form. The Palisades of the Hudson are a range forty miles long of this rock.

BASE. In chemistry, a term used to designate those substances which readily combine with acids, as alkalies, metallic oxides, etc.; in general terms, all substances which readily combine with others; in architecture, a pedestal.

BASIL. *Ocymum basilicum.* Two species. The one named is most usually cultivated for culinary purposes; an aromatic annual; the fragrance resembling cloves; a native of India. Among the French it is considered important in some soups, especially mock turtle; also in sauces and salads, the young leaves being the portions used. As an edging for large beds it is pretty. In the United States it is little used in cooking. The seed should be sown north, in a cold frame about the first of April and transplanted as soon as danger of frost is over. It requires a fertile, mellow soil and a warm exposure, and should be planted in rows one foot apart, the plants about eight inches in the rows. The stalks are cut for drying when in flower.

BASS. 1. The inner bark of the Lime or Linden Tree (*Tilia glabra*); used by gardeners to bind plants, and in the form of mats, to protect trees, frames. The American Linden Basswood, furnishes good bass. 2. A fresh water fish. (See Fish).

BATH. In chemistry, sand, water, or oil heated in a metallic vessel communicating a steady and regulated heat to chemical vessels in distilation, drying, or evaporation.

BATRACHIAN, BATRACHIA. An order of reptiles including the frogs and toads, and all reptiles which, like them, have naked skins and external branchiæ in the early stage of existence; those batrachia which retain the gills or gill aperatures throughout life are called "perennibranchiate," or amphibious.

BATTATAS. A name for the sweet potato.

BATTENS. Strips of wood two to four inches broad, nailed over the cracks in the vertical siding of buildings; any strip nailed over a crack.

BAUME'S AREOMETER, or HYDROMETER. A hydrometer, the zero of which is pure water at 58° Fahrenheit, and the 15° is the density of a mixture of fifteen parts common salt and eighty-five parts water, by weight.

BAY. 1. The term for a color inclining to a chestnut. In reference to the horse this color has various shades, from the very light bay to the dark bay, which approaches nearly to the brown; but it is always more bright and shining There are also dappled bays. All bay horses are really called brown. Bay horses have generally black manes. There are light bays, and gilded bays, which are somewhat of a yellowish color. The chestnut bay is that which comes nearest to the color of the chestnut. The bay is one of the best colors of horses, and horses of all the different shades of bays are generally sought after as indicating good temper and constitutional vigor. 2. Bay, in forestry, is a common name for the laurels, especially *Laurus nobilis.* Bayberry is the *Myrica cerifera.* 3. Bay of a barn; that part where the mow is placed. Hence such barns as have the threshing floor in the middle, and a space for a mow on each side, are called barns of two bays.

BEAK. The rostrum or sharp termination of a fruit.

BEAM. A horizontal timber used to resist or sustain weight.

BEAN. *Phasolus.* In the United States the bean is a tender annual, either dwarf or climbing, and is cultivated both for the succulent green pods and ripe seeds. The dwarf varieties vary in height from twelve to twenty-four inches, and require no poles. The climbing varieties require poles for their support. There are varieties intermedial between the bush and climbing bean, but which do not require support as the White Marrow, one of the best of the white varieties to be used as dry, ripe beans. Among the varieties used as string beans, the Turtle Soup or Tampico Bean produces abundant runners two feet or more in length. Beans when planted in drills—the usual and proper way for all the dwarf and half dwarf varieties—should be sown, as to the drills, thirty inches apart, to allow of horse cultivation; and if the drills are bedded up by running a horse hoe lightly between before sowing, on ordinary prairie land, it will increase their earliness and assist in the ease of cultivation, and subsequently the hilling with the horse hoe. When ripe, the crop is allowed to stand until the pods are quite dry, and pulled by the roots while moist with dew, the roots being pressed together in the hand and the handfulls set upon their tops in windows to dry. When sufficiently cured, they are to be laid loosely on scaffolds or laid around branched stakes, the roots in and the tops pointing down, to become quite dry before threshing. When threshed, the beans should be cleaned from the chaff in a fanning mill and be spread on a smooth airy floor and turned, from time to time, until they are entirely cured; thus they will not heat and mould when put in barrels. For the general crop of dry beans, they should not be planted until the days and nights are warm, or about the first week in June in the North, since the whole family are inter-tropical plants and exceedingly impatient, not only of frost, but cold storms. The pole varieties should be planted, the lower growing sorts three feet apart one way, by about two feet the other, and the taller climbers, as Scarlet Runners, Lima, etc., four feet one way, by three feet the other. Among the dwarf varieties, the China Red-eye is one of the most hardy and also moderately early. Early Valentine is productive and among the earliest; planted in June, they will afford green pods in fifty days, and ripen in eleven weeks. Long Yellow Six-weeks is also among the earliest of the early sorts, productive and excellent for a string bean. The so-called wax varieties are now generally cultivated for their succulent pods. The White Kidney Bean makes an excellent family bean for shelling green, coming in about the time of the first green corn, and is much used for making succotash. The pole or running varieties are less hardy than the dwarf varieties, and must not be planted in the open air until the days and nights are permanently warm, or about the time the earliest peas come in blossom. The Carolina and large Lima are the best of their class. Concord is a good shell bean, healthy and vigorous. The Corn Bean makes an excellent string bean. Indian Chief known also as Wax and Butter Bean, makes an excellent string or shell bean. Sabre or Cimeter, is productive and an excellent string or shell bean, and valuable for pickling. Among those considered ornamental, may be mentioned the Scarlet Runner, the Painted Lady and the White Runner. In England, Horse Beans (*vicia*), a family different from the garden bean and the bean of commerce (*Phaseolus*). There are a number of varieties of the horse bean raised in England as food for horses, and in Germany they are sown to some extent for soiling. All varieties of beans are considered to leave the soil open, porous and mellow. Again they are not an exhausting crop, notwithstanding the abundance of nutritive substance they contain, and this rich in azotized matter. The proportion of nutritive matter in beans, as compared with other grain is given by Einhof, as follows:

	Per cent. by weight.	Pounds per bushel.
Wheat	74	47
Rye	70	39
Barley	65	33
Oats	58	23
Peas	75	49
Kidney Beans	84	54

Von Thaer, in his experiments in feeding, to determine the value of beans as food for cattle, in his comparative estimate rates field beans as equal in value to one-third of wheat, and two-thirds of Indian corn or barley. The probability is that in countries adapted to the crop, that beans and Indian corn will admirably supplement each other in feeding, since Indian corn is rich in carbon, oil and starch, and beans are rich in nitrogen, as much as thirty per cent. of casein being found in the ripe seeds. Stock, however, must be learned to eat beans. We have never succeeded in getting any farm animals to eat beans except they were ground and mixed with grains.

BEARD. The awn of cereal grains and grasses.

BEARER. In building, any upright which supports timbers.

BEAR'S FOOT. Hellebore.

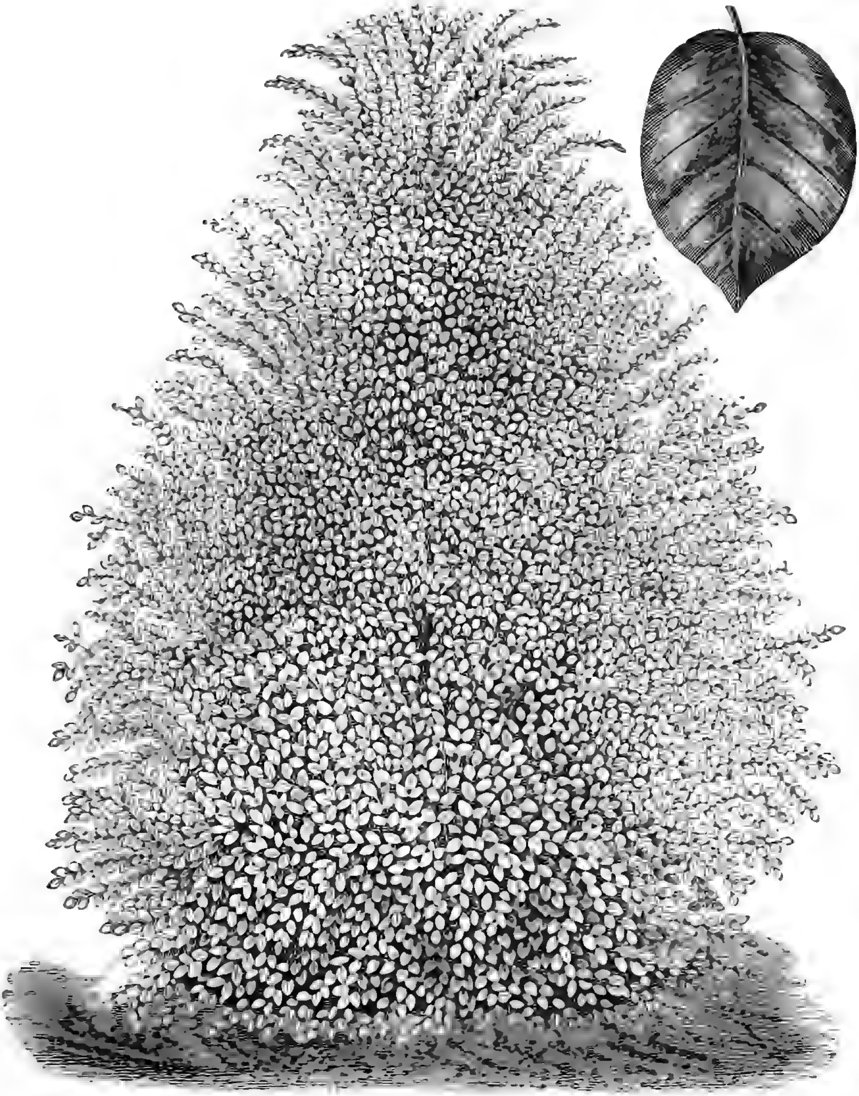
BEASTS. A term used in England to designate neat or horned cattle.

BEDS. In geology, seams of strata, as coal beds. In agriculture, a raised surface designed for the special care of a crop, as bedding up land with the plow.

BEE. (See Bees.)

BEECH. *Fagus.* One of the loftiest trees of the American forests, and widely distributed. The beech likes a deep, rich, moist soil, in favorable situations sometimes attaining an immense size, even to four and five feet in diameter. *Fagus sylvatica* is the European variety, and *F. ferrugina* (Red Beech), the variety usually found in our forests. The beech belongs to the natural botanical order (*Cupulifera*), and is described as follows: Staminate flowers numerous, in globose, pedunculate, pendulous catkins; fertile flowers in pairs, on a short peduncle, in an ovoid, prickly involucre; pistil, with the base covered by the calyx; styles three, awl-shaped; the nut triangular. *Fagus ferrugina* (American Beech), leaves are oblong, ovate, taper-pointed, distinctly and often coarsely toothed; petioles and midrib nearly naked; prickles of the fruit recurved or spreading. The beech is one of the most beautiful trees of the forest, and some of the nursery-grown varieties highly ornamental. The illustration we give will show the general characteristics fo the species, when grown singly, but also one of the most ornamental forms. It can, however, hardly be recommended for forest planting, since its wood quickly decays if exposed to alternate wet and dry. Its wood is firm, hard grained, compact, and when well seasoned does not warp, and is much used for shoe lasts, the wood of planes and other mechanical tools. The nuts are triangular in shape like buckwheat, small, and should, if intended for germination, be preserved in moist sand until planted. The beech is a superficial rooted tree, and if the trees be cut down in winter sprouts are thrown up the next spring. Thus the beech, like the chestnut, is easily renewed. The wood is liable to the attacks of insects, is inferior to the maple for fuel, but yields a large amount of potash in its ashes. The bark contains sufficient tannin for tanning leather, but is not used extensively for this purpose.

BEE MOTH. *Galleria cereana.* This insect belongs to the family of snout moths, *Pyralidæ.* The snout is not the tongue, but the palpi, which fact was not known by Mr. Langstroth, who is usually so accurate, as he essayed to correct Dr. Harris, who stated correctly, that the tongue, the ligula, was very short and hardly visable. This family includes the destructive hop moth, and the noxious meal and clover moths, and its members are very readily recognized by their unusually long palpi, the so-called snouts. The eggs of the bee-moth are white, globular and very small. These are usually pushed into crevices by the female moth as she extrudes them, which she can easily do by aid of her spy-glass-like ovipositor. They may be laid in the hive, in the crevice underneath it or about the entrance. Soon these eggs hatch, when the gray, dirty looking caterpillars, with brown heads, seek the comb on which they feed. To better protect themselves from the bees, they wrap themselves in a silken tube which they have the power to spin. They remain in this tunnel of silk during all their growth, enlarging it as they eat. By looking closely, the presence of these larvæ may be known by this robe of glistening silk, as it extends in branching outlines along the surface of the comb. A more speedy detection, even, than the defaced comb, comes from the particles of comb, intermingled with the powder-like droppings of the caterpillars, which will always be seen on the bottom-board in case the moth-larvæ are at work. Soon, in three or four weeks, the larvæ are full grown. Now the six-jointed, and the ten prop-legs—making sixteen in all, the usual number of caterpillars—are plainly visible. These larvæ are about an inch long. They now spin their cocoons, either in some crevice about the hive, or, if very numerous, singly or in clusters on the comb, or even in the drone-cells in which they become pupæ, and in two weeks, even less, sometimes, during the extreme heat of summer, the moths again appear. In winter, they may remain as pupæ for months. The moths or millers—sometimes incorrectly called moth-millers—are of an obscure gray color, and thus so mimic old boards, that they are very readily passed unobserved by the apiarist. They are about three-fourths of an inch long, and expand nearly one and one-fourth inches. The females are darker than the males, possess a longer snout, and are usually a little larger. The wings, when

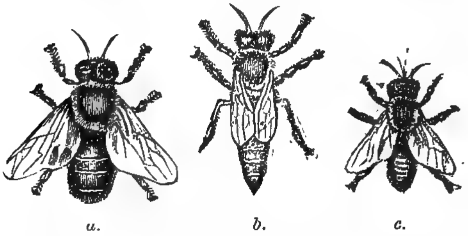


RIVERS' PURPLE-LEAVED BEECH

the moths are quiet, are flat on the back for a narrow space, then slope very abruptly. They rest by day, yet, when disturbed, will dart forth with great swiftness, so Réuamur styled them nimble-footed. They are active by night, when they essay to enter the hive and deposit their one or two hundred eggs. If the females are held in the hand they will often extrude their eggs; in fact, they have been known to do this even after the head and thorax were severed from the abdomen, and still more strange, while the latter was being dissected. It is generally stated that these are two-brooded, the first moths occurring in May, the second in August. Yet, as I have seen these moths in every month from May to September, and as I have proved by actual observation that they may pass from egg to moth in less than six weeks, I think under favorable conditions there may be even three broods a year. It is true that the varied conditions of temperature—as the moth larvæ may grow in a deserted hive, in one with few bees, or one crowded with bee life—will have much to do with the rapidity of development. Circumstances may so retard growth and development that there may not be more than two, and possibly, in extreme cases, more than one brood in a season.—Manual of the Apiary.

BEER. The fermented infusion of malt, flavored with hops. But other sweet infusions, treated in the same way, or without hops, are also termed beers, as persimmon beer, sassafras, spruce, liquorice and sarsaparilla root beer.

BEES. Apiculture, or the care of bees, has a peculiar fascination for its votaries, and is especially adapted to the tastes of women and men who have a few hours leisure each day. It is a fact that some of the most successful bee-keepers in the country are women, the danger of being stung amounting to almost nothing, if the bees are rightly handled. So, also, some of the most intelligent writers on bees are, and have been, women. Bee literature is by no means wanting. Besides the many foreign works of value, the field of bee literature is fully covered in the United States. The illustrations we give will show the different genders of the honey-bee perfectly; *a* being the drone or male bee; *b*, the female or fertile bee; and *c*, the neuter or working bee. The honey-bee belongs to the order *Hexapods*, or true insects; to the sub-order *Hymenoptera*, which also includes the wasps, ants, ichneumon-flies, and saw-flies. The group embraces insects possessing a tongue, by which they may suck fluid food, and also strong jaws for biting and gnawing. The honey-bee belongs to the family *Apidæ*, which includes all insects that feed their young or larvæ, on pollen and honey. Of the natural history of the honey-bee, Prof. Cook, in his Manual of the Apiary, says: The insects of this family have broad heads, elbowed antennæ which are usually thirteen-jointed in the males and only twelve-jointed in the females. The jaws or mandibles are very strong, and often toothed; the tongue or ligula, as also the second jaws or maxillæ, one each side the tongue, are long, though in some cases much shorter than in others, and frequently the tongue when not in use is folded back, once or more, under the head. All the insects of this family have a stiff spine on all four of the anterior legs, at the end of the tibia, or the third joint from the body, called the tibial spur, and all—except the genus *Apis*, which includes the honey-bee, in which the posterior legs have no tibial spurs—have two tibial spurs on the posterior legs. All of this family except one parasitic genus, have the first joint or tarsus of the posterior foot much widened, and this together with the broad tibia is hollowed out, forming quite a basin or basket on the outer side, in nearly all the species; and generally, this basket is made deeper by a rim of stiff hairs. These receptacles or pollen baskets are only found, of course, on such individuals of each community as gather pollen. A few of the *Apidæ*—thieves by nature—cuckoo-like, steal unbidden into the nests of others, usually bumble-bees, and here lay their eggs. As their young are fed and fostered by another, they gather no pollen, and hence, like drone bees, need not, and have not pollen baskets. The young of these lazy tramps, starve out the real insect babies of these homes, by eating their food and in some cases, it is said, being unable, like the young cuckoos, to hurl these rightful children from the nest, they show an equal if not greater depravity by eating them, not waiting for starvation to get them out of the way. These parasites illustrate mimicry, already described, as they look so like the foster mothers of their own young, that unscientific eyes would often fail to distinguish them. Probably bumble-bees are no sharper, or they would refuse ingress to these merciless vagrants. The larvæ of all insects of this family are maggot-like—wrinkled, footless, tapering at both ends, and as before stated, feed upon pollen and honey. They are helpless, and thus, all during their babyhood—the larvæ state—the time when all insects are most ravenous, and the only time when many insects take food, the time when all growth in size, except such enlargement as is required by egg-development, occurs, these infant bees have to be fed by their mothers or elder sisters. They have a mouth with soft lips and weak jaws, yet it is doubtful if all or much of their food is taken in at this opening. There is some reason to believe that they, like many maggots—such as the Hessian-fly larvæ—absorb much of their food through the body walls. From the mouth leads the intestine, which has no anal opening. So there is no excreta other than gas and vapor. To this family belongs the genus of stingless bees (*Melipona*), of Mexico and South America, which store honey not only in the hexagonal brood-cells, but in great wax reservoirs. They, like the unkept hive-bee, build in hollow logs. They are exceedingly numerous in each colony, and it has thus been thought that there were more than one queen. They are also very prodigal of wax, and thus may possess a prospective commercial importance in these days of artificial comb-foundation. In this genus the basal joint of the tarsus is triangular, and they have two submarginal cells, not three, to the front wings. They are also



smaller than our common bees, and have wings that do not reach to the tip of their abdomens. Another genus of stingless bees, the genus *Trigona*, have the wings longer than the abdomens, and their jaws toothed. These, unlike the *Melipona*, are not confined to the New World, but are met in Africa, India and Australasia. These build their combs in tall trees, fastening them to the branches much as does the *Apis dorsata*, not here mentioned. Of course insects of the genus *Bombus*—our common Bumble-bees—belong to this family. Here the tongue is very long, the bee large, the sting curved, with the barbs very short and few. Only the queens survive the winter. In spring she forms her nest under some sod or board, hollowing out a basin in the earth, and after storing a mass of bee-bread—probably a mixture of honey and pollen—she deposits several eggs in the mass. The larvæ so soon as hatched out, eat out thimble-shaped spaces, which in time become even larger, and not unlike in form the queen-cells of our hive-bees. When the bees issue from these cells the same are strengthened by wax. Later in the season these coarse wax cells become very numerous. Some may be made as cells and not formed as above. The wax is dark, and doubtless contains much pollen, as do the cappings and queen-cells of the honey-bees. At first the bees are all workers, later queens appear, and still later, males. In *Xylocopa*, or the Carpenter-bees, which much resemble the Bumble-bees, we have a fine example of a boring insect. With its strong mandibles or jaws it cuts long tunnels, often one or two feet long in the hardest wood. These burrows are divided by chip partitions into cells, and in each cell is left the bee-bread and an egg. The Mason-bee—well named—constructs cells of earth and gravel, which by aid of their spittle they have power to cement, so that they are harder than brick. The Tailor or Leaf-cutting bees, of the genus *Megachile*, make wonderful cells from variously shaped pieces of leaves. These are always mathematical in form, usually circular and oblong, and are cut—by the insect's making scissors of its jaws—from various leaves, the rose being a favorite. I have found these cells made almost wholly of the petals or flower leaves of the rose. The cells are made by gluing these leaf-sections in concentric layers, letting them over-lap. The oblong sections form the walls of the cylinder, while the circular pieces are crowded as we press circular wads into our shot-guns, and are used at the ends or for partitions where several cells are placed together. When complete, the single cells are in form and size much like a revolver cartridge. When several are placed together, which is usually the case, they are arranged end to end, and in size and form are quite like a small stick of candy, though not more than one-third as long. These cells I have found in the grass, partially buried in the earth, in crevices, and in one case knew of their being built in the folds of a partially-knit sock, which a good house-wife had chanced to leave stationary for some days. These leaf-cutters have rows of hair underneath, with which they carry pollen. I have noticed them each summer for some years swarming on the Virginia Creeper, often called Woodbine, while in blossom, in quest of pollen, though I never saw a single hive-bee on these vines. The Tailor-bees often cut the foliage of the same vines quite badly. The genus *Osmia*, are also called Mason-bees. Their glistening colors of blue and green possess a lustre and reflection unsurpassed even by the metals themselves. These rear their young in cells of mud, in mud-cells lining hollow weeds and shrubs, and in burrows which they dig in the hard earth. In early summer, during warm days, these glistening gems of life are frequently seen in walks and drives intent on gathering earth for mortar, or digging holes, and will hardly escape identification by the observing apiarist, as their form is so much like that of our honey-bees. They are smaller; yet their broad head, prominent eyes, and general form, is very like that of the equally quick and active, yet more soberly attired, workers of the apiary. Other bees—the numerous species of the genus *Nomada* and of *Apathus*, are the black sheep in the family *Apidæ*. These tramps, already referred to, like the English Cuckoo and our American Cow-blackbird, steal in upon the unwary, and, though all unbidden, lay their eggs; in this way appropriating food and lodgings for their own yet unborn. Thus these insect vagabonds impose upon the unsuspecting foster-mothers in these violated homes. And these same foster-mothers show by their tender care of these merciless intruders, that they are miserably fooled, for they carefully guard and feed infant bees, which with age will in turn practice this same nefarious trickery.

In relation to the anatomy and physiology of the honey-bee, Prof. Cook says: A very remarkable feature in the economy of the honey-bee, described even by Aristotle, which is true of many other bees, and also of ants and many wasps, is the presence in each family of three distinct kinds, which differ in form, color, structure, size, habits and function. Thus we have the queen, a number of drones, and a far greater number of workers. Huber, Bevan, Munn and Kirby also speak of a fourth kind blacker than the usual workers. These are accidental, and are, as conclusively shown by Baron Von Berlepsch, ordinary workers, more deeply colored by loss of hair, dampness, or some other atmospheric condition. American apiarists are too familiar with these black bees, for after our severe winters they prevail in the colony, and, as remarked by the Baron, they quickly disappear. Munn also tells of a fifth kind, with a top-knot, which appears at swarming seasons. I am at a great loss to know what he refers to, unless it be the pollen masses of the *Asclepias*, or Milk-weed, which sometimes fasten to our bees and becomes a severe burden. The queen, although referred to as the mother bee, was called the king by Virgil, Pliny, and by writers as late as the last century, though in the ancient Bee Master's Farewell, by John Hall, published in London in 1796, I find an admirable description of the queen bee, with her function correctly stated. Réaumur as quoted by Wildman on Bees, published in London in 1770, says: This third sort has a grave and sedate walk, is armed with a sting, and is mother of all the others. Huber, to whom every apiarist owes so much, and who, though blind, through the aid of his devoted wife and intelligent servant, Frances Burnens, developed so many interesting facts, demonstrated the fact of the queens maternity. This author's work, second edition, published in Edinburgh in 1808, gives a full history of his wonderful observations and experiments, and must ever rank with Langstroth as a classic, worthy of study by all. The queen, then, is the mother bee—in other words, a fully developed female. Her ovaries are very large, nearly filling her long abdomen. The tubes already described as composing them are very numerous, while the spermatheca is plainly visible. This is muscular, receives abundant nerves, and thus, without doubt, may or may not be compressed to force the sperm cells in contact with the eggs as they pass by the duct. Leuckart estimates that the spermatheca will hold more than 25,000 000 spermatozoa. The possession of the ovaries and attendant organs, is the chief structural peculiarity which marks the queen, as these are the characteristic marks of females among all animals. But she has other peculiarities worthy of mention: She is longer than either drones or workers, being more than seven-eighths of an inch in length, and, with her long tapering abdomen, is not without real grace and beauty. The queen's mouth organs, too, are developed to a less degree than are those of the worker-bees. Her jaws or mandibles are weaker, with a rudimentary tooth, and her tongue or ligula, as are also the labial palpi and maxillæ considerably shorter. Her eyes, like the same in the worker-bee, are smaller than those of the drones, and do not meet above. So the three ocelli are situated above and between. The queen's wings, too, are relatively shorter than those either of the workers or drones, for instead of attaining to the end of the body, they reach but little beyond the third joint of the abdomen. The queen, though she has the characteristic posterior tibia and basal tarsus, in respect to breadth, has not the cavity and surrounding hairs, which form the pollen baskets of the workers. The queen possesses a sting which is longer than that of the workers, and resembles that of the bumble-bees in being curved, and that of bumble-bees and wasps, in having few and short barbs—the little projections which point back like the barb of a fish-hook, and which, in case of the workers, prevent the withdrawing of the instrument, when once fairly inserted. While there are seven quite prominent barbs on each shaft of the worker's sting, there are only three on those of the queen, and these are very short, and, as in a worker's sting, they are successively shorter as we recede from the point of the weapon. Aristotle says that the queen seldom uses her sting, which I have found true. I have often tried to provoke a queen's anger, but never with any evidence of success. Neighbour gives three cases where queens used their stings, in one of which cases she was disabled from further egg-laying. She stings with slight effect. The queen, like the neuters, is developed from an impregnated egg, which, of course, could only come from a queen that had previously mated. These eggs are not placed in a horizontal cell, but in one specially prepared for their reception. These queen-cells are usually built on the edge of the comb, or around an opening in it, which is necessitated from their size and form, as usually the combs are too close together to permit their location elsewhere. These cells extend either vertically or diagonally downward, are composed of wax mixed with pollen, and in size and form much resemble a peanut. The eggs must be placed in these cells, either by the queen or workers. Some apiarists think that the queen never places an egg in a queen cell, but I have no doubt of the fact, though I never witnessed the act. I have frequently seen eggs in these cells, and, without exception, in the exact position in which the queen always places her eggs in the other cells. John Hall, in the old work already referred to, whose descriptions, though penned so long ago, are wonderfully accurate, and indicate great care, candor and conscientious truthfulness, asserts that the queen is five times as long laying a royal egg as she is the others. From the character of his work, and its early publication, I can but think that he had witnessed this rare sight. Some candid apiarists of our own time and country—E. Gallup among the rest—claim to have witnessed the act. The eggs are so well glued, and are so delicate, that, with Neighbour, I doubt the possibility of a removal. The opponents to this view place their belief on a supposed discord between the queen and neuters. This antagonism is inferred, and I have but little faith in the inference or the argument from it. I know that when royal cells are to be torn down, and inchoate queens destroyed, the workers aid the queen in this destruction. I have also seen queens pass by unguarded queen-cells, and yet respect them. I have also seen several young queens dwelling amicably together in the same hive. Is it not probable that the bees are united in whatever is to be accomplished, and that when queens are to be destroyed all spring to the work, and when they are to live all regard them as sacred? It is true that the actions of bees are controlled and influenced by the surrounding conditions or circumstances, but I have yet to see satisfactory proof of the old theory that these conditions impress differently the queen and the workers. The conditions which lead to the building of queen-cells and the peopling of the same are—loss of queen, when a worker larva from one to four days old will be surrounded by a cell; inability of a queen to lay impregnated eggs, her spermatheca having become emptied; great number of worker-bees in the hive; restricted quarters; the queen not having place to deposit eggs, or the workers little or no room to store honey; and lack of ventilation, so that the hive becomes too close. These last three conditions are most likely to occur at times of great honey secretion. A queen may be developed from an egg, or from a worker larva less than three days old. Mr. Doolittle has known queens to be reared from worker larvæ taken at four and a half days from hatching. In this latter case, the cells adjacent to the one containing the selected larva are removed, and the larva selected by a royal cell. The development of the queen larva is much like that of the worker, soon to be detailed, except that it is more rapid, and is fed richer and more plenteous food, called royal jelly. This peculiar food, as also its use and abundance in the cell, was first described by Schirach, a Saxon clergyman, who wrote a work on bees in 1771. According to Hunter, this royal pabulum is richer in nitrogen than that of the common larvæ. It is thick like rich cream; slightly yellow, and so abundant that the queen larva not only floats in it during all its period of growth, but quite a large amount remains after her queenship vacates the cell. We often find this royal jelly in incomplete queen-cells, without larvæ. The larval queen is longer and more rapid of development than the other larvæ. When developed from the egg—as in case of normal swarming—the larvæ feeds for five days, when the cells are capped by the workers. The infant queen then spins her cocoon, which occupies about one day. The end of the cocoon is left open. Some one has suggested that this is an act of thoughtful generosity on the part of the queen larva, thus to render her own destruction more easy, should the welfare of the colony demand it, as now a sister queen may safely give the fatal sting. The queen now spends nearly three days in absolute repose. Such rest is common to all cocoon-spinning larvæ. The spinning, which is done by a rapid motion to and fro of the head, always carrying the delicate thread, much like the moving shuttle of the weaver, seems to bring exhaustion and need of repose. She now assumes the nymph or pupa state. At the end of the sixteenth day she comes forth a queen. Huber states that when a queen emerges, the bees are thrown into a state of joyous excitement, so that he noted a rise in the temperature of the hive from 92° to 104° Fahrenheit. I have never tested this matter accurately, but I have failed to notice any marked demonstration on the natal day of her ladyship, the queen, or extra respect paid her as a virgin. When queens are started from worker larvæ, they will issue as imago in ten or twelve days from the date of their new prospects. Mr. Doolittle has known them to issue in eight and one-half days. As the queen's development is probably due to superior quality and increased quantity of food, it would stand to reason that queens started from eggs are preferable; the more so, as under normal circumstances, I believe they are almost always thus started. The best experience sustains this position. As the proper food and temperature could best be secured in a full colony—and here again the natural economy of the hive adds to our argument—we should infer that the best queens would be reared in strong colonies, or at least kept in such colonies till the cells are capped. Experience also confirms this view. As the quantity and quality of the food, and the general activity of the bees is directly connected with the full nourishment of the queen-larvæ, and as these are only at the maximum in times of active gathering—the time when queen-rearing is naturally started by the bees—we should also conclude that queens reared at such seasons are superior. Five or six days after issuing from the cell—Neighbour says the third day—if the day is pleasant, the queen goes forth on her "marriage flight;" otherwise she will improve the first pleasant day thereafter for this purpose. Huber was the first one to prove that impregnation always takes place on the wing. Bonnet also proved that the same is true of ants, though in this case millions of queens and drones often swarm out at once. I have myself witnessed several of these wholesale matrimonial excursions among ants. I have also frequently taken bumble-bees in copulo while on the wing. I have also noticed both ants and bumble-bees to fall while united, probably borne down by the expiring males. That butterflies, moths, dragon-flies, etc., mate on the wing is a matter of common observation. That it is possible to to impregnate queens when confined, I think very doubtful. The queens will caress the drones, but the latter seem not to heed their advances. That this ever has been done I also question, though many think they have positive proof that it has occurred. Yet, as there are so many chances to be mistaken, and as experience and observation are so excessive against the possibility, I think that these may be cases of hasty or inaccurate judgment. Many, very many, with myself, have followed Huber in clipping the queen's wing, only to produce a sterile or drone-laying queen. Prof. Leuckart believes that successful mating demands that the large air-sacks of the drones shall be filled, which he thinks is only possible during flight. The demeanor of the drones leads me to think, that the excitement of flight, like the warmth of the hand, is necessary to induce the sexual impulse. Parthenogenesis, in the production of males, has also been found by Siebold to be true of other bees and wasps, and of some of the lower moths, in the production of both males and females. While the great Bonnet first discovered what may be noticed on any summer day, all about us, even on the house-plants at our very windows, that parthenogenesis is best illustrated by the *Aphides*, or plant-lice. In the fall males and females appear, which mate, when the female lays eggs, which in the spring produce only females, these again produce only females, and thus on, for several generations, till with the cold of autumn come again the males and females. Bonnet observed seven successive generations of productive virgins. Duval noted nine generations in seven months, while Kyber observed production exclusively by parthenogenesis in a heated room for four years. So, we see, that this strange and almost incredible method of increase, is not rare in the insect world. About two days after she is impregnated, the queen, under normal circumstances, commences to lay, usually worker-eggs, and as the condition of the hive seldom impels to swarming the same summer, so that no drones are required, she usually lays no others the first season. The queen, when considered in relation to the other bees of the colony, possesses a surprising longevity. It is not surprising for her to attain the age of three years in the full possession of her powers, while they have been known to do good work for five years. Queens, often at the expiration of one, two, three or four years, depending on their vigor and excellence, either cease to be fertile, or else become impotent to lay impregnated eggs—the spermatheca having become emptied of its sperm-cells. In such cases the workers usually supersede the queen; that is they destroy the old queen, ere all the worker eggs are gone, and take of the few remaining ones to start queen-cells, and thus rear young, fertile and vigorous queens. The function of the queen is simply to lay eggs, and thus keep the colony populous; and this she does with an energy that is fairly startling. A good queen in her best estate will lay 2,000 or 3,000 eggs in a day. I have seen a queen in my observing hive, lay for some time at the rate of four eggs per minute, and have proved by actual computation of brood-cells, that a queen may lay over 3,000 eggs in a day. Langstroth and Berlepsch both saw queens lay at the rate of six eggs a minute. The latter had a queen that laid 3,021 in twenty-four hours, by actual count, and in twenty days laid 57,000. This queen continued prolific for five years, and must have laid, says the Baron, at a low estimate, more than 1,300,000 eggs. Dzierzon says queens may lay 1,000,000 eggs, and I think these authors have not exaggerated. The drones—the male bees—are usually found in the hive from May to November. Their presence or absence depends on the present and prospective condition of the colony, there being usually several hundred to each hive. It was discovered by Dzierzon in 1845, that the drones hatch from unimpregnated eggs. Drones may also come from a fertile worker, occasionally seen, or from an unimpregnated queen, but usually from an impregnated queen which has voluntarily prevented fertilization necessary to produce a worker. The drone is fed six and a half days as a larva, before the cell is capped. The caps being quite convex so as to be easily distinguished from the worker brood. After mating, the drone organs adhere to the queen, the act of copulation always proving fatal to the drone. In relation to the neuter or worker-bees, says Prof. Cook, in this connection, they were called the bees by Aristotle, and Wildman and Bevan say they are by far the most numerous individuals of the hive—there being from 1,500 to 4,000 in every good colony. It is possible for a colony to be even much more populous than this. These are also the smallest bees of the colony, as they measure but little more than one-half of an inch in length. The workers—as taught by Schirach, and proved by Mlle. Jurine, of Geneva, Switzerland, who, at the request of Huber, sought for and found, by aid of her microscope, that abortive ovaries are undeveloped females. Rarely, and probably very rarely, except that a colony is long or often queenless, as is frequently true of our nuclei, these bees are so far developed as to produce eggs, which, of course, would always be drone eggs. Such workers—known as fertile—were first noticed by Reim, while Huber actually saw one in the act of egg-laying. Except in the power to produce eggs, they seem not unlike the other workers. Huber supposed that these were reared in cells contiguous to royal cells, and thus received royal food by accident. The fact, as stated by Mr. Quinby, that these occur in colonies where queen-larvæ were never reared, is fatal to the above theory. Langstroth and Berlepsch thought that these bees, while larvæ, were fed, though too sparingly, with the royal aliment, by bees in need of a queen, and hence the accelerated development. The workers, as might be surmised by the importance and variety of their functions, are structurally very peculiar. Their tongues, labial palpi, and maxillæ, are very much elongated, while the former is very hairy, and doubles under the throat when not in use. The length of the ligula enables them to reach into flowers with long tubes, and by the aid of the hairs they lap up the nectar. When the tongue is big with its adhering load of sweet, it is doubled back, enclosed by the labial palpi and maxillæ, and then extended, thus losing its nectar, which at the same time is sucked into the large honey-stomach. The bees, at will, can force the honey back from the honey-stomach, when it is stored in the honey-cells or given to the other bees. The jaws are very strong, without the rudimentary tooth, while the cutting edge is semi-conical, so that when the jaws are closed they form an imperfect cone. Thus these are well formed to cut comb, knead wax, and perform their various functions. Their eyes are like those of the queen, while their wings, like those of the drones, attain the end of the body. These organs as in all insects with rapid flight, are slim and strong, and, by their more or less rapid vibrations, give the variety of tone which characterizes their hum. Thus we have the rapid movements and high pitch of anger, and the slow motion and mellow note of content and joy. On the outside of the posterior tibia and basal tarsus is a cavity, made more deep by its rim of hairs, known as the pollen basket. In these pollen baskets is compacted the pollen, which is gathered by the mouth organs, and carried back to the four anterior legs. Opposite the pollen baskets are regular rows of golden hairs which probably aid in storing and compacting the pollen balls. On the anterior legs of the workers, between the fimur and tibia, is a curious notch, covered by a spur. Some have supposed that it aided bees in reaching deeper down into tubular flowers, others that it was used in scraping off the pollen, and still others have thought that it was to enable bees to hold on when clustering. The first two functions may belong to this, though other honey and pollen-gathering bees do not possess it. The latter function is performed by the claws at the end of the tarsi. The workers, too, possess an organ of defense which they are quick to use if occasion requires. This is not curved as in the queen, but straight. The gland which secretes the poison is double, and the sack in which it is stored, is as large as a flaxseed. The sting proper, is a triple organ consisting of three sharp spears, very smooth and of exquisite polish. The most highly-wrought steel instruments, under a high magnifier, look rough and unfinished, while the parts of the sting show no such inequalities. One of these spears is canaliculate—that is, it forms an imperfect tube—and in this canal work the other two, which fill the vacant space, and thus the three make a complete tube, which connects with the poison sack and pass the poison. The slender spears which work in the tube, are marvelously sharp, and project beyond it when used, and are worked alternately by small but powerful muscles, so they may pass through buckskin, or even through the thick scarfskin of the hand. These are also barbed at the end with teeth, seven of which are prominent, which extend out and back like the barb of a fish-hook. Hence, they cannot be withdrawn, if it penetrates any firm substance, and so when used, it is drawn from the bee, and carries with it a portion of the alimentary canal, thus costing the poor bee its life. The workers hatch from an impregnated egg, which can only come from a queen that has met a drone, and is always laid in the small, horizontal cell. These eggs are in no wise different, so far as we can see, from those which are laid in the drone or queen cells. All are cylindrical and slightly curved, and are fastened by one end to the bottom of the cell, and a little to one side of the centre. As already shown, these are voluntarily fertilized by the queen, as she extrudes them, preparatory to fastening them in the cells. These eggs, though so small—one-sixteenth of an inch long—may be easily seen by holding the comb so that the light will shine into the cells. With experience, they are detected almost at once, but I have often found it quite difficult to make the novice see them, though very plainly visible to my experienced eye. The egg hatches in three days. The larva, incorrectly called grub, maggot—and even caterpillar, by Hunter—is white, footless, and lies coiled up in the cell till near maturity. In six days the cell is capped over by the worker-bees. This cap is composed of pollen and wax so it is darker, more porous, and more easily broken than the caps of the honey-cells; it is also more convex. The larva, now full grown, hav-having lapped up all the food placed before it, surrounds itself with a silken cocoon, so excessively thin that it requires a great number to appreciably reduce the size of the cells. These always remain in the cell after the bees escape, and give to old comb its dark color and great strength. Yet they are so thin, that cells used even for a dozen years, seem to serve as well for brood as when first used. In three days the insects assume the pupa state and in twenty-one days the bee emerges from the cell. The worker-bees never attain a great age. Those reared in autumn may live for eight or nine months, and if in queenless stocks, where little labor is performed, even longer; while those reared in spring will wear out in three, and when most busy, will often die in from thirty to forty-five days. None of these bees survive the year through, so there is a limit to the number which may exist in a colony. The function of the worker-bees is to do all the manual labor of the hives. They secrete the wax, which forms in small pellets under the over-lapping rings, under the abdomen. I have found these wax-scales on both old and young. According to Fritz Müller, the admirable German observer, so long a traveler in South America, the bees of the genus melipona secrete the wax on the back. The young bees build the comb, ventilate the hive, feed the larvæ, and cap the cells. The older bees—for, as readily seen in Italianizing, the young bees do not go forth for the first one or two weeks—gather the honey, collect the pollen, or bee-bread, as it is generally called; bring in the propolis or bee-glue, which is used to close openings, and as a cement, supply the hive with water (?); defend the hive from all improper intrusions; destroy drones when their day of grace is past; kill and arrange for replacing worthless queens; destroy inchoate queens, drones, or even workers, if circumstances demand it, and lead forth a portion of the bees when the conditions impel them to swarm. When there are no young bees, the old bees will act as house-keepers and nurses, which they otherwise refuse to do. The young bees, on the other hand, will not go forth and glean, even though there be no old bees to do this necessary part of bee-duties. An indirect function of all the bees in the hive is to supply animal heat, as the very life of the bees require that the temperature inside the hive be maintained at a rate considerably above freezing. In the chemical process attendant upon nutrition, much heat is generated, which, as first shown by Newport, may be considerably augmented at the pleasure of the bees, by forced respiration. The bees, too, by a rapid vibration of their wings, have a power to ventilate their hives, and thus reduce the temperature, when the weather is hot. Thus they moderate the heat of summer, and temper the cold of winter.

BEET. *Beta vulgaris.* This is the common beet of the garden, a half hardy perennial plant, forming its esculent root the first season and producing its seed the second. The roots which attain their full development the first season, must be cared for before cold weather, since they do not stand actual freezing. In harvesting, care should be taken not to bruise the skin, since it causes the root to bleed and impairs their quality. In topping beets, when they are intended for the table, it is usual to wring off the leaves, and this for the reason that they are supposed to keep better. This, however, is an error, and need only be observed when roots are wanted for seed. When they are raised for making sugar the entire crown is taken off below the marks formed by the leaves, since this portion of the root contains nitre and other salts, inimical to the production of sugar. For home use it is usual to twist off the tops, and to keep them in full perfection over winter the roots should be packed in sand. For use on the table the seed may be sown in the spring as soon as the ground can be worked, this will give early roots for cooking. From the first to the middle of June, another sowing may be made for winter and spring use, since the half grown roots are more succulent and tender than the full grown ones. The beet is produced entirely within the earth, except some of the varieties, as the mangel-wurzel, which are raised for cattle-feeding. The varieties are numerous, the Bassano being one the earliest but of inferior quality; the Bark-skinned, Early Blood Turnip, and Egyptian are the earliest. Wyatt's Dark Crimson is especially fine for long keeping. The improved Long Blood is the sort usually raised for winter, the root being long, tapering, of proper size for slicing, and particularly rich in color and flavor. The varieties of mangel-wurzel usually cultivated for stock-feeding are, the Long Yellow, Red Globe, Yellow Globe, and Cow Horn. The beet has attained its chief importance from its extended cultivation in Europe for the manufacture of sugar. France, Belgium, Germany, Austria and Russia being the largest producers of sugar. It will perhaps be surprising to many to know that one-third of all the sugar produced in the world, is made from beets; yet such is the fact. The sugar produced is fully equal to that made from the sugar cane, and identical in its chemical composition, being really cane sugar, as distinguished from glucose, as the sugar made from the starch of corn, potatoes, etc., is called. The varieties generally cultivated for sugar are the White Silesian or some of its sub-varieties. In Europe, so particular are manufacturers as to the purity and quality of the seed used, that large estates are devoted exclusively to the cultivation of particular varieties pure. In the United States, several attempts have been made in Illinois, Wisconsin, California and Maine, to produce sugar from the beet, but so far the enterprise has not been successful, pecuniarily, principally from the excessive cost of labor. The manufacture of sugar from the beet is a nice process from first to last, requiring the strictest care and manipulation. The attempt made at Chatsworth, Ill., to make beet sugar, was intended to test the matter thoroughly, and a large capital and 2,400 acres of land were devoted to the purpose for ten years. At last, however, the company were obliged to give way before the obstacles presented; first, from the strong nitrous nature of the soil, but principally from the want of water to work the crops, after about $13,000 had been expended in boring for a supply. After the breaking up of the company at Chatsworth the machinery was moved to Freeport, where the water supply was abundant, and the soil supposed to be eminently adapted to the crop. Here, however, the failure was more pronounced than at Chatsworth. In Wisconsin two factories were started and both abandoned. In California the industry is languishing, and in Maine the enterprise has not yet been prosecuted long enough to allow an estimate to be made of its probable success. As showing the importance of the production of sugar from beets, and the relative proportion as between beet and cane sugar, it may be stated that in 1875 the consumption of sugar in the United States was thirty-eight pounds for each individual. In 1876 it was thirty-six pounds. The sugar supply of the world in 1875 was 3,457,623 tons. Forty per cent of this was beet sugar, made in Europe. The production of maple sugar in the United States in that year was 13,000 tons, and of beet sugar and sorghum only 2,000 tons. The production of cane sugar in the United States, (Louisiana) was 95,000 tons. According to the report of the State Agricultural Society of California, the production of beet sugar in California has been as follows: 500,000 pounds of sugar in 1870. In 1871 there were 800,000 pounds made, in 1872 it amounted to 1,125,000, and in 1873 to 1,500,000 pounds. In 1873 the report of beets raised was 10,073 tons, so the yield of sugar may be set down as having been seven per cent., a yield that should afford a handsome profit, if economy and business tact was used in the manufacture. In the latter part of 1880, a company—European and Canadian—are said to have capitalized a large sum, with a view of thoroughly testing the feasibility of beet sugar manufacture in Canada. With cheaper labor than in the United States, and a climate where the pulp may be utilized in feeding stock, it is hoped the project will be successful and profitable.

BEETLE. A heavy wooden maul for driving wedges or other metal implements, when it is not wished to destroy the form of the metal. (See Beetles.)

BEETLES. The common name of the larger coleopterous insects, having hard wing-cases. The late Dr. Le Baron, in his Fourth Entomological Report for the State of Illinois, gives a synopsis of the tribes of the coleoptera, which will be of value to the reader as a means of identification. The tribes of beetles are as follows:

I. Predaceous ground beetles.
II. Predaceous water beetles.
III. Water scavenger beetles.
IV. Land scavenger beetles.
V. Short-winged scavengers.
VI. Stag beetles.
VII. Lamellicorn dung beetles.
VIII. Leaf-chafers.
IX. Saw-horned wood beetles.
X. Aberrant wood beetles.
XI. Soft-winged predaceous beetles.
XII. Parasitic beetles.
XIII. Heteromerous bark beetles.
XIV. Heteromerous ground beetles.
XV. Heteromerous fungus beetles.
XVI. Snout beetles.
XVII. Short-horned wood-borers.
XVIII. Long-horned wood-borers.
XIX. Tetramerous plant beetles.
XX. Trimerous fungus beetles.
XXI. Plant-louse beetles.

The synopsis of the tribes of the coleoptera is as follows:

Tribe I. Tarsi, usually five-jointed, sometimes four or three-jointed in very small species, slender and sparsely haired, except Tribe XI, and except that the interior, or anterior and middle tarsi are sometimes dilated and brush-like beneath in the males. Elytra covering the whole or nearly the whole of the abdomen. Antennæ filiform and simple; outer lobe of maxillæ palpiform, giving the appearance of six palpi. Legs long and fitted for running; hind trochanters large, egg-shaped and prominent; tarsi always five-jointed.

Tribe II. Hind legs flattened and fringed for swimming; trochanters not prominent; the fourth joint of the anterior and middle tarsi sometimes indistinct in very small species.

Tribe III. Antennæ clavate or capitate. Palpi usually very long, sometimes longer than the short antennæ; antennæ six to nine jointed, strongly clavate; middle and hind coxæ dilated; middle and hind tarsi sometimes fringed; habits aquatic.

Tribe IV. Antennæ clavate, but with the club neither pectinate nor lamellate, and nearly or quite filiform in the exceptional group of sub-clavicornes; size small or very small (except Silphidæ).

Tribe V. Elytra much shortened, usually covering less than half of the abdomen; antennæ more or less moniliform.

Tribe VI. Palpi not elongated; antennæ eleven-jointed, rarely ten or nine jointed; coxæ not dilated; habits not aquatic. Club of antennæ pectinate; mandibles usually strongly toothed or even branched; size large or medium.

Tribe VII. Club of antennæ lamellate; size often large; sometimes small, but never very small. Abdomen wholly covered by the elytra (except Copridæ); hind legs set far back.

Tribe VIII. Tip of abdomen exposed; hind legs not set far back.

Tribe IX. Antennæ filiform and usually serrate; outer lobe of maxillæ not palpiform. Prosternum prolonged to a point behind and received in the mesosternum; body very firm; legs short; tarsi always five-jointed; joints not dilated and brush-like beneath, but often furnished with membranous lobes on the under side.

Tribe X. Prosternum not prolonged behind. Body moderately firm; legs more or less elongated; tarsi various.

Tribe XI. Body soft, elytra thin and flexible; tarsi usually somewhat dilated and brush-like beneath, with the fourth joint bilobed; last joint of palpi sometimes dilated.

Tribe XII. Anterior and middle tarsi five-jointed, hind tarsi four-jointed; the joints slender, sparsely haired or spinous, sometimes silky or pubescent beneath, but never dilated, brush-like and bilobed as in the remaining sections; except sometimes the penultimate joint in parts of Tribes XII and XIII. Head as wide as the thorax, and attached to it by a neck; body rather soft and elytra flexible; antennæ filiform sometimes serrate or pectinate; anterior coxæ prominent and contiguous; colors various, and often diversified; larvæ usually parasitic.

Tribe XIII. Head narrower than the thorax, and usually partly inserted in it; body firm; color black or brown, rarely diversified. Antennæ filiform; anterior coxæ somewhat prominent, and nearly or quite contiguous; color mostly brown, sometimes black; larvæ sub-cortical.

Tribe XIV. Antennæ sometimes filiform, but usually more or less clavate; anterior coxæ small, depressed, and never contiguous. Antennæ usually moderately and gradually enlarged towards the tip, but sometimes filiform, and usually as long as the head and thorax; body oblong; color black or dark metallic; larvæ mostly terrestrial.

Tribe XV. Antennæ usually short and perfoliate; body short, oval or subquadrate; color brown, or black with red spots, sometimes metallic; larvæ fungivorous.

Tribe XVI. Tarsi apparently four-jointed, with all the joints, except the last, dilated, brush-like beneath, and with the penultimate joint usually bilobed (except Scolytidæ). Head more or less prolonged into a snout or rostrum; antennæ usually capitate; larvæ fructivorous.

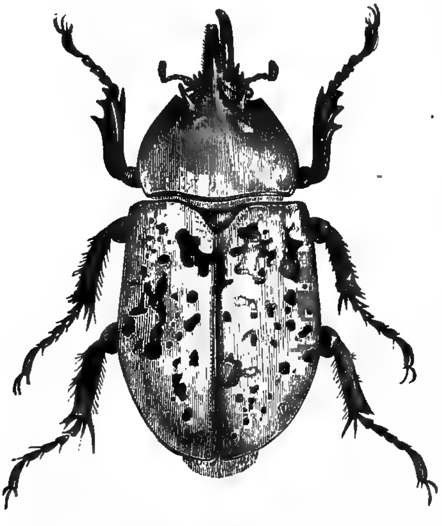
Tribe XVII. Head not prolonged into a snout. Antennæ clavate or capitate; tarsi not dilated; form subcylindrical; size small; color brown or black; larvæ lignivorous.

Tribe XVIII. Antennæ usually filiform or setaceous: sometimes slightly widened towards the tip; tarsi always dilated and brush-like beneath, with the penultimate joint usually bilobed. Form elongated; antennæ almost always long, and filiform or setaceous; often as long as the body or longer; size and colors various; larvæ lignivorous.

Tribe XIX. Form short, and more or less oval; antennæ filiform, or a little thickened towards the end, and never much more than half as large as the body; size below medium or small; colors various; larvæ herbivorous.

Tribe XX. Tarsi usually apparently three-jointed, sometimes four or five-jointed, the joints dilated and brush-like beneath, with the penultimate joint usually deeply bilobed; antennæ usually strongly clavate, rarely sub-clavate. Form oval or oblong; antennæ of moderate length; colors red and black, usually arranged in large spots or stripes; habits fungivorous.

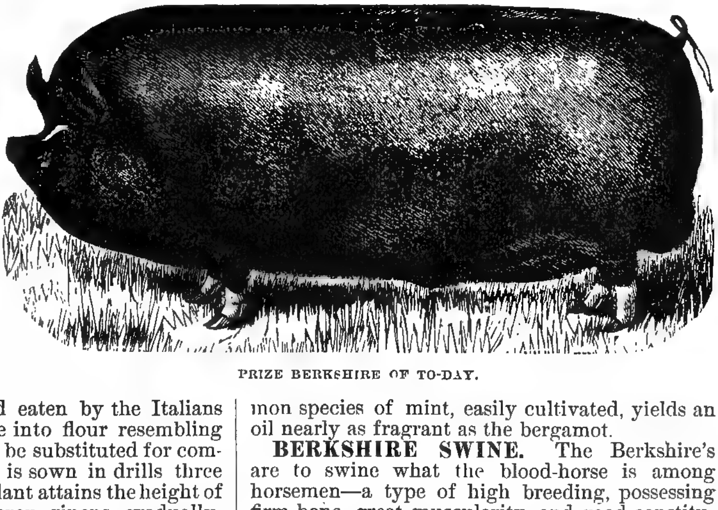
Tribe XXI. Form rounded, or sub-hemispherical; antennæ very short; colors mostly red and black, arranged in dots; habits carnivorous.



As being of interest we give cut showing the largest of our native beetles (*Dynasitis tityus*, Linn.) a species, however, not injurious. (See, also, Insects, Entomology, and articles under proper names of the species noticed, as injurious or beneficial.)

BELLADONNA. The deadly Night-shade, *Atropa belladonna*. It is valuable in medicine as an anodine, antispasmodic and narcotic. Dose for horse or ox, two ounces; sheep, five grains. If the extract is used the dose would be two drachms for the horse, two-thirds of a drachm for the ox, and one-half drachm for a sheep.

BELT. In planting, a strip or portion of land planted with trees for the purpose of ornament, or warmth or shelter. The planting of belts or wind-breaks for protection, is variously estimated by practical men, but there is no doubt of their value in agriculture in the protection of orchards, nurseries, for stock and homesteads.



PRIZE BERKSHIRE OF TO-DAY.

BELVIDERE. Is a small place at the top of a house for a lookout.

BENE. *Sesamum orientale.* An annual plant of the family *Bignoniaceæ.* Successfully cultivated south of Pennsylvania. The seeds abound in oil, are nutritious, and eaten by the Italians roasted, boiled, and made into flour resembling buckwheat. The oil may be substituted for common olive oil. The seed is sown in drills three or four feet apart. The plant attains the height of four or five feet. The crop ripens gradually, and is taken in the early autumn; fifteen to twenty bushels are given per acre, from which forty to fifty gallons of oil may be obtained. Its cultivation is not remunerative in the United States.

BONOT. An old name for a double mouldboard plow.

BENT GRASS. *Agrostis.* A family containing some of our most valuable grasses, as Red Top and White Bent Grass (*Fiorin*), and others not valuable to the agriculturist. The family have decidedly creeping, subterranean stems, and some of them are difficult to exterminate. Yet there are but few plants, however noxious, but will succumb to a summer fallow, followed by a cleanly-kept, hoed crop, and most of the grasses may be subdued by a thoroughly cultivated crop of corn. (See article Grass.)

BENZINE. It should be generally understood that benzine, which is so freely used to remove grease and other stains from clothing, is a very dangerous article. It is distilled from petroleum, and is extremely volatile and inflammable, and if this vapor is mixed with air it becomes explosive. Some people are very careless with it, allowing a vial of this fluid to stand near a fire or a lamp, while its odor prevades the room. This is dangerous, for it takes very little to do mischief. A four-ounce bottle overturned and vaporized, would make the air of a room explosive; and if ignited, might occasion loss of life. Another important fact to know is, that if the vial containing benzine is left uncorked, flame will run to it several feet. Most all the compounds sold by the druggist under fanciful names for the purpose of taking out grease, have benzine for one of their ingredients, therefore anything suspected of containing it, either pure or mixed, should be kept tightly stopped, in a cold place and entirely away from possible contact with flame.

BENZOIC ACID. A vegetable acid found in balsams and some grasses.

BENZOIN. The concrete exudation of the *Styrax benzoin* of the East. It is a resin combined with benzoic acid.

BERGAMOT. *Citrus bergamia.* Cultivated in the South of Europe for the fragrant oil of the rind of its fruit. *Mentha citrata*, a common species of mint, easily cultivated, yields an oil nearly as fragrant as the bergamot.

BERKSHIRE SWINE. The Berkshire's are to swine what the blood-horse is among horsemen—a type of high breeding, possessing firm bone, great muscularity, and good constitution, so far as this may be compatible with high fattening qualities. They are more uniform in color, than any of the white and black breeds. The fashionable color now being white feet, tips of tails, and a little white in the face, the rest of the body being jet black. More than forty years ago, as we then knew and bred them, there were many upon which a sandy color would crop out. They were larger boned and coarser in their make-up, but nevertheless, perhaps, containing more lean flesh (muscle) than at the present day; not so kindly in fattening, neither did they contain so much lard, but their hams, shoulders and bacon were, we think, superior to the more modern Berkshires, or those of to-day. The illustration will show the perfection of Berkshire breeding (fat) as we now see them at our fairs. The best type of this breed of to-day have short noses; slightly dished faces; small, fine, erect ears; eyes wide apart; straight backs, preserving its width from the neck to the rump; muscular hams and shoulders; the bacon pieces well broken with strips of lean, fine hams, short legs, excellent hoofs, and in killing showing but little offal. Their vigor make them excellent gleaners, to follow cattle fattened in the field, and their weight, from 300 to 600 pounds, render them sought after by the packers, especially of hams and bacon. They have been with us always a favorite breed on account of their muscular development, as among the middle breeds, as the Essex have been among the small breeds. It is, however, not to be denied, that they will not stand starving. They require strong feed and plenty of it, to reach the best development, and what animal does not? Nevertheless, we do not think they assimilate, quite so much of their food, when the bulk of it is corn, as do some of the breeds more inclined to lard. Yet, no breed will reach good development on scant food, and when muscle as well as fat is wanted, the breeder or feeder would have to hunt far for a hog better combining all good qualities, and of medium weight.

BERMUDA GRASS. Scutch Grass, *Cynodon dactylon.* One of the most valuable of the grasses in the South. It is not recorded as having seeded in the United States, being an introduced exotic, a native of Africa, introduced into the West Indies and thence to the United States. It is propagated by the root or creeping stems. Planted in squares of from two to three feet apart, it quickly covers the ground. The soil should be put in complete tilth by deep plowing and thorough harrowing, when the best returns are to be expected. It is considered one of the heaviest croppers, and as making hay fully equal to any grass cultivated south of Tennessee. As high as six tons have even been recorded as the product of hay per acre. In the middle States of the South this grass is not of so much value as in the extreme southern States. In the true grass region, stock, other than sheep, prefer the regular pasture grasses to the Bermuda. Its persistent hold on the soil, when it will survive the winter, makes it most valuable for hillsides liable to wash, and for other situations where a tough mass of roots are required to hold the soil together. Its strong, creeping rhizoma root-stalks, tenacity of life even in the hottest weather, and its dense, firm, tough sward, making it almost impossible to be plowed up, has rendered it obnoxious to cotton farmers of the South; yet its value in restoring fertility to worn-out soils should not be overlooked. It is in fact only by cotton farmers that this grass is really dreaded. It delights in a warm, sandy soil, does not like shade, and hence the roots are planted. The weeds should be mown off the first year. (See Grasses for cut.)

BERRY. In botany, a fruit filled with pulp, in which the seeds are imbedded, as the currant and gooseberry; also called *bacca.*

BETEL. The leaf of an acrid narcotic pepper, chewed by the natives of the East Indies.

BETULA. The generic name of the birch family. The *populifolia* (white), *excelsa* (yellow), *rubra* (red). (See Birch.)

BEVEL. An instrument to take angles.

BI. From *bis,* twice; a common chemical prefix to words meaning two or twice, as bi-tartrate, bi-noxide.

BIBULOUS. Absorbent. In chemistry blotting-paper is often termed bibulous paper.

BIENNIAL. This term is usually applied to plants which grow one year and flower the next, after which they perish. Many tender biennials, if sown early in the spring, will flower in autumn and then perish, thus actually becoming annuals; so winter wheat, a biennial, may by cultivation be turned into an annual wheat.

BIESTINGS. First milk of cows after calving.

BIFURCATE. Two-pronged, or forked.

BIGNONIA. A handsome genus of shrubbery climbers. *Bignonia radicans,* the well known trumpet flower, belongs to this class. It is not entirely hardy west of Lake Michigan and north of 40°; south of this line and up to 42° east of Lake Michigan it is one of the most beautiful of perennial climbers.

BIKH. *Aconitum ferox.* A very poisonous Eastern monkhood.

BILABIATE. Two-lipped, or petalled; applied to flowers.

BILBERRY. Whortleberry. (See Cranberry.)

BILE. The secretion of the liver. Any interruption in its production is attended with great lassitude, sickness, fever, and yellowness of the eyes and skin. Moist, marshy places, and food rich in oil, as butter and fat, produce bilious attacks. Fall and spring are the seasons most likely to produce bilious attacks in new countries. Sometimes biliary calculi, or stones, are formed. The composition of the bile is very complex, according to the analyses of some physiologists. Liebig, regarded it as a natural soap, nearly consisting of cholate of soda.

BILL. A hedging knife with a curved point.

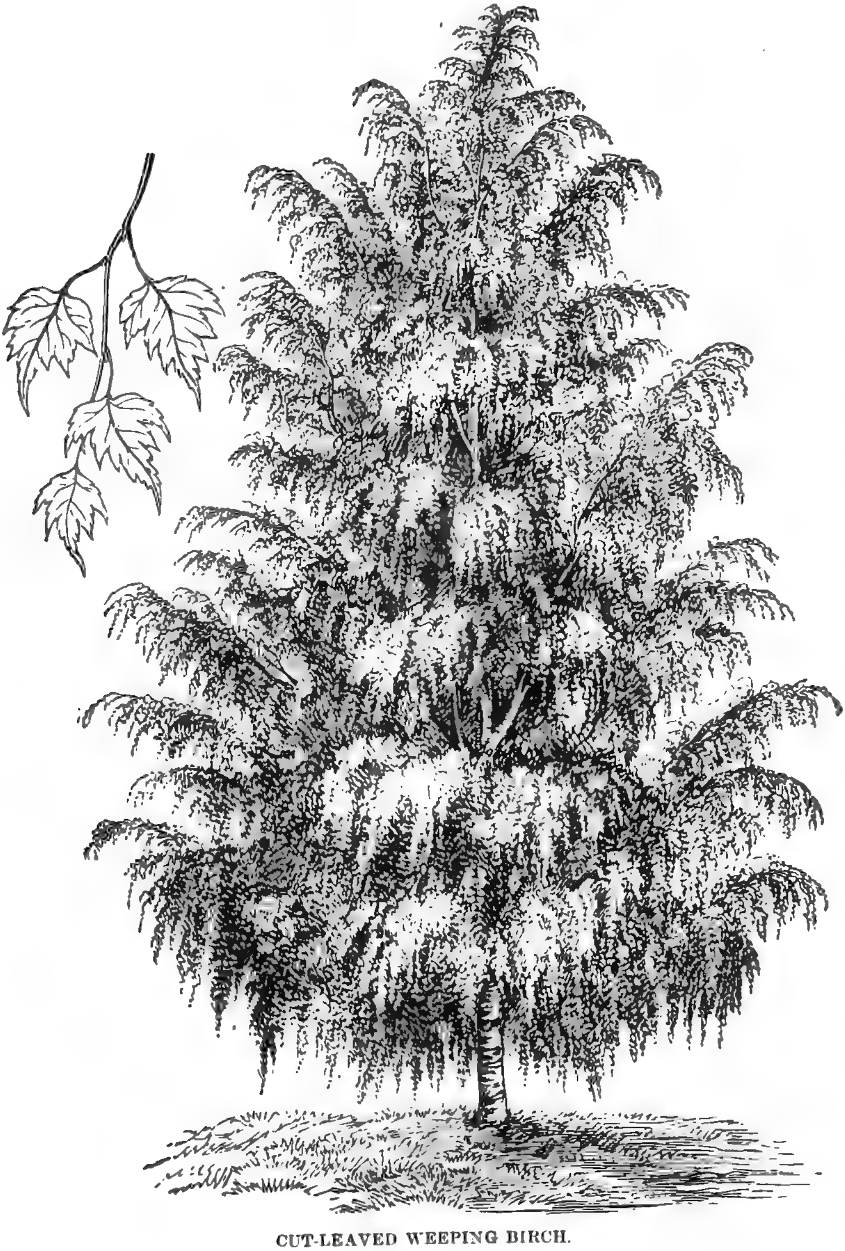
BIND-WEED. A common name for most climbing plants, but especially directed to the convolvulaceous species.

BIOCELLATE. When an insect's wing is marked with two eye-like dots.

BIPINNATE. Leaves that are doubly pinnate; in which the secondary stalks or petals are pinnated.

BIRCH. *Betula.* The birches are mostly natives of northern latitudes, or elevated situations, generally above latitude 40°, and extending well up toward the arctic circle. The foliage is generally thin and light, and the whole tribe are graceful, and some of them elegant. The Black (sweet) or Cherry Birch (*B. lenta*) is one of the handsomest and most valuable for its timber. It is widely distributed from New England West, well up in Canada, and south along the mountain ranges. It grows to a height of sixty or seventy feet, and some trees two to three feet in diameter;

a most excellent fuel and most valuable for cabinet work. It likes a rich soil, such as is suited to the Sugar Maple, and ripens its seed in late autumn. The seeds of all the birches should be kept moist and cold until sown, and thinly covered and moist until they germinate. Red Birch (*B. nigra*), also called River Birch, is found on the banks of rivers, growing to a lofty stature and often two feet in diameter. It is found in the warmest situations of any of the birches, and its wood is similar in quality to the Yellow Birch. The seeds ripen in June and should be sown before they become fully dry. The Yellow Birch (*B. excelsa*) is a handsome-growing tree far north, with a straight trunk, usually found in cool, moist soils. The wood is strong and fine grained and much used for turning, also for furniture. It does well on prairie soils, except dry, sandy or gravelly soils. The Canoe Birch (*B. papyracea*), also called Paper Birch, is found north of 40° and well north in the British possessions where it attains great size. It is most valuable and highly prized for the many uses its bark may be put to; is an ornamental tree, and thrives in most



CUT-LEAVED WEEPING BIRCH.

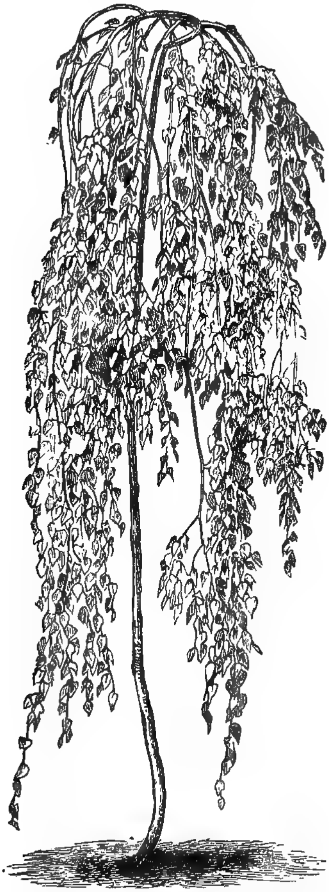
situations, growing rapidly. The seeds ripen in July and should be sown immediately. The White Birch (*B. populifolia*) is a small tree, but ornamental, growing in waste barren soils. The European White Birch is often planted for ornament, and thrives in the most barren soil. Some of the cut-leaved varieties are highly ornamental. The Cut-leaved Weeping Birch, of which we give an illustration, being among the handsomest. The birches have been sung by many poets. Coleridge calls it—

> "—most beautiful
> Of forest trees,—the lady of the wood."

Bryant says:

> " The fragrant birch above him hung
> Her tassels in the sky,
> And many a vernal blossom sprung,
> And nodded careless by."

The following are varieties of the birch family (the alders belonging to this group) not mentioned above. Western Birch (*Betula occidentalis*), Rocky mountains. This species is a small tree, rarely over twenty-five feet high and six inches in diameter. It is found in the Rocky mountains, along streams in Colorado, Utah, etc. Speckled Alder (*Alnus incana*), northeastern United States. It is a shrub, or very small tree, growing along streams in New England, New York, and northward, and of no particular value. California Alder (*Alnus rhombifolia*), California. Oregon Alder (*Alnus Oregona*), California and Oregon, quite often become large trees, sixty to eighty feet high, with trunks two feet in diameter. We give herewith a cut of a lovely weeping birch. This is a variety of the white birch, first exhibited at the Paris Exposition in 1867, and must be grafted on another stock. The branches, as will be seen, run directly parallel with the stem, and directly to the ground; and its unique habit, elegant form and beautiful foliage, renders its name decidedly appropriate, and one of the prettiest objects for a small lawn.



WHITE PENDULOUS BIRCH.

BIRD-LIME. A glutinous vegetable product prepared by first boiling mistletoe berries in water until they break, then pounding them in a mortar, and washing away the husky refuse with other portions of water; and made also from the middle bark of the holly. The bark is stripped in June or July, and boiled for six or eight hours in water, until it becomes tender; the water is then separated from it, and it is left to ferment for two or three weeks, until it becomes a mucilage, which is pounded in a mortar into a mass, and then thoroughly rubbed by the hands in running water till all the fibrous matters and other impurities are washed away; the bird-lime is then suffered to remain fermenting by itself in an earthen vessel, in a soft heat, for some weeks. The bark of the Wayfaring Tree is sometimes employed. The fragrant gum which exudes from the Styrax, or American Sweet Gum—a large tree, growing in the middle and southern States—also makes a good bird-lime, being extremely tenacious. It is also made chemically.

BIRD PEPPER. A species of *capsicum* which affords the best Cayenne pepper. Started in a hot bed in March, any of the capsicum family may be cultivated up to 44° north, and still farther northward in favored localities.

BIRDS. The feathered tribes are among the most highly organized of created beings except man, possessing, as so many of them do, either elegance of plumage, great vivacity, or fine vocal powers. The increased prevalence of insect life in all thickly settled countries, is due, in a measure, to the indiscriminate destruction of birds and insect-eating animals. The objection from pomologists, that they also eat fruit, although well founded as to the thrush family and some others, is no argument against the wholesale destruction of birds, especially in breeding time. To the farmer birds do not labor under the same objection. The moiety of grain they consume being too insignificant to be weighed for a moment against the good they accomplish. As against the thrush family, which in Illinois for instance, comprises nine species, viz: the Robin, the Cat-bird, the Brown Thrush, the Wood Thrush, the Hermit Thrush, Swainson's Thrush, the Alice Thrush, the Mocking Bird and Wilson's Thrush or the Wren, from the fact that the thrush tribe, the Robin and Brown Thrush especially, prey largely on predaceous beetles, or those insects whose food is other insects, we must consider carefully whether the injury done in eating predaceous beetles is more than counterbalanced by the good accomplished in eating insects injurious to vegetation. During the nesting season there is no doubt as to the benefits accomplished by insect-eating birds. The careful investigations of Prof. Forbes, director of the Illinois State Department of Natural History, would seem to cast a strong doubt on the fact that the thrush family is beneficial to fruit growers. Nevertheless, taking singing birds as a whole, when they are driven away insect life does increase unduly. Prof. Forbes seems to be of the opinion, from his examinations, that at least the good accomplished by the birds is not unmixed with evil, and acknowledges that the experiments must be continued much longer to be able to arrive at any accurate conclusion. It must be borne in mind, also, that the food of the young birds is almost exclusively insect. Prof. Treadwell, of Cambridge, was obliged to feed young Robins their weight in insects every day, to keep them from starving to death. Thomas M. Bremer, M.D., an eminent ornothologist of Boston, Mass., in a paper read in 1879, mentions as one of the prominent causes of the increase of insects in Europe, to be the wholesale killing of birds. The great Frederick of Prussia once nearly exterminated the sparrows in his kingdom, in a fit of royal wrath, because they took agrarian liberties with his fruit; and what was the consequence? The caterpillars, which the sparrows had kept in check, having no one now to prevent their increase, multiplied at such a fearful rate that they swept before them the foliage, and with the foliage all the fruit also. It is said that for two years not a cherry, apple, peach, plum, currant or any kind of fruit could be raised in any portion of the kingdom. Sensible at last of his mistake, this great king, conquered for the first time, in a field where his impotence was but too apparent, yielded to the necessity, and expended more money in reintroducing the sparrow than he had wasted in destroying them, but only after a loss to his subjects of a million of dollars. It has been ascertained that one pair of jays will feed its young on half a million of caterpillars in a season, and that each bird will destroy, during the winter, eggs that in the following spring would have hatched into at least a million or more of the larvæ. Our blue-jays would do the same if we would let them and not persecute them. Their favorite food is the egg of our apple tree, or tent-caterpillar, and for their young the larva of this same insect is also their choice. A pair of blue-jays in an orchard have cleared it so effectually of every caterpillar in a single season, that not one single insect could be found. This is not merely theory, but absolute fact, demonstrated by the careful investigation of the venerable Dr. Kirtland, of Cleveland. So completely did his carefully protected jay extirpate these pests from the lake shore of that part of Ohio, that absolutely not a single individual specimen could be found for miles around Cleveland. The investigations of M. Prevost, acting for the French government, demonstrated that those birds generally regarded as being insect-eaters, are not as a rule the most beneficial; but that for the most part, the birds which render the greatest service are those against which the popular predjudices are strongest. Thus the sparrows, the starling and crows are the great destroyers of the cockchafers, and so our crows and black-birds are of the May-beetles, and we are but just finding out that many birds we have deemed to be our enemies are really our best friends. Another important law of nature revealed by M. Prevost's investigation is of especial interest. This is, that nearly all birds, during the period of reproduction, whatever may be their natural food at other times, are almost entirely insect-eaters, and that they feed their young almost exclusively with insect food. Then the amount of insect food a young bird will consume is enormous. Dr. Wyman took from the crop of a young pigeon a mass of canker-worms that was more than twice the weight of the bird itself. Charles V. Riley, Ph. D., Chief of the United States Entomological Commission, in his report upon the subject of usefulness of birds, following some experiments in feeding two plovers with grasshoppers and other insects, under which they consumed 1,616 insects, says: At this rate twenty old plovers would eat 3,000 insects each day. or 90,000 in a month. And suppose, further, that these twenty plovers had ten nests, which averaged four young ones each. At sixty insects each day for each young plover, the forty would consume 2,400 every twenty-four hours, or 72,000 a month. The twenty plovers and their progeny together, would consume 162,000 insects each month. At this same rate 1,000 plovers and their young would consume in one month 8,100,000 insects. That many locusts removed in one year from a farm of 160 acres would probably render it capable of producing crops even when these insects are doing their worst. As there are many birds that eat more insects than do the plovers, as well as many that eat less, 150 insects a day is probably a fair average for all insectivorous birds. The prairie chicken (Grouse) has been ruthlessly destroyed by farmers, under the supposition that they destroy large quantities of grain. Such, however, is not the fact. The losses from the eating of the grain before harvest time is quite insignificant in proportion to the good these birds accomplish. Their food in summer is almost wholly insects, and in winter they eat the seeds of weeds, to far more than compensate for the little corn they destroy in the fields, as the following from Dr. Riley, will show: Four prairie chickens were examined. The contents of the first were one grain of corn, five grains of wheat, thirty-eight seeds of polygonums (mostly *P. amphibium*), seven seeds of cassia, and thirteen of sunflowers, and seventeen not identified. The contents of the second were fourteen seeds of polygonums, thirty-one of sunflowers, three of cassia, eleven of verbenas (wild), four euphorbias and 113 wild rose seeds. The contents of the third were thirteen seeds of cassia, twenty-nine of wild roses, twelve seeds of polygonums, two grains of wheat, one grain of barley, and thirty-four not identified. The fourth chicken had in its stomach fifteen seeds of the gentians, thirty-three of rag-weeds, three of wild roses, four of euphorbias, and twenty-nine minute seeds not identified. Of the eight quail examined during the same month, only one had a few grains of wheat in its stomach. All the rest were filled with grass-seed and the seed of weeds, principally the latter. Those examined in the winter of 1875 gave the same average results. The following are among the more common of the insect-eating birds of the prairies and groves of the West:

ORDER PASSERES: Perchers. SUB-ORDER OSCINES: Singing birds. FAMILY TURDÆ: Thrushes. Robin (*Turdus migratorius*); Wood thrush (*T. Mustelinus*); Hermit Thrush (*T. pallasi*); Olive-backed Thrush (*T. Swainsoni*); Wilson's Thrush, Tawny Thrush (*T. fuscescens*);

Mocking-bird (*Mimus polyglottus*); Catbird (*M. Carolinensis*); Sandy Mocking-bird; Thrasher (*Harporhynchus rufus*); Eastern Bluebird (*Sialia sialis*).

FAMILY SAXICOLIDÆ: Stone Chats. Rocky Mountain Bluebird (*Sialia arctica*).

FAMILY SYLVIDÆ: Sylvias. Ruby-crowned Kinglet (*Regulus calendula*); Golden Crested Kinglet (*Regulus satrapa*).

FAMILY CINCLIDÆ: Dippers. Water Ouzels, Western Bluebird, (*Cinclus Mexicanus*); Blue-gray Gnat-catcher (*Polioptila cærulea*).

FAMILY PARIDÆ: Titmice. Tufted Titmouse (*Lophophanes bicolor*); Plain-crested Titmouse (*L. inornatus*); Long-tailed Chickadee (*Parus atricapillus septentrionalis*).

FAMILY SITTIDÆ: Nuthatches. Slender-billed Nuthatch (*Sitta Carolinensis aculeata*); Red-bellied Nuthatch (*S. Canadensis*).

FAMILY CERTHIIDÆ: Creepers. Brown Creeper (*Certhia familiaris*).

FAMILY TROGLODYTIDÆ: Wrens. Rock Wren (*Salpinctes obsoletus*); Great Carolina Wren (*Thryothorus Ludovicianus*); Bewick's Wren (*T. Bewicki*); House Wren (*T. ædon*); Western House Wren (*T. ædon*); Water Wren (*Anorthura troglodytes hyemalis*); Long-billed Marsh Wren (*Telmatodytes palustris*); Short-billed Marsh Wren (*Cistothorus stellaris*).

FAMILY ALAUDIDÆ: Larks. Horned Lark, Shore Lark (*Eremophila alpestris*).

FAMILY MOTACILLIDÆ: Wagtails. Titlark, Pipit, Wagtail (*Anthus Ludovicianus*).

FAMILY SYLVICOLIDÆ: American Warblers. Black-and-White Creeping Warbler (*Mniotilta varia*); Blue Yellow-backed Warbler (*Parula Americana*); Prothonotary Warbler (*Protonotaria citrea*); Worm-eating Warbler (*Helmitherus vermivorus*); Blue-winged Yellow Warbler (*Helminthophaga pinus*); Blue Golden-winged Warbler (*H. chrysoptera*); Nashville Warbler (*H. ruficapilla*); Virginia's Warbler (*H. Virginiæ*); Tennessee Warbler (*H. peregrina*); Blue-eyed Yellow Warbler, Golden Warbler, Summer Warbler (*Dendroica æstiva*); Black-throated Green Warbler (*D. virens*); Black-throated Green Warbler (*D. cærulescens*); Cerulean Warbler (*D. cærulea*); Yellow-rump Warbler (*D. coronata*); Blackburnian Warbler (*D. Blackburniæ*); Black-poll Warbler (*D. striata*); Bay-breasted Warbler (*D. castanea*); Chestnut-sided Warbler (*D. Pennsylvanica*); Black-and-Yellow Warbler (*D. maculosa*); Prairie Warbler (*D. discolor*); Yellow-throated Warbler (*D. dominica*); Yellow Redpoll Warbler (*D. palmarum*); Pine-creeping Warbler (*D. pinus*); Golden-crowned Thrush, Orange-crowned Accentor (*Seiurus aurocapillus*); Water Thrush (*S. nævius*); Large-billed Water Thrush (*S. motacilla*); Kentucky Warbler (*Oporornis formosa*); Maryland Yellow-throat (*Geothlypis trichas*); Mourning Warbler (*G. Philadelphia*); Macgillivray's Warbler (*G. Macgillivrayi*); Yellow-breasted Chat (*Icteria virides*); Hooded Fly-catching Warbler (*Myiodioctes mitratus*); Wilson's Green Black-capped Fly-catching Warbler (*M. pusillus*); Canadian Fly-catching Warbler (*M. Canadensis*); Redstart (*Setophaga ruticilla*).

FAMILY TANAGRIDÆ: Tanagers. Scarlet Tanager (*Pyranga rubra*); Summer Redbird (*P. æstiva*); Louisiana Tanager (*P. Ludoviciana*).

FAMILY HIRUNDINIDÆ: Swallows. American Barn Swallow (*Hirundoe rythrogastra*); White-bellied Swallow (*Tachycineta bicolor*); Violet-green Swallow (*T. thalassina*); Cliff Swallow, Eave Swallow (*Petrochelidon lunifrons*); Bank Swallow (*Cotyle riparia*); Rough-winged Swallow (*Stelgidopteryx serripennis*); Purple Martin (*Progne purpurea*).

FAMILY AMPELIDÆ: Waxwings. Bohemian Waxwing (*Ampelis garrulus*); Cedar-bird, Cherry-bird, Carolina Waxwing (*A. cedrorum*); Townsend's Fly-catching Thrush (*Myiadestes Townsendi*).

FAMILY VIREONIDÆ: Greenlets. Red-eyed Vireo (*Vireo olivaceus*); Brotherly-love Vireo (*V. Philadelphicus*); Warbling Vireo (*V. gilvus*); Yellow-throated Vireo (*V. flavifrons*); Blue-headed or Solitary Vireo (*V. solitarius*); White-eyed Vireo (*V. Noveboracensis*); Bell's Vireo (*V. belli*).

FAMILY LANIIDÆ: Shrikes. Butcher-bird, Northern Shrike (*Collurio borealis*); White-rumped Shrike (*C. Ludovicianus excufitorides*).

FAMILY FRINGILLIDÆ: Finches, etc. Evening Grosbeak (*Hesperiphona vespertina*); Pine Grosbeak (*Pinicola enucleator*); Purple Finch (*Carpodacus purpureus*); Gray-crowned Finch (*Leucosticte tephrocotis*); Red-poll Linnet (*Ægiothus linaria*); American Goldfinch, Thistle-bird, Yellow-bird (*Chrysomitris tristis*); Snow-bunting, Snowflake (*Plectrophanes nivalis*); Lapland Longspur (*P. Lapponicus*); Chestnut-collared Bunting, Black-bellied Longspur (*P. ornatus*); Maccown's Bunting (*P. Maccowni*); Bay-winged Bunting, Grass Finch (*Poœcetes gramineus*); Yellow-winged Sparrow (*Coturniculus passerinus*); Henslow's Bunting (*C. Henslowi*); Lincoln's Sparrow (*Melospiza Lincolni*); Song Sparrow (*M. melodia*); Eastern Snowbird (*Junco hyemalis*); Canadian or Tree Sparrow (*Spizella monticola*); Chipping Sparrow (*S. socialis*); Clay-colored Sparrow (*S. pallida*); White-throated Sparrow (*Zonotrichia albicollis*); White-crowned Sparrow (*Z. leucophrys*); Harris' Sparrow (*Z. querula*); Lark Finch (*Chondestes grammica*); Lark Bunting (*Calamospiza bicolor*); Black-throated Bunting (*Euspiza Americana*); Rose-breasted Grosbeak (*Goniaphea Ludoviciana*); Black-headed Grosbeak (*G. melanocephala*); Blue Grosbeak (*G. cærulea*); Indigo-bird (*Cyanospiza cyanea*); Cardinal Grosbeak, Virginian Redbird (*Cardinalis Virginianus*); Ground Robin, Marsh Robin, Towee Bunting, Chewink (*Pipilo erythrophthalmus*).

FAMILY ICTERIDÆ: American Starlings. Bobolink, Reed-bird, Rice-bird (*Dolichonyx oryzivorus*); Cow-bird, Cow-blackbird (*Molothrus ater*); Red-winged Blackbird (*Agelæus phœniceus*); Yellow-headed Blackbird (*Xanthocephalus icterocephalus*); Meadow-lark, Field-lark (*Sturnella magna*); Orchard Oriole, Chestnut Hangnest (*Icterus spurius*); Baltimore Oriole, Golden Robin, Hangnest (*I. Baltimore*); Bullock's Oriole (*I. Bullocki*); Rusty Grackle (*Scolecophagus ferrugineus*); Blue-headed Grackle, Brewer's Blackbird (*S. cyanscephalus*); Purple Grackle, Crow-blackbird (*Quiscalus purpureus*).

FAMILY CORVIDÆ: Crows, etc. Raven (*Corvus corax*); White-necked Raven (*C. cryptoleucus*); Common Crow (*C. Americanus*); Clarke's Crow, American Nutcracker (*Picicorvus Columbianus*); American Magpie (*Pica melanoleuca Hudsonica*); Blue Jay (*Cyanurus cristatus*).

SUB-ORDER CLAMATORES. FAMILY TYRANNIDÆ: American Fly-catcher, Kingbird, Bee-martin (*Tyrannus Carolinensis*); Arkansas Fly-catcher (*T. verticalis*); Great Crested Fly-catcher (*Myiarchus crinitus*); Say's Fly-catcher (*Sayornis sayus*); Pewit Fly-catcher, Phœbe Bird (*S. fuscus*); Olive-sided Fly-catcher (*Contopus borealis*); Wood Pewee (*C. virens*); Western Wood Pewee (*C. Richardsoni*); Traill's Fly-catcher (*Empidonax Trailli*); Least Fly-catcher (*E. minimus*); Yellow-bellied Fly-catcher (*E. flaviventris*).

ORDER PICARIÆ: Picarian Birds. SUB-ORDER CYPSELI: Cypseliform birds. FAMILY CAPRIMULGIDÆ: Goat-suckers. Whip-poor-will (*Antrostomus vociferus*); Whip-poor-will (*A. vociferus*); Nuttall's Whip-poor-will (*A. Nuttali*); Night-hawk, Bull-bat, Pisk (*Chordeiles Virginianus*).

FAMILY CYPSELIDÆ: Swifts. Chimney Swift, Chimney Swallow (*Chætura pelagica*).

FAMILY TROCHILIDÆ: Humming-birds. Ruby-throated Humming-bird (*Trochilus colubris*).

FAMILY ALCEDINIDÆ: Kingfishers. Belted Kingfisher (*Ceryle alcyon*); Black-billed Cuckoo (*Coccygus erythrophthalmus*); Yellow-billed Cuckoo (*C. Americanus*).

FAMILY PICIDÆ: Woodpeckers. Hairy Woodpecker (*Picus villosus*); Downy Woodpecker (*P. pubescens*); Yellow-bellied Woodpecker (*Sphyrapicus varius*); Red-bellied Woodpecker (*Centurus Carolinus*); Red-headed Woodpecker (*Melanerpes erythrocephalus*); Golden-winged Woodpecker, Flicker (*Colaptes auratus*); Red-shafted Woodpecker. Mexican Flicker (*C. Mexicanus*).

ORDER RAPTORES: Birds of Prey. FAMILY STRIGIDÆ: Owls. American Barn Owl (*Strix flammea Americana*); Great Horned Owl (*Bubo Virginianus*); Red Owl, Mottled Owl, Screech Owl (*Scops asio*); American Long-eared Owl (*Otus vulgaris Wilsonianus*); Short-eared Owl (*Brachyotus palustris*); Barred Owl (*Syrnium nebulosum*); Great White or Snowy Owl (*Nyctea scandiaca*); Burrowing Owl (*Speotyto cunicularia hypogæa*).

FAMILY FALCONIDÆ: Diurnal birds of Prey. Marsh Hawk, Harrier (*Circus cyaneus Hudsonius*); Swallow-tailed Kite (*Elanoides forficatus*); Pigeon Hawk (*Accipiter fuscus*); Cooper's Hawk, Chicken Hawk (*A. Cooperi*); The American Goshawk (*Astur atricappillus*); American Lanier or Prairie Falcon (*Falco Mexicanus polyagrus*); Peregrine Falcon, Duck Hawk (*F. communis*); American Merlin (*F. Columbarius Richardsoni*); Sparrow Hawk (*F. sparverius*); Red-tailed Buzzard, Hen Hawk (*Buteo borealis*); Swainson's Buzzard (*B. Swainsoni*); American Rough-legged Hawk (*Archibuteo lagopus sancti-Johannis*); Ferrugineous Buzzard, California Squirrel Hawk (*A. ferrugineus*).

ORDER COLUMBIDÆ: Pigeons, etc. FAMILY COLUMBIDÆ: Pigeons. Wild Pigeons, Passenger Pigeon (*Ectopistes macrura*); Carolina Dove, Common Dove (*Zenædura Carolinensis*.)

ORDER GALLINÆ: Gallinaceous birds. FAMILY MELEAGRIDIDÆ: Turkeys. Common Wild Turkey (*Meleagris gallopavo Americana*).

FAMILY TETRAONIDÆ: The Grouse, etc. SUB-FAMILY TETRAONINÆ: Grouse. Sage Cock, Cock of the Plains (*Centrocercus urophasianus*); Southern Sharp-tailed Grouse (*Pediœcetes phasianellus Columbianus*); Pinnated Grouse, Prairie Hen (*Cupidonia cupido*); Ruffed Grouse (*Bonasa umbellus*).

SUB-FAMILY ODONTOPHORINÆ: American Partridges.

Virginia Partridge or Quail, Bob White (*Ortyx Virginiana*).

ORDER GRALLATORES: Wading birds. Sub-order Limicolæ: Shore birds. Family Charadriidæ: Plover. Sub-family Charadriinæ: True Plover, Black-bellied Plover (*Squatarola Helvetica*); American Golden Plover (*Charadrius fulvus Virginicus*); Killdeer Plover (*Ægialitis vocifera*); Semipalmated or Ring Plover (*Æ. semipalmata*); Piping Plover, Ring Plover (*Æ. meloda circumcincta*); Mountain Plover (*Eudromias Montanus*).

Family Recurvirostridæ: Avocets. Avocet (*Recurvirostra Americana*).

Family Phalaropodidæ: Phalaropes. Wilson's Phalarope (*Steganopus Wilsoni*).

Family Scolopacidæ: Snipes, etc. American Woodcock (*Philohela minor*); American Snipe, Wilson's Snipe (*Gallinago Wilsoni*); Red-breasted Snipe, Gray Snipe (*Macrorhamphus griseus*); Semipalmated Sandpiper (*Ereunetes pusillus*); Least Sandpiper (*Tringa minutilla*); Baird's Sandpiper (*T. Bairdi*); Bonaparte's Sandpiper, White-rumped Sandpiper (*T. fuscicollis*); Red-breasted Sandpiper, Robin Snipe (*T. canutus*); Great Marbled Godwit (*Limosa fedoa*); Greater Telltale, Tattler (*Totanus melanoleucus*); Lesser Telltale, Lesser Yellowshanks (*T. flavipes*); Solitary Tattler, Wood Tattler (*T. solitarius*); Spotted Sandpiper (*Tringoides macularius*); Bartramian Sandpiper or Tattler, Upland Plover (*Actiturus Bartramius*); Buff-breasted Sandpiper (*Tryngites rufescens*); Long-billed Curlew (*Numenius longirostris*); Hudsonian Curlew (*N. Hudsonicus*); Esquimaux Curlew (*N. borealis*).

Sub-order Herodionæ: Herons and their Allies. Family Ardeidæ: Herons. Great Blue Heron (*Ardea Herodias*); Great White Egret, White Heron (*Herodias egretta*); Little White Egret, Snowy Heron (*Gazzetta Candidissima*); American Bittern (*Botaurus minor*).

Sub-order Alectorides: Cranes, Rails, etc. Family Gruidæ: Cranes. White or Whooping Crane (*Grus Americana*); Sandhill Crane (*G. Canadensis*).

Family Rallidæ: Rails. King Rail, Fresh-water Marsh Hen (*Rallus elegans*); Carolina Rail, Ortolan (*Porzana Carolina*): Little Black Rail (*P. Jamaicensis*); Florida Gallinule (*Gallinula galeata*); American Coot, Mud Hen (*Fulica Americana*).

ORDER LAMELLIROSTRES: Anserine birds. Family Anatidæ: Swans, Geese and Ducks. Trumpeter Swan (*Cygnus buccinator*); Snow Goose, White Brant (*Anser hyperboreus*); Canada Goose, Common Wild Goose (*Branta Canadensis*); Mallard (*Anas Boschas*); Dusky Duck, Black Duck (*A. obscura*); Pintail, Sprigtail (*Dafila acuta*); Green-winged Teal (*Querquedula Carolinensis*); Blue-winged Teal (*Q. discors*); Shoveller, Spoonbill Duck (*Spatula clypeata*); Summer Duck, Wood Duck (*Aix sponsa*); Butter-ball, Dipper, Spirit Duck (*Bucephala albeola*); Ruddy Duck (*Erismatura rubida*).

ORDER STEGANOPODES: Totipalmate birds. Family Pelecanidæ: Pelicans. White Pelican (*Pelecanus trachyrhynchus*).

ORDER LONGIPENNES: Long-winged Swimmers. Family Laridæ: The Pomarine Jeager (*Stercorarius pomatorhinus*); Great Black-backed Gull (*Larus marinus*); Herring Gull (*Larus argentatus*); Ring-billed Gull (*L. Delawarensis*); Franklin's Rosy Gull (*Chrœcocephalus Franklini*); Forster's Tern (*Sterna Forsteri*); Arctic Tern (*S. macrura*); Least Tern (*S. superciliaris antillarum*); Black Tern (*Hydrochelidon lariformis*).

ORDER PYGOPODES: Diving birds. Family Podicipidæ: Grebes. American Eared Grebe (*Podiceps auritus Californicus*).

BIRD'S-FOOT TREFOIL. A European plant of the lotus family, a small, clover-like plant, growing in pastures. It has the power of preserving its verdure in extreme hot weather. The lotus, in its varieties, is inferior to red clover, with the exception of *L. villosus*, which is cultivated in some portions of Europe, especially in France, on light soils. The plant may possibly possess some value in California, and other sections subject to extreme heat and drought. Elsewhere it would be inferior to the true clovers and grasses.

BISEXUAL. In plants, having stamens and pistils in the same flower; now termed hermaphrodite.

BISHOPING. A cant word for disguising the age of a horse; from the name of the scoundrel who invented it. It is performed by filing the teeth of an old horse, burning the cups or corrugations black, to give them a resemblance to the teeth of a young horse.

BISON. The American bison (*Bos Americanus*) once roamed over nearly the whole of the North American continent from latitude 33° to 64°. It is fast disappearing, and is now confined to the Far West and the gorges of the Rocky mountains, ranging from Slave lake in the British possessions to Southern New Mexico. The bison has been repeatedly domesticated, and easily becomes tractable. The flesh has been much extolled by plainsmen, but really is inferior to beef, except the hump, which is rich, tender, and of fine flavor. The flesh bears the same relation to beef that venison does to mutton, and the only use in domestication of the animal would be to furnish another to the list of flesh foods and agricultural products. In its osteology—bony system—it differs from the ox species in every part of the world, having fifteen ribs on a side, while the ox has only thirteen. One of the principal values of the buffalo is in the hide, from which buffalo robes are made. In winter his body is covered with long, coarse hair, mixed with much woolly and finer hair. The hair of the forehead is often more than a foot long. The fleece of a single animal has been found to weigh, sometimes, as much as eight pounds. This the Indians work into cloth, gloves, leggings, etc. A full grown buffalo will weigh from 1,200 to 2,000 pounds. Instances have been cited of greater weights. He can withstand great extremes of heat and cold, and has fleetness, vigor of constitution and muscular strength far superior to that of the ox. As a beast of draft and burthen suited to the arid plains of the West, if he could be rendered perfectly tractable, this animal might perhaps become as profitable in some cases there as the camel is in the desert. American enterprise, however, builds railroads almost in advance of civilization, and hence the buffalo will probably never be used for this purpose. Before the present generation of men pass away, it is more than probable the buffalo will become practically extinct in North America. The buffalo has been crossed in a number of instances upon the common cow, and is entirely fertile therewith. We knew of no instance where the experiment has been fully carried out with a view of ascertaining the subsequent and continued fertility of the progeny, nor of their adaptation to the production of economical food, or as beasts of burthen or draft, though the extraordinary journeys they perform, and the distance they will travel in a day, show their powers of endurance to be nearly equal, if not fully equal, to that of horses, when kept only on grass.

BISTORT. *Polygonum bistorta.* An acrid plant when fresh; of the knot-weed family.

BISULCATE. With two fissures; also two-hoofed, as in cattle.

BIT. The iron part of the bridle which goes into the mouth and serves to guide the animal.

BITTER ALMOND. A variety of the almond of a bitter taste.

BITTER DOCK. (See Dock.)

BITTERNS. The residue in evaporating saline water for the salt. It contains sulphate of magnesia and chloride of magnesia, as well as small quantities of soda, potash and bromides. It is used to take up superabundant moisture in fruit-preserving and other houses, where low temperature and dry air is required.

BITTER SWEET. An extensive genus (*Solanum*), the berries of which, of a red and dark color are considered to be poisonous.

BITUMEN. A mineral pitch. Several varieties, as petroleum, asphaltum, mineral tar, and naphtha, are distinguished; the tar of gas works is bitumen.

BIXA. The genus yielding the *B. orellana*, or annotto. (See Dairying.)

BLACKBERRY. *Rubus*. The common erect blackberry (*R. villosus*) and *R. trivialis*, or dewberry, are those generally planted; the latter, however, but seldom. The upright varieties delight in a rather compact soil and are found wild in glades of the forest, shaded banks, openings, and the edges of groves. Of late years its cultivation has become quite extended for market, and it may now be found plentifully, in season, in all our principal city and village markets. It has a wide range, extending even to 45° north, and south nearly to the Gulf of Mexico, on favorable situations. The root is astringent and is used in cases of diarrhœa. The varieties adapted to general cultivation in various parts of the United States are, Kittatinny, Lawton, Wilson and Snyder. Of the list the last named is being generally adopted in the northwest on account of its bearing qualities and hardiness. The distance apart at which to plant the bushes is from five to six feet between the rows and about four feet in the rows. If the rows are six feet apart, the plant may be three and one-half feet apart in the row.

BLACKBERRY WINE. (See Gallizing.)

BLACK CATTLE. The Highland cattle of Scotland of which the West Highlanders may be considered the modern type, used to be designated as Black Cattle and also as Kyloes, from the ferries they were obliged to cross in being driven to market. The word Kyloe is thought perhaps to be a corruption of the Gælic word, signifying highland, and pronounced *kael*. They are well adapted to take care of themselves on the bleak hills of Scotland, and the outlying islands, and, when mature, fatten easily and kindly. Their beef is considered the finest which reaches the London market. We believe they have never been imported into the United States with a view of introducing the breed. They are described by Youatt as follows: The Highland bull should be black, the head not large, the ears thin, the muzzle fine, and rather turned up. He should be broad in the face, the eyes prominent, and the countenance calm and placid. The horns should taper finely to a point, and neither drooping too much nor rising too high; should be of a waxy color, and widely set on at the roots. The neck should be fine, particularly where it joins the head, and rising with a gentle curve from the shoulder. The breast (*brisket*) wide, and projecting well before the legs. The shoulder broad at the top, and the chine so full as to leave but little hollow behind them (that is, the crops are full). The girth behind the shoulder deep; the back straight, wide, muscular and flat; the ribs broad, the space between them and the hips well ribbed home; the belly not sinking low in the middle; yet, in the whole, not forming the round and barrel-like carcass which some have described. The thigh tapering to the hock-joint;

the bones larger in portion to the size than in the breeds of the southern districts. The tail set on a level with the back. The legs short and straight. The whole carcass covered with a thick, long coat of hair, and plenty of hair also about the face and horns, and that hair not curly. As to their value he adds: The value of the West Highland cattle consists in their being hardy and easily fed; in that they will live, and sometimes thrive, on the coarsest pastures; that they will frequently gain from a fourth to a third of their original weight in six months' good feeding; that the proportion of offal is not greater than in the most improved larger breeds; that they will lay their flesh and fat equally on the best parts; and that, when fat, the beef is close and fine in the grain, highly flavored, and so well mixed or marbled, that it commands a superior price in every market.

BLACK FLY. The small black beetle (*Haltica nemorum*) which infests cruciferous plants, and especially the turnip. (See Flea Beetle.)

BLACK GUM. *Nyssa multiflora.* A tree sometimes attaining often more than from fifty to seventy feet or more in height, and twenty inches in diameter. Natural to the United States south of 40° The wood is solid and little liable to split; it is used for naves or hubs, and in ship-building for the caps of masts. The berries are dark, and eaten by birds. *N. quatica*, or Tupelo, is less in size, and grows as far north as Canada. It is valuable as a dense wood, and used by carriage-builders.

BLACK LEG. (See Blain and Murrain.)

BLACK THORN. The European sloe, *Prunus spinosa.* Sometimes the *Cratægus flava* is called by this name in America.

BLACK, TO DYE. For a large dress, take two ounces of extract of logwood and the same of blue vitriol; dissolve the vitriol in sufficient soft water to cover the goods; put them wet into suds, simmer two hours; then wash in three good suds. Throw away the vitriol water and wash the kettle. Make the dye with the extract in plenty of water; put in the goods and let them simmer two hours longer, stirring very often to prevent spotting. Rinse well in cold water, and wash clean in suds.

BLACK TONGUE. (See Blain and Murrain.)

BLACK TWITCH, or COUCH. *Agrostis alba.* Marsh Couch Grass.

BLACK WATER. *Hematuria.* A disease to which horses and mares are sometimes subject, but under good care rarely found. A disease of the general system, characterized by excess of urea in the blood, by urine of a nearly black (dark coffee color), and by spasms of the hind quarters. Mares are especially subject to attacks during the period of heat. Sudden exertion, after a period of inaction, may bring it on, also conjestion and torpidity of the lungs and liver. The animal will be restless, will sweat profusely, and want to lie down. Spasms of the muscles of the hind quarters ensue, sometimes extend to the shoulder, with partial paralysis of the hind limbs, with respiration and pulse rapid. and voiding of quantities of dark urine. Breathing grows difficult, general spasms, and tetanus ensue, and the animal dies. The treatment consists in placing the animal in a roomy place, entirely free. If paralyzed, turn the animal over occasionally. Induce free action of the bowels, by means of the following: Four to six drachm powdered aloes, and one to two ounces cream of tartar, mixed in one or two parts of warm water. If it does not act in five or six hours, repeat. In any case assist the medicine with injections of a quart of soap suds and four ounces oil of turpentine, and give what cool water will be drank. Use no stimulants, sedatives, bleeding or blistering. When the disease abates, raise the animal to its feet, support it if necessary in slings, and rub the limbs briskly to restore circulation, and give three times a day the following ball: One drachm powdered nux vomica and two drachms sulphate of iron. Give complete rest and light nutritious food until the animal recovers, with plenty of fresh air, and such exercise as will be naturally taken.

BLACK WATER OF CATTLE. This is known also as red water and bloody urine, and is an entirely different disease from black water in the horse (which see). The urine always contains albumen and broken down corpuscles. The kidneys do not indicate inflammation, but is somewhat similar in character to Bright's disease. It attacks cows in a low state soon after calving, and is induced by poor and generally bad feeding. There will be prostration, rapid and trembling pulse, palpitation of the heart, bloody, followed by very dark urine, and diarrhœa, as well as by great constipation of the bowels. In cows, soon after calving, will be loss of milk, which sometimes froths, and standing in the pail deposits a reddish sediment. The vagina will also be contracted. The first step is to thoroughly open the bowels and keep them open. If there be diarrhœa, do not try to stop it. Give at a dose, and repeat every two days for six or eight days, or until comparatively natural evacuations take place, the following: Two ounces castor oil in one pint of linseed oil. When the succeeding constipation is released, remit the doses. Generous food, easily digestible, fresh succulent grass in summer, or in winter ground oatmeal and cornmeal boiled, also half a dozen eggs beaten up in a gallon of milk, three times a day should be allowed. In addition to the oil, the following mixed in a pint of gruel, and given twice a day will be indicated: One-half ounce chlorate of potash, one-half ounce tincture of chloride of iron.

BLADE. In agriculture, a shoot or spire of grass, wheat, etc.

BLADE-BONE. The *scapula*, or broad bone of the shoulder.

BLAIN, BLACK TONGUE. This is a disease varying in its form, and known under various names, as charbon (a coal) of the French, contagious anthrax of the English, and under various names in England and America, as black quarter, black tongue, bloody murrain and quarter ail. When it attacks the tongue, it is called blain; when in the throat, it assumes the form of putrid sore throat, or malignant sore throat. When the intestines are attacked, it is bloody murrain. When the spleen is attacked, it may assume the form of apoplexy of the spleen, or splenic fever; so, also, it may take on the form of inflammatory fever, which assuming a low typhoid form, ends in death. If malignant inflammation attacks the internal organs, the disease becomes anthrax fever, or, as stated before, bloody murrain, with bloody urine, bloody effusions from the nose, eyes and ears, which if prompt relief be not given, carries off the animal within one or two days. In its malignant forms, every portion of the animal carries deadly contagion with it, even to other animals, and man. It is a blood-poisoning. No fully successful treatment has ever been discovered; hence the cheapest and most merciful treatment (except in the case of particularly valuable cattle, where sure means of insolation may be had) is to kill and then bury the carcass deeply in the ground. In ordinary cases of murrain, a change to high, dry pastures will often effect a cure. When the disease, in any of its epidemic forms appear, the germs of the disease should be arrested by fumigating the quarters of the animals afflicted, with sulphur and tar, in the proportion of one pound of sulphur to two quarts of pure tar. Saturate tow with the mixture, and burn so it may thoroughly smoke the building. (See Fumigation.) In all forms of this disease, bleeding, purging, and all so-called heroic treatment is worse than useless, and all local applications to "kill" the swellings and ulcers are injurious. The idea is to divest the blood of its poison; it is the true one. Put a seton in the dewlap (a coarse tape an inch wide and twelve or more inches long), smeared with powdered cantharides and turpentine, each one part, and eight parts balsam of fir. The two should stand together in a vessel of warm water for two hours, when the balsam may be added. The seton should be put in at the first symptoms of the disease. Probably the best method of treating the disease internally is by giving one or even two drachms of quinine every two or three hours in severe cases, with hypodermic injections every hour, of the following solution: Two grains of iodine, five grains of iodide of potassium, and one ounce of water. Use a syringe full in severe cases. In very severe cases this may be thrown directly into a vein, but hypodermic treatment must be performed by a veterinarian or a physician. In ordinary treatment the vesicles or pustules should be opened and swabbed with a solution of twenty grains of chloride of zinc, an ounce of water, or in this proportion; or, touch them with nitrate of silver, or even the hot iron. One ounce each of chloride of potash and sulphite of soda, in one or two quarts of water, should also be given two or three times a day. As a stimulant especially useful, two to four drachms carbonate of ammonia dissolved in half a tumblerful of whisky, and diluted with two tumblerfuls of water should be given several times a day, as occasion may seem to require, by allowing it to trickle slowly down the throat from a bottle or horn. (See article Murrain.)

BLANCHING. In gardening, the whitening of the stems, stalks, or leaves of plants, by tying them together, or earthing them up so as to exclude the light, and thus diminish the intensity of their native properties and make them sweet, as with celery. Lettuce, endive, cauliflower, etc., are blanched by tying the outer leaves together over the head.

BLASTEMA. A term sometimes used to designate the embryo.

BLATTA. The cockroach genus.

BLAZE. A white mark or star in the face of an animal.

BLEACHING STRAW GOODS. Wash soiled straw hats, bonnets, or other straw goods, in pure water, and then put them into a box with burning sulphur. The fumes arising unite with the moisture of the bonnets, and this (sulphurous acid thus formed) bleaches them.

BLEMISH. 1. Any kind of imperfection in a horse or other animal. In horses they consist of broken knees, loss of hair in the cutting places, mallenders and sallenders, cracked heels, false quarters, splents, or excrescences which do not occasion lameness; and wind-galls and bog-spavins, where they prevail to any great degree. 2. The knots on the outside of trees, and shakes internally, are termed blemishes.

BLIGHT. A general term for the diseases of trees and crops, whether produced by temperature, moisture, insects, or parasitic fungi.

BLIGHT, AMERICAN. The *Eriosoma* (*aphis*) *lanigera*, or woolly plant-lice. It is not, however, an insect native to America, but was originally imported from Europe.

BLINKERS, BLINDERS. Expansions of the sides of the bridle of a horse, intended to prevent him from seeing objects on either side, but at the same time not to obstruct his vision in front. In training horses, they should always be learned to travel kindly without blinkers.

BLISTER BEETLE, BLACK. (See Cantharides.)

BLISTERING. The operation of stimulating the surface of some part of the body of an animal, by means of acrid applications, so as to raise small vesicles at the surface. It is frequently employed for the purpose of removing local affections of different kinds, such as hard, indolent tumors. The ordinary horse-doctor resorts to blistering whenever he suspects internal inflammation. It is as disreputable as it is vicious, since in deep-seated inflammations, it causes pain and irritation of the viscera, and also leaves a blemish often difficult to eradicate. The use of blisters is, after acute inflammation has ceased, to absorb deposits, or effect some organic change by stimulation, as in reducing, for instance, an enlarged gland, the ripening (suppuration) of an abscess, hastened, etc. A strong blistering ointment is made of one ounce each of powdered resin and powdered cantharides (blistering fly), and four ounces of lard; place the lard and resin in a vessel and set in boiling water until heated; then add the flies and stir until cool. Blistering ointment of medium strength may be made of one ounce powdered cantharides and six ounces of lard, treated as before directed. A mild ointment that will not blemish, but thoroughly applied will raise a good blister is made with one ounce of powdered cantharides and twelve ounces of lard, made as before directed. Avoid the addition of arsenic, corrosive sublimate, and other poisons; they are useless and dangerous. Blistering ointments are applied by first shaving off the hair, washing and drying the skin, and rubbing the ointment in with considerable friction. If first brushed over lightly with turpentine it will act quicker, but this is not to be used in ordinary cases. If it be required that the blister shall act for a considerable time, dress the part with the blistering ointment diluted with oil from one-half to one-quarter the original strength. If this is not necessary, foment the blistered part with warm water the second day, and dress the part with lard or olive oil. When any animal is blemished it must be so secured that it can not bite or rub the irritated part. A tincture or sweating lotion that will not raise a full blister, but simply irritate the part, is made by steeping for ten or fifteen days, in a warm place, one ounce of best powdered cantharides in a pint of proof alcohol. This strength may be increased if necessary by adding from one to four ounces of solution of ammonia to a preparation containing one ounce of cantharides. This sweating blister may be applied repeatedly and without shaving the hair. A very strong blistering solution may be made by adding a quart of spirit of turpentine to four ounces of powdered cantharides, and macerating the whole for a month, when the clear fluid will form a very strong liquid blister. If so powerful a stimulant be not required, the liquid may be diluted with an equal part of oil. As a rule cattle are not blistered. A mustard plaster made with hot water and well rubbed in is usually all that will be needed to produce the necessary irritation. In blistering always remember the following rules: Avoid much blistering in hot weather. Never blister more than two places at one time; or an inflamed part, or when erysipelas or mortification is suspected. Blistering is apt to produce stranguary in horses, if not watched. In case of nervous irritability, loss of appetite, or stranguary (inability to urinate), following blistering, give the horse two drachms of opium; wash the blistered part with strong suds of warm water and soft soap; dry, and dress with sweet oil. Instead of opium, five to ten grains of morphia may be used, or inject hypodermically one or two grains of morphia under the skin.

BLOOD. The fluid which circulates through the body, giving nourishment to all parts. It consists of albumen, fibrin, red globules, fatty matters, water, and saline substances. The composition of blood is nearly identical with that of flesh.

BLOOD HORSE, AMERICAN. The thoroughbred horse of America derives its existence directly from the best blood of that wonderful sub-family of British horses, the English thoroughbred. That they have not degenerated, has from time to time been amply attested on our own racing grounds, and especially so of late years, upon the English turf by American horses laboring under the disability of having been carried from their native climate to one less congenial to this noble animal. In the history of the English blood horse, will be given the salient parts relating to the origin and improvement of the English thoroughbred. Here it will be simply necessary to state something of the dates of the importation of the sires and dams to this country, and what they have performed. That the thoroughbred horse is the foundation upon which must be built all that is of most value in the trotting horse, the roadster, the carriage horse, and even the horse of all work, is now so generally acknowledged. that it seems almost unnecessary to so state. It would not have been done, were it not for the fact that occasionally some narrow-minded individual will decry this wonderful sub-family of horses, because gamblers and other disreputable men have used them on the race-course for the purpose of cheating and swindling. As well might the trotting horse of America be consigned to oblivion, and, indeed, all horses of speed and pleasure, because their veins were strongly imbued with the blood of that wonderful make-up of bone, sinew, muscle, and nerve force—the thoroughbred horse. Fortunately at the South, soon after the settlement of the colonies, and later in the West, the value of his blood was justly appreciated. So in the middle states. In New York, New Jersey and Pennsylvania, the blood horse has long had an existence. Yet in Maryland and Virginia, and in Kentucky and Tennessee, the thoroughbred has been bred in his greatest perfection, and has produced a most glorious galaxy of sires and dams, inferior in speed, strength and stoutness to none on earth. The late William Henry Herbert, under the *nom de plume* of Frank Forester, carefully collected a mass of valuable historical information in his Horse and Horsemanship of the United States, and the British Provinces of North America, and we give therefrom a synopsis of the salient points: In the reign of Queen Anne, the last of that house who sat on the royal throne of England, the English thoroughbred horse may be regarded as fully established; the Darley Arabian, sire of Flying Childers, Curwen's Barb, and Lord Carlisle's Turk, sire of the Bald Galloway, being imported in her reign. Sixteen years after her death, and three years before the foundation of Georgia, the youngest of the royal colonies, twenty-one foreign and fifty native stallions, some of them the most celebrated horses the world has ever seen, such as Childers, Bartlett's Childers, the Grey Childers, the Bald Galloway, Bay Bolton, Coneyskins, Crab, Fox, Hartley's Blind Horse, Jigg, Soreheels and Trueblue, were covering in the United Kingdoms; and from some of those are descended almost all our racers of the present day. Six years before this the first Racing Calendar was published in England, with nearly seven hundred subscribers. During this period it was, precisely, that the American colonies were planted; and, as might be anticipated, English horses of pure blood were at an early date introduced; and in those regions, where the settlement was principally effected by men of birth, attached to the Cavalier party, race-horses were kept and trained, race-courses were established, and a well authenticated stock of thoroughbred animals, tracing to the most celebrated English sires, many of which were imported in the early part of the eighteenth century, was in existence considerably before the outbreak of the old French war. In the Eastern States, the settlers of which were for the most part attached to the Puritan party, and therefore opposed to all amusements and pastimes as frivolous at the least and unprofitable, and to horse-racing more especially as profane and positively wicked, very few horses of pure blood were imported; racing did not take strong root in them, nor in the last century were stables of racers kept to the east of New York. Virginia and Maryland as the headquarters of the Cavaliers—the former State having for a long time refused submission to the commonwealth and to stout old Oliver—as the seat of the aristocracy, fashion and wealth of the colonies, prior to the Revolution—took an early and decided lead in this noble pursuit; and, while the love of the sport continues to distinguish their descendants, who are by far the most equestrian in their habits of any other citizens of the Republic, the result of the liberality of the free settlers is yet visible in the blood of their noble steeds. It is probable that racing may have commenced simultaneously, or very nearly so, in the two States above named. It was an attribute of the principal towns of Maryland some years previous to Braddock's defeat in 1753, and it is nearly certain that Spark, owned by Governor Ogle, of that colony, presented to him by Lord Baltimore, who received him as a gift from the Prince of Wales, father to King George III., came hither previous to that event, and was among the first horses of great distinction brought to America, though it can not be shown, what was the date of his importation. About the year 1750, Colonel Tasker imported into Maryland the celebrated English mare Selima, a daughter of the Godolphin Arabian, one of the most distinguished mares that ever ran in America, and progenitrix through Rockingham, Mark Antony, and many others, of half the best and most fashionable blood in America. Nearly about the same time, there were imported into Virginia, Routh's Crab, by old Crab, dam by Counsellor, daughter of Coneyskins, supposed to be in or about 1745. In 1747, Monkey, by the Lonsdale Bay Arabian, dam by Curwen's Bay Barb, daughter of the Byerly Turk and a Royal mare. He was twenty-two years old when imported, but left good stock. In 1748, Roger of the Vale, afterwards known as Jolly Roger, by Roundhead, out of a partner mare, Woodcock, Croft's Bay Barb, Dickey Pierson, out of a Barb mare. Roundhead was by Flying Childers, out of Roxana, dam of Lath and Cade, by the Bald Galloway, out of a daughter to the Acaster Turk. Woodcock was by Merlin, out of a daughter of Brimmer. Dickey Pierson by the Dodsworth Barb out of the Burton Barb mare. In about 1764, was imported Fearnought, got by Regulus, out of Silvertail, by Whitenose, grand-dam by Rattle. Thus Fearnought is come of the very highest and purest blood in England, and has left his mark largely on the blood-horse of Virginia. It is said that before his time there was little beyond quarter racing in Virginia, that his progeny were of uncommon figure, and first introduced the size and bottom of the English racehorse into America. This must be taken, however, with reservations, as it is evident from what has been stated in regard to Selima, that four-mile racers were the fashion, in Maryland at least, fifteen years before that date, and it is only to be understood in the case of second-rate racers, that quarter running was in vogue at this period. These capital horses were shortly followed by Morton's Traveller, who was probably got by Partner, a grandson of the Byerly Turk, and grandsire of King Herod, dam by the Bloody Buttocks Arabian. These were probably the best early horses that were imported into America; and to these, with the mares Selima, Queen Mab, Jenny Cameron, Kitty Fisher, Miss Colville and a few others of about the same period, may be traced all, or almost all, the families of running horses now existing in the United States, in a greater or less degree, and with nearly as much certainty as the English champions of the olden day may be followed up to imported Arab and Barb on both sides. From Virginia and Maryland, the racing spirit extended itself rapidly into the Carolinas, where it has never to this day flagged. The oldest race-courses in this country, which are yet kept up for purposes of sport, are the Newmarket course, near Petersburgh, Va., and the Washington course, near Charleston, S.C. At Alexandria, Va., there was a race-course early in the last century, and the courses in the neighborhood of Richmond have been in existence above seventy years. Not very long after this date, and previous to the Revolutionary war, there were two race-courses on Long Island, in the State of New York—one called Newmarket, near the centre of Suffolk county, and the other near Jamaica in Queens county, at both of which trials of speed were frequently had; but whether there were meetings at stated intervals and for regular prizes is not known. It was not until about the commencement of the present century, however, that what may be called race-courses proper were established in New York; the first club for the promotion of the breed of horses by means of racing, taking date from 1804, in which year the old Newmarket course was remodelled, and regular meetings with two and three-mile heats were established. Long prior to this time, however, the improvement of the breed of horses had created much interest in that State, and as early as 1764 and 1765 two celebrated horses were imported — Wildair, by Cade, and Lath, by Shepherd's Crab—by Colonel Delancy of King's Bridge, who also imported the Cub mare, dam of Mr. Gibson's Cub mare, killed on the course at Lancaster. Both Wildair and Lath greatly distinguished themselves as sires; the former was esteemed so valuable that he was reimported to England. Another horse, Sloven, said to be by Cub, is stated by Skinner and by Edgar, on the faith of a pedigree signed Jacob Adlie, to have been imported also into New York in about 1764; he is not, however, to be found in the British Stud-book—Weatherby's; and I am not aware that any of the greater champions of the American turf trace their descent to Sloven. In North and South Carolina racing commenced with spirit, second (if second) only to the date of its commencement in Virginia and Maryland. Flimnap, Sweeper and Toby, all horses held in high estimation at the time, were imported between the years 1760 and 1770; the former a grandson on both sides of the Godolphin Arabian, and both the others tracing to the same great progenitor, and to other ancestors scarcely of inferior note; the last named was imported by Colonel Alston, of racing celebrity in North Carolina. Into Pennsylvania, which State has never shone particularly on the racing turf, were brought two horses, Gray Northumberland, also called Irish Gray, said to have been bred by Lord Mazarine, and to have been a racer in high form, supposed imported by Mr. Crow, and about the same time, Old England, pedigree also unknown, but supposed begot by Old England, son of Godolphin Arabian. To these must be given the credit of running one of the oldest great American time races on record, so long ago as 1767, against two other horses, one of whom, Selim, it is not easy to identify, three of the same name appearing to have covered nearly at the same time. The English sires most renowned in post-revolutionary days, until we come down to the day of the Leviathans, Sarpedons, Trustees, Priams and Glencoes, have been: Medley—imported into Virginia in 1783, by Gimcrack; dam Arminda, by Snap. Shark—foaled in 1771, and imported into Virginia by Marske, out of the Snap mare. Diomed—foaled in 1777; imported into Virginia, 1798. He was by Florizel, dam by Spectator. Diomed is probably the greatest sire of the greatest winner-getters ever brought into this country. Had he got none but Sir Archy, out of imported Castianira—who brought him to America in her belly—that renown alone would have been more than enough; for scarce a recent horse in England, unless it be Pot8o's, has so distinguished himself as a progenitor. Gabriel—foaled 1790; imported into Virginia, was got by Dorimant; dam Snap mare. The year of Bedford's importation is not exactly known. He was a great stallion, and there is hardly a family of horses in the Southern States which do not in some degree, more or less, partake of his blood. He was a singularly formed horse—a rich bay—with a peculiar elevation on his rump, amounting in appearance to an unsightliness, if not to an absolute deformity. This mark, known as the Bedford Hump, he has transmitted to his posterity, and, whatever may have been the original opinion as to its beauty, it has been worn by so many celebrated winners, that it has come of late to be regarded as a fore-shadowing of excellence, rather than a deformity. It has been worn by Eclipse, Black Maria, her brother, Shark, Boston, Argyle, and many others of note. The editor would here remark that what one authority says of Tennessee may also be said of Kentucky, which immediately that her sons became forehanded enough they commenced to breed thoroughbred horses. At the north, as settlement made good roads practicable, the attention of breeders was turned to trotting horses. That they also were indebted to the staunchest thorough blood for their success, the record of the modern trotting phenomenans will attest. It will not be necessary here to follow the account of successive sires and dams as they have appeared. It will be sufficient as a matter of interest, to present a record carefully prepared of the fastest and best running time, and most creditable performances made at all distances, to end of year 1879; the time being in minutes, seconds, and quarters of a second:

Half a mile:—Olitipa, by imported Leamington, Saratoga, July 25, 1874, 0.47¾.

Five-eighths of a mile:—Bonnie Wood, by imported Bonnie Scotland, Saratoga, July 20, 1878, 1.02¾.

Three-quarters of a mile:—First Chance, by Baywood, Philadelphia, Pa., October 17, 1876, 1.15.

One mile:—Ten Broeck, by imported Phæton, Louisville, Ky., May 24, 1877, 1.39¾.

Mile Heats:—Kadi, by Lexington, Hartford, Conn., September 2, 1875, fastest second heat, and fastest two heats ever run, 1.42½, 1.41¼.

One mile and one-eighth:—Bob Woolley, by imported Leamington, Lexington, Ky., September 6, 1875, 1.54.

One mile and a quarter:—Charley Gorham, by Blarneystone, Lexington, May 18, 1877, 2.8½.

One mile and three-eighths:—Spendthrift, by imported Australian, Jerome Park, June 10, 1879, 2.25¾.

One and a half miles:—Tom Bowling, by Lexington, May 12, 1874, 2.34¾. This horse was permitted to extend the run to two miles.

One mile and five-eighths:—Ten Broeck, by imported Phæton, Lexington, Ky., September 9, 1875, 2.49¼.

One and three-quarter miles:—One Dime, by Wanderer, Lexington, September 12, 1879, 3.05¼.

Two miles:—Ten Broeck, by imported Phæton, against time, Louisville, May 29, 1877, 3.27½.

Two mile Heats:—Brandemante, by War Dance, Jackson, Miss., November 17, 1877, 3.32¼, 3.29. Doubtful.

Willie D., by Revolver, Prospect Park, September 11, 1879, 3.34½, 3.35.

Two miles and one-eighth:—Aristides, by imported Leamington, Lexington, Ky., May 10, 1876, 3.45½.

Two miles and a quarter:—Preakness, by Lexington, Springbok, by imported Australian, dead heat, 3.56¼.

Two and a half miles:—Aristides, by imported Leamington, Lexington, Ky., May 13, 1876, 4.27½

Two miles and five-eighths:—Ten Broeck, by imported Phæton, Lexington, Ky., 1876, 4.58½.

Two miles and three-quarters:—Hubbard, by Planet, Saratoga, 1873, 4.58¾.

Three miles:—Ten Broeck, by imported Phæton, Louisville, Ky., September, 23, 1876, 5.26½.

Three mile Heats:—Brown Dick, by imported Margrave, New Orleans, April 10, 1865; the best second heat on record, and second best three-mile heat race, 5.30¾, 5.28.

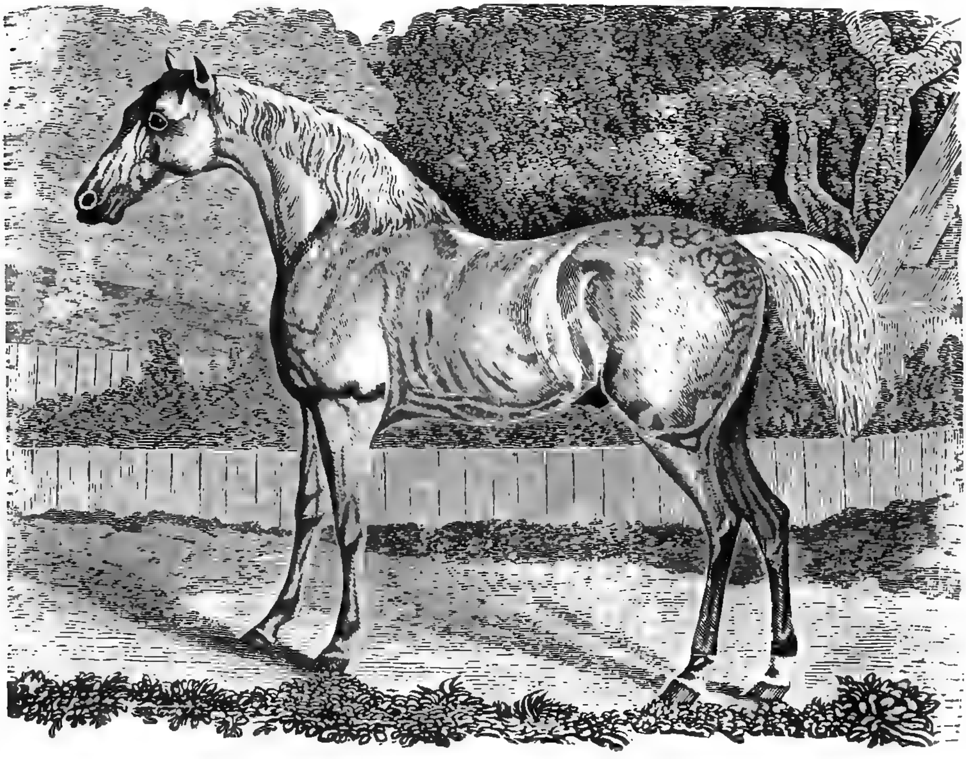
Four miles:—Ten Broeck, by imported Phæton, vs. Fellowcraft's time, Louisville, Ky., September 7, 1876, 7.14¾.

Four mile Heats:—Lecompte, by Boston, at New Orleans, April 8, 1854, beating Lexington and Reube, 7.26, 7.38¼.

Hurdle Races:—Joe Rodes, by Virgil, mile heats, over four hurdles, St. Louis, June 4, 1878, 1.50¾, 1.50¼.

Steeple Chases:—Dead Head, by Julius, about two and three-quarter miles, thirty-six leaps, Saratoga, August 26, 1878, 5.33½.

BLOOD-HORSE, ENGLISH. The history of the blood-horse in England has been so accurately and carefully traced by the late William Henry Herbert, one of the most accomplished writers of horses and field sports, in America, from an Englishman's view, that we accept therefrom so much as will give a correct idea and history of the origin and growth of the blood-horse in England. Our authority says: It being, in the first place, admitted that the English blood-horse is the most perfect animal of his race, in the whole world, both for speed and endurance, and that the American blood-horse directly traces, without mixture, to English, and, through the English, to Oriental parentage, it is absolutely necessary to revert to the origin and original creation of the former variety, in order to come at the pedigree, characteristics, and history of the latter. With American blood-horses, it is not as it is with American men; the latter may, in many cases, trace their descent to an admixture of the blood of many nations; the former, on the contrary, must trace to the blood of the English thoroughbred; or, if it should fail to do so, must suffer in consequence of the taint of any foreign strain. I do not, of course, mean to assert that, in a horse of unquestioned excellence and performance, it would be a defect to trace to a new and recent cross of Arab or Barb blood; but I do mean to say, that such pedigree would be of no advantage to the character of the animal; since it is clear that, by no Oriental horse recently imported into Great Britain has the British blood-horse been improved—the Wellesley Arabian having got but one offspring of even moderate racing celebrity, Fair Ellen—while no horse of the pure blood of the desert, by any allowance of weight, has been enabled to win a race on the English turf, though, within the last twenty years, many have been started for prizes. It is believed that no Barb, Arab or Turk, imported into America, has ever got a horse of true pretensions on the turf, or which has an important race; and yet, within a few years, or during the second quarter of the century, a considerable number have been introduced to this country, many of them gifts from sovereign potentates to different Presidents of the United States, reputed to be of the noblest breed, and surely, as regal gifts, presumable to have been of true blood. The theory and presumed cause of the worthlessness of Arab Sires at the present day, will be discussed hereafter, when we come to treat of breeding and the influence of lineal descent on the production and transmission of hereditary qualities in the horse. It suffices, at present, to observe that the English race-horse is now on all hands admitted to be an animal of superior hereditary qualities to the pure-bred horse of the desert; and that the race horse in America—the only country wherein he does not appear to have degenerated from his ancestry—is identical in breed and qualities with the progenitors, to whom he traces his pedigree. Quoting from various sources the author continues: That horses were introduced into Britain long before the Christian era, we have abundant evidence, and that the inhabitants had acquired great experience in their use is equally certain. In the ancient British language *rhediad* is the word for a race—*rheder*, to run—and *rhedecfa*, a race. All these spring from the Gaulish *rheda*, a chariot. Here, then, is direct evidence that horses were introduced from Gaul, and that chariot races were established at a very early period. I would here observe, that this evidence is not to my mind direct or conclusive, as to the fact of the introduction of the horse from Gaul; although it is so, as to the antiquity of chariot-racing in both countries, and to the non-Roman descent or introduction of the British or Gaulish animal. And my reason for so saying is that, as the blood, the religion and the language of the Britons were cognate if not identical with those of some, at least, of the Gallic tribes, it is no more certain that the Gallic *rheda* is the theme of the British *rheder*, than that it is derived therefrom. It does, however, in a great degree prove that the Gallic and British horses were identical, and descended not from any breed transmitted through Greece and Italy, but from one brought inland to the northward of the Alps; perhaps by those Gauls, who ravaged Upper Greece and Northern Italy, almost before the existence of authentic history; perhaps by their original ancestors; at all events, of antique Thracian or Thessalic descent, and, therefore, of remote but direct Oriental race, in all probability again improved by a later desert cross, derived from the Numidian cavalry of the Carthaginian Barcas, long previous to the Cæsarian campaigns in Gaul or the invasions of the sacred island of the Druids. This, however, is of small immediate moment, and is more curious and interesting to the scholar and the antiquary, than to the horsemen or horse-breeder. From the different kinds of vehicles, noticed by the Latin writers —the *carruca*, the *covinus*, the *essedum*, or war-chariot—it would appear that the ancient Britons had horses trained to different purposes, as well domestic as warlike. It is well observed by Youatt, in his larger work on the horse, that from the cumbrous structure of the car and the fury with which it was driven, and from the badness or non-existence of roads, they must have been both active and powerful in an extraordinary degree. Cæsar, he adds, though without stating his authority, thought them so valuable, that he carried many of them to Rome; and the British horses were, for a long time after, in great request in various parts of the Roman empire. I regret that, owing to the omission of giving authority, I have been unable to verify the latter statement; I have failed to discover any allusion to the facts stated in the writings of Cæsar himself; nor can I recall to mind any mention of British horses, in any of the classical authorities, whether in prose or poetry; nevertheless, I presume, from the general care and truthfulness of this able writer, that there is no doubt as to the accuracy of his assertion. During the occupation of England by the Romans, the British horse was crossed to a considerable extent by the Roman horse—continues the author in the volume first quoted; for which I would myself, for reasons above stated, prefer to substitute by the foreing horses of the Roman mercenary or allied cavalry,



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and yet strange to say, no opinion has been given by any historian, Roman or British, as to the effect of this. After the evacuation of England by the Romans and its conquest by the Saxons, considerable attention was paid to the English breed of horses, and we know that after the reign of Alfred, running horses were imported from Germany; this being the first historical intimation we have of running horses in England. It is scarcely to be doubted that this importation produced a marked effect on the character of the native breed; but here, as before, no historian has thought it worth his while to record the fact of either improvement or deterioration. English horses, after this, appear to have been highly prized on the continent, so that the German horses which were presented by Hugh Capet to Athelstan had been turned to good account. The English themselves, were, however, anxious to preserve the monopoly of the breed, for in 930 A. D., a law prohibited the exportation of horses. In Athelstan's reign many Spanish horses were imported, which shows the desire of the English, even at that early period, to improve the breed. It is no wonder that their descendants should have produced the finest horses in the world. Shortly before the Norman conquest a horse was valued at thirty shillings, a mare or colt at twenty shillings, an ox at thirty pence, a cow at twenty-four pence—these prices in case of their being destroyed or negligently lost—and a man at a pound. Money, it should be noted, then being equivalent to at least fifteen times its present value. William the Conqueror took great pains to improve the English breed, introducing many fine animals from Normandy, Flanders and Spain. This monarch owed his success at Hastings chiefly to his cavalry; his own horse was a Spanish one. In this reign we have the first notice of horses being employed in agriculture. They had been used for the saddle for many centuries—Bede informing us that the English began to use horses as early as 631 A. D., and that people of rank distinguished themselves by appearing frequently on horseback. During the Conqueror's reign, the then Earl of Shrewsbury, Roger de Belesme, brought a number of Spanish horses to his estate of Powisland. The breed issuing from these is highly eulogized by Giraldus, Cambrensis and Dayton. In the reign of Henry I. we have an account of the first Arab horse imported into the country. It was presented by Alexander I., King of Scotland, to the church of St. Andrew's, with many valuable accoutrements, and a considerable estate. History, however, is silent as to the purposes to which this animal was devoted, and as to what ultimately became of him there is no record. Coming down to the time of King John, we find, according to Youatt, that he imported many chosen stallions, 100 on a single occasion, and such was his anxiety to possess the best, that he would accept strong horses for the rent of crown lands, and as fines for the renewal of leases, and that his personal stud was both numerous and excellent. Edward III. bought fifty Spanish horses and such care was taken that a formal application was made to the King of France for safe conduct to the troop having them in charge. This monarch, says M. Youatt, had many running horses, though M. Youatt professes himself not clear whether it meant speedy horses in opposition to war horses, or those used specially for racing purposes. Mr. Herbert says: In the reign of Richard II. horse-jockeyship and the tricks of dealers had increased to such an extent, that a special proclamation was issued, regulating the price of animals of various kinds, and fixing a maximum value. Like all other sumptuary laws and prohibitory statutes effecting to regulate trade, this proclamation proved wholly useless and fell dead. It is curious, however, as proving the great increase in the value of horses, since the preceding reign, and showing what were, four hundred and fifty years ago, and what are still, the chief breeding districts. It was ordered to be published in the counties of Lincoln and Cambridge, and in the north and east ridings of York. The price was restricted to that determined by former sovereigns. Exportation of horses was strictly forbidden, especially to Scotland, as a kingdom with which England was constantly at war; and it is remarkable, that even in the time of Elizabeth, it was felony to export a horse to Scotland. These prohibitions, how contrary, soever, to recent and more enlightened views as to the injurious effects of such restrictions on the freedom of trade, distinctly proved two things. First, that the people and monarchs of England had now become fully awake to the value of race and breed in horses; and second, that the superior quality of English horses was thus early acknowledged abroad, and that the demand for them was supposed to be greater than the superfluity. We can now—quoting again from Mr. Youatt—collect but little of the history of the horse until the reign of Henry VII. at the close of the fifteenth century. He continued to prohibit the exportation of stallions, but allowed mares to be exported, when more than two years old, and under the value of six shillings and eight pence. James I. coming to the throne of England, purchased the Markham Arabian for £500 (an extraordinary price in those times), but he was found to be deficient in speed. Race meetings were now regularly held at Newmarket, and various other places, in addition to those already held at Chester, there being an account of a race being run there in 1665. Mr. Youatt also mentions races previous to King James' time, and says those of King James were in great part, matches against time, or trials of speed and bottom for absurdly long and cruel distances. Thus, from the time of James, the history of racing and English race-horses, and of course increased care in breeding and management, may be said to commence. Coming down to the time of Cromwell, Mr. Herbert says: During the protectorate, though he was compelled by the necessity of conciliating the absurd prejudices of the Puritans, to forbid racing, was yet an ardent lover of the horse, and an earnest promoter and patron of all that belongs to horsemanship, purchased of Mr. Place, afterwards his stud-master, the celebrated White Turk—still recorded as the most beautiful southeastern horse ever brought into England, and the oldest to which our present strain refers. To him succeeds Villiers, Duke of Buckingham, his Helmsley Turk, and to him Fairfax's—the same great statesman and brave soldier, who fought against Newcastle at Marston—Morocco Barb. And to these three horses it is that the English race-horse of the old time chiefly owes its purity of blood, if we except the royal mare, specially imported by Charles II., to which it is—mythically, rather than justly—held that all English blood should trace. Of all succeeding importations, those, which are principally known and referred to, as having notoriously amended our horse—by proof of stock begotten of superior qualities, and victorious on the turf through long generations—but few are true Arabs. We have, it is true, the Darley Arabian, the Leeds Arabian, Honeywood's White, the Oglethorpe, the Newcome, Bay Mountain, the Damascus, Cullen's Brown, the Chestnut, the Londsdale Bay, Combe's Gray and Bell's Gray Arabians; but what is generally called the Godolphin Arabian, as it seems now to be the prevailing opinion—his origin not being actually ascertained—was a Barb, not an Arab from Arabia proper. Against these, again, we find Place's White Turk, D'Arcey's Turk, the Yellow Turk, Lister's or the Straddling Turk, the Byerly Turk, the Selaby Turk, the Acaster Turk; Curwen's Bay Barb, Compton's Barb, the Thoulouse Barb, Layton's Barb Mare, great-great-grandam of Miss Layton; the Royal Mares, which were Barbs from Tangier, and many other Barb horses, not from the Eastern desert, heading the pedigrees of our best horses. In this connection, I would observe that the very reasons for which the Marquis of Newcastle condemned the Markham Arabian, viz., that when regularly trained he could do nothing against race-horses—on account of which condemnation he has received a sneer or a slur from every writer who has discussed the subject, are those which, at this very moment, prevent prudent breeders from having recourse to to Oriental blood of any kind. They can not run or last against the English horse. They have not the size, the bone, the muscle, or the shape, if we except the beautiful head, the fine neck, thin withers, and admirably long, deep and sloping shoulders, which are the inevitable characteristics of the race. Therefore, all men who breed with an eye to profit—and howsoever it might have been in the olden times of the turf, there are few now who have not an eye to it, either as hoping to win on the turf, or to produce salable stock—prefer to put their mares to known English winning horses, proved getters of winners, of unquestioned bottom and stoutness, rather than to try stallions of the desert blood, concerning which nothing is known beyond the pedigree. It is not necessary to follow the history of the English blood-horse further. It has been written voluminously by various English and American writers. From the writings of Youatt in England, and Herbert in America, the horseman may thoroughly inform himself. He is not a pure breed, but made up of various bloods, and inherits from Oriental blood, style, and soundness in wind, limb and hoof. By careful breeding through many generations, his speed has been increased, while the general constitution of the thoroughbred, has not specially suffered. Artificial care has made an artificial animal of him, yet certainly, the blood-horse of the present day is far superior to his masters either on the Oriental or British side, as far superior in speed and stoutness, as is the modern Short-horn and Hereford cattle superior in beef points to their progenitors of 150 years ago. Fleet and enduring as is the English thoroughbred in Great Britain, the American descendants, have fully kept pace with them, as is well attested in many hard fought races in England and America. As to the thoroughbred twenty-five or thirty years ago, Stonehenge, an English writer, as honest as he was graphic, says: By an examination of the racing time-tables as recorded of late years, it will be seen that from thirteen and a half to fourteen seconds per furlong is the highest rate of speed attained in any of our races, above a mile, and with eight stone seven pounds, carried by three-year-old horses. In 1846, Surplice and Cymba won the Derby and Oaks, each running the distance in two minutes forty-eight seconds, or exactly fourteen seconds per furlong. This rate has never since that time been reached; the Flying Dutchman having, however, nearly attained it, but failing by two seconds—making his rate fourteen seconds and one-sixth per furlong. But the most extraordinary three-year-old performance is that of Sir Tatton Sykes over the St. Leger Course, one mile six furlongs, and 132 yards in length, which he ran in three minutes and sixteen seconds, or at a rate of as nearly as possible thirteen and a half seconds per furlong. With an additional year and the same weight, this speed has been slightly exceeded by West Australian, even over a longer course, as at Ascot in 1854, when he defeated Kingston by a head only; running two miles and four furlongs in four minutes and twenty-seven seconds, or as nearly as possible at the rate of thirteen and a half seconds and one-third per furlong. This performance is the best in modern days, considering the weight, the age, and the distance; and it will compare very favorably with the often-quoted exploit of Childers over the Beacon Course in 1721, when, being six years old, he beat Almanzor and Brown Betty, carrying nine stone two pounds, and doing the distance in six minutes forty seconds, or at the rate of fourteen seconds and one-third per furlong. Thus, allowing him his year for the extra mile in the course, and for the two pounds which he carried above Kingston's weight, he was outdone by the latter horse at Ascot by one second per furlong, and likewise by West Australian at the usual allowance for his age. Again; comparing these performances on the English turf with the recently lauded exploits of the American horses, it will be found that there is no cause for the fear lest our antagonists in the "go-ahead" department should deprive us of our laurels. On the second of April, 1855, a time-match was run at New Orleans between Lecomte and Lexington, both four years old, in which the latter, who won, did the four miles, carrying seven stone five pounds, in seven minutes nineteen and three-quarter seconds, or, as nearly as may be, thirteen and three-quarter seconds per furlong. This is considered by the Americans the best time on record, and is undoubtedly a creditable performance; though when the light weight is taken into account, not so near our best English time as would at first sight appear. On the 14th of April, Brown Dick and Arrow ran three miles over the same course in five minutes twenty-eight seconds, or at the rate of thirteen seconds and two-thirds per furlong; the former a three-year-old, carrying six stone two pounds, and the latter five years old, six stone twelve pounds. Thus it will appear that Kingston, of the same age as Arrow, and carrying nine stone instead of seven stone twelve pounds, ran two and a half miles at a better rate than Arrow did his three miles, by one-third of a second per furlong. And it has been shown that in the year last past, two horses exceeded the greatest performance of the olden times by a second per furlong, and beat the best American time of modern days by one-third of a second per mile. The assertion, therefore, that our present horses are degenerated in their power of staying a distance under weight, is wholly without foundation; since I have shown that, even taking the time of the Childers' performance as the true rate, of which there is some doubt, yet it has recently been beaten very considerably by West Australian and Kingston. Many loose assertions have been made as to the rate of the horse, for a single mile in the last century, but there is not the slightest reliance to be placed upon them. That any race-horse ever ran a mile within the minute, is an absurd fiction; and it is out of the question to suppose that if Childers could not beat our modern horses over the Beacon Course, he could beat them a shorter distance. Stoutness was undoubtedly the *forte* of the early race-horses; they were of small size, very wiry and low, and could unquestionably stay a distance, and could race month after month, and year after year, in a way seldom imitated in these days; but that they could in their small compact forms run as fast in a short spin as our modern three-year-olds, is quite a fallacy, and no racing man of any experience would admit it for a moment. The size and shape of the modern thoroughbred horse are superior to those of olden days, if we may judge by the portraits of them handed down to us by Stubbs, who was by far the most faithful animal painter of the eighteenth century. In elegance of shape we beat the horses of that day very considerably, more especially in the beauty of the head and the formation of the shoulders, which have been much attended to by breeders. In size, also, there has been an immense stride made, the average height of the race-horse having been increased by at least a hand within the last century. This enlargement is, I believe, chiefly due to the Godolphin Arabian, who was the sire of Babraham, the only horse of his time which reached sixteen hands, and sire or grandsire of several which were more than fifteen hands, much above the average height of horses at that time—as, for instance, Fearnought, Genius, Gower Stallion, Infant, Denmark, Bolton, Cade, Chub, Lofty and Amphion. Indeed it will be found, by an examination of the horses of that time, that out of 130 winners in the middle of the eighteenth century, there were only eighteen of the height of fifteen hands and upwards, of which eleven were by Godolphin or his sons, three descended from the Darley Arabian, two from the Byerley Turk, and two from other sources. It may therefore be assumed, with some degree of probability, that the increase in size is in a great measure due to the Godolphin, in addition to the extra care and attention which the horse has received during the same time. Nevertheless, all the care and forcing in the world will not increase the size of some breeds; and unless there was this capability of being forced, no amount of attention would have brought the horse to the present average, which may be placed at about fifteen hands three inches.

BLOOD-ROOT. *Sanguinaria Canadensis.* This root is of a red color; is valuable in medicine, being used as an emetic, and in coughs. In large doses it is poisonous, and should not be given except under the advice of a physician. The leaves are sometimes given to horses to assist in shedding the hair in the spring, and the root, also, to exterpate bots.

BLOOD-SHOT. In farriery, a popular term for that red appearance which the eye exhibits when inflamed. The best treatment is to bathe the eye with a lotion composed of one drachm of white vitriol (sulphate of zinc) dissolved in half a pint of water.

BLOOD SPAVIN, or BOG SPAVIN. In farriery, a swelling of the vein that runs along the inside of the hock of the horse, forming a soft tumor in the hollow part, often attended with weakness or lameness of the hock. (See Spavin.)

BLOOM, or BLOSSOM. A general name for the flowers of plants, but more especially of fruit-trees. The office of the blossom is partly to afford protection, and partly to draw or supply nourishment to the fertilizing organs of the plant, for the perfecting of the embryo fruit or seed. Bloom is a term applied to the delicate powder which coats the outer surface of such smooth-skinned fruits as the grape and plum. In gathering such fruits, care should always be observed to prevent this bloom from being removed by handling or otherwise, as it injures the appearance.

BLOW-FLY. The *Musca carnaria.* It deposits eggs upon meat, which in a few hours become maggots, and hasten the decay rapidly; gauze cloths are used to keep them off; salt or cayenne pepper serves as a preventive, by indisposing the fly to lay eggs on surfaces smeared with them.

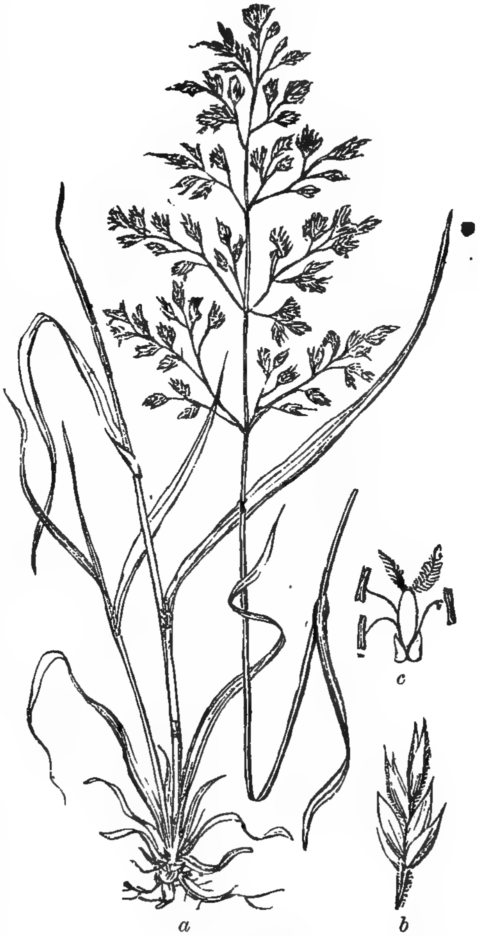
BLOWN, or COLIC. Undue distention of the stomach, from fermentation of food, as wet grass, bad fodder, musty hay, ergoty, or even sound grain eaten in undue quantities, causing the liberation of gas faster than it can be passed off, is usually termed hoven in cattle, and also blast, blown, colic and wind-dropsy in farm animals. In cattle and sheep the trouble is in the third stomach, and if relief is not given, often ends in death. There will be swelling of the belly on the left side. The bowels will be torpid and constipated, the breathing difficult, the eyes wild, with other indications of intense pain. If the distension has extended to both sides, the danger is imminent. A trocar, or in lieu thereof, a sharp-pointed pen-knife, should be thrust into the rumen, where the swelling is greatest, and the opening kept apart by a silver tube, or a large quill thrust in the opening, to allow the escape of the gas. In cases not so severe, pressing and kneading of the stomach, to force the gas up the gullet, may give relief, or a half inch rubber tube well oiled, and furnished with a button of wool also well oiled, may be carefully worked down into the stomach. As a stimulant, one drachm of green mustard and one ounce of whisky, mixed in a little water, may be given by allowing it to trickle down slowly, to insure its safe passage into the third stomach. This may be repeated as may be deemed necessary. If this does not give relief, four drachms of the solution of potash, and one ounce of lard-oil and of common salt may be mixed in a gill of water, and be given. Preventives are, not to turn stock into flush pastures wet with dew when hungry. Sheep may have one quarter of the above dose. Colic or gripes in the horse must not be confounded with this affection. It is a contraction of the muscular coats of the stomach, and is caused by bad food, exhaustion, drinking cold water, change of food, and various other causes.

Intestinal colic, is shown by severe pain, looking at the flanks, pawing, lying down, rolling, and then suddenly getting up. The pulse and breathing are quick, and there are sometimes small discharges, both of dung and water. The bladder being generally distended. The most prompt means is the injection under the skin, of ten grains of morphia by means of a hypodermic syringe, and repeated in one hour if necessary. Give a ball by the mouth of five to ten drachms of powdered aloes. (See article Ball, or Bolus.) Assist this with an injection of half a pint of turpentine mixed with one quart of soapsuds. Avoid all dosing with alkaline drenches so much in vogue with the ignorant. In simple cases, one ounce each of chloroform, laudanum and sulphuric ether, and eight ounces of linseed oil will answer, if aided by the injection as given above. If there is much gas and swelling, give the following: Mild spirits of ammonia and sulphuric ether, of each one ounce, and powdered aloes one-half ounce; mix in a pint of tepid water, and give at one dose. Gentle walking exercise will also tend to give relief and assist in the action of the medicines.

BLUBBER. The cellular substance in which whale oil or fat is stored.

BLUEBIRD. *Sylva sialis.* A familiar insectivorous bird that should be encouraged on farms.

BLUE-GRASS. *Poa pratensis.* The genus poa is one of the most important of the family of grasses, being decidedly the most valuable of our pasture grasses in soil suited to it. Upon rich, open, argillaceous soils, containing lime, and upon rich dry limestone soils proper, it is entirely at home, furnishing an abundance of early and late pastures, and south of the latitude of 40° north, and thence south it furnishes much valuable winter pasture. In Kentucky, the Blue-grass region has become famous, the world over. The profusion of nutritious, radical leaves constitute the superior excellence of this grass. It is also known as Spear-grass, Green-grass, and Smooth Meadow-grass. It is a perennial creeping rooted grass, smooth-stemed, flowering in May and June, according to the latitude, and ripening a month later. In poor soils it soon deteriorates and is of little value. *Poa compressa,* to which the name of Blue-grass might more properly be applied, is also known as Blue-grass in some portions of the North, also as Wire-grass and Flat-stalked Meadow-grass. This also is a perennial creeping rooted grass, the plant smooth, but with short and fewer radical leaves than the so-called Kentucky Blue-grass. It has found its way into most pastures in the North, and if less flush, certainly is as rich or richer pasturage than *Poa pratensis.* Both species are said to have been introduced, but if so, they have taken kindly to their adopted home, and have proved most valuable wherever acclimated. The cut shows the Kentucky Blue-grass (*Poa compressa.*) Kentucky Blue-grass is chiefly distinguished by the woolly web at the base of the floret, and the hairs on the lateral nerves of palea; the inner palea is a very little shorter than the outer, and is occasionally bifid at the summit. The culms are generally smooth, as are the sheaths, but they are occasionally a little rough; the upper sheath is much longer than its leaf. It is indigenous in all the Northern States, generally found on calcareous soil. The following from various authentic sources, will give an idea of the value of this grass, and of the general estimation in which it is held. No grass varies so much from alterations of soil and climate and exposure, as this. The flowers are sometimes tumid and tinged with red; under other circumstances, they are a pale green, and compressed. The culms and leaves are sometimes a dark bluish green; sometimes of a pale yellowish green; sometimes one foot high, and at others over three feet. British authors enumerate six or seven sub-varieties of it, with a view of classifying these differences; we have representatives of most of them in this country. This great difference of habit causes a very different value to be assigned to it in different sections of the country. Thus, Mr. Klippart says, that it is very much in favor in Southern Ohio, whilst in Northern and Northeastern Ohio it is considered a very unwelcome guest in the grass lands. A Kentucky farmer, quoted by Mr. Flint, says of it: In our climate it is not only the most beautiful of grasses, but the most valuable of crops. It is the first deciduous plant which puts forth its leaves here,



KENTUCKY BLUE-GRASS.

a, the plant; *b*, a spikelet, and *c*, a pistil, removed from the palea, showing the scales at the base of the ovary.

ripens its seeds about the 10th of June, and then remains green, if the summer is favorable in moisture, growing slowly till about the last of August, when it takes a second vigorous growth until the ground is frozen by winter's cold. If the summer is dry, it dries up utterly, and will burn if set on fire, but even then, if the spring growth has been left upon the ground, it is very nutritious to all grazing stock, and especially to sheep and cattle and all ruminating animals. When left to have all its fall growth, it makes fine winter pastures for all kinds of grazing animals. Cattle will not seek it through the snow, but sheep, mules and horses will paw it off and get plenty without any other food. When covered with snow, cattle require some other feeding; otherwise, they do well all winter upon it. It makes also the best hay. I have used it for twenty years. It should be cut just as the seeds begin to ripen, well spread and protected from the dew at night. When properly cured, stock seem greatly to prefer it to all other hay. Thus much for the Kentucky farmer, who testifies that it is about as good as any grass can be. Dr. Darlington tells us, in his Agricultural Botany, that it is, indeed, as Muhlenberg terms it, *optimum pabulum*, being decidedly the most valuable of all the grasses known to our pastures. Prof. Buckman, of the Royal Agricultural College at Cirencester, says that it yields a good bulk for the rick, and sends up a quantity of herbage for the aftermath, which is less injured by the cold and other climatic changes than almost any other species. We have extracted these widely differing opinions respecting this grass, that our readers may see how little is really known about the grasses and how imperfectly our observations of them have been made. This is one of the most widely diffused grasses in the world. We have had the amplest opportunities for observing it, and yet we can come to no agreement upon its merits. Some things about it are admitted upon all hands. It enters into the composition of the best meadows and pastures in Europe and America. The famous pastures of Kentucky, which will fatten animals faster than any other in the known world, are filled with this grass. The fine meadows and pastures of Vermont, on the western slope of the Green mountains, contain a very large proportion (at least two-thirds) of it. Wherever the sweetest and best keeping butter is made, this grass will occupy a very conspicuous place in the pastures; the best butter can not be made where this is wholly missing in the pasture. Although some grasses start earlier in the spring, yet it affords a good bite much earlier than most species. There is no grass known that bears the extreme cold as well as this, even as far north as Vermont; after lying exposed to the cold and snow all winter it is eaten greedily by the cattle in the spring, and they are found to thrive upon it; sheep and even horses will paw away the snow in winter and eat the grass beneath with great avidity. It only sends up one flowering culm in a season, and these stand far apart; hence, at the first cutting, the burthen of hay is less than that afforded by several other species, bnt in August there is a great growth of root leaves which give a heavy bulk at the second cutting; the rowen, which is more abundant than any other, fully makes up for the deficiency of the first crop. In the west, wherever it will grow, and in the northern portion of the Southern States it is the chief reliance for winter pasture. It succeeds in light lands where fibrous rooted grasses would fail. Its nutritive properties, as given by Mr. Way, are as follows: In one hundred pounds of grass there are 67.14 pounds of water; 3.41 pounds of albuminous or flesh-forming principles; 0.86 pounds of fatty matters; 14.15 pounds of heat-forming principles, such as sugar, gum, etc.; 12.49 pounds of woody fibre, and 1.95 pounds of mineral matter or ash. According to the analyses of Scheven and Ritthausen, *Poa pratensis* gave for 100 pounds of grass, sixty-two pounds of water, four pounds of albuminous matter, 1.1 pounds of fatty matters, 15.4 pounds of heat-producing principles, 15.6 pounds of woody fibre, and 1.8 pounds of ash. The Woburn experiments show the production of an acre to be 10,209 pounds, which lost 7,337 pounds in drying, and gave 279 pounds of nutritive matter. When the seed was ripe, it yielded 8,507 pounds to the acre, which lost 5,104 pounds in drying, and gave 199 pounds of nutritive matter. The produce of the aftermath was 4,083 pounds to the acre, and yielded 111 pounds of nutritive matter. The discrepancies in these estimates of its nutritive value are undoubtedly due in a great measure to differences in the soil and climate of the places of its growth. We have never seen the culms longer than two and a half feet. Its average height in the regions that we are most acquainted with does not exceed eighteen inches. We have never seen any record of its producing more than three tons of hay to the acre, and have never actually seen a greater yield than one ton to an acre. It is well adapted for irrigation. When irrigated lands are ridged this always occupies the crowns of the ridges. Its favorite habitat is a limestone soil, which, if not too dry, will produce it in the greatest abundance. It is found in positions 3,000 feet above the level of the sea, but its valuable qualities are not manifested at over half that altitude. The seeds are acuminate or pointed, furrowed on the flat sides, and are furnished with a thick, woolly web, which entangles the seed. It weighs about thirteen pounds to the bushel. With the aid of a glass they may be clearly distinguished from the seeds of *P. trivialis*, the latter being shorter, rounder and nearly quite flat on the face. Dr. Darlington says that it is unnecessary to sow the seed in Pennsylvania if the field is well limed and manured. It will at once take possession of the land and grow vigorously. Hence, in that region the prevalence and the luxuriant growth of this grass is one of the best evidences that the land is in good condition and well managed. In many parts of Illinois, where the prairie is once depastured, although not a spear of this grass was seen before, the whole ground will be covered with it, to the complete and the permanent exclusion of the former prairie plants. In poor lands, and in those ill adapted for this grass, its growth is exceedingly dwarfish, and it would hardly be recognized by a superficial observer as belonging to the same species as that which he sees in more favored localities. It is probably owing to this cause that so many contradictory statements have been given with respect to its qualities. The straw of this grass, when bleached, is plaited like leghorn for bonnets, which are quite equal to the leghorn in beauty, and superior in fineness. None of the grasses surpass it in the beauty of its forms and the gracefulness of its movements. Nowhere can we find more fairy-like delicacy of structure and contour, more graceful curves of motion, or greater softness and purity of color, than in the expanded panicles of Blue-grass. *Poa Compressa* is also called Blue-grass and Wire-grass. The panicle is somewhat spreading in flowering time, but otherwise contracted; the branches in pairs or threes, short, flexuous, rough, often one-sided, the lowermost rather remote. Culm much compressed, decumbent, nine to eighteen inches long, usually about a foot long, geniculate at the base. It bears four or five leaves with smooth, striated sheaths. The leaves are smooth, short, linear, keeled, of a dark bluish green color. We know no grass of so dark a color except, perhaps, some specimens of *Festuca nutans*. Upper leaf about equal in length to its sheath. Perennial; rhizoma creeping, and flowers in June and July. It seems to be the prevalent opinion among botanists that it was introduced from abroad; but in some regions it certainly appears to be indigenous. It is found in dry fields and banks. Frequently it may be seen growing in the joints of slaty rocks. It is also often found in damp clays, which are intermingled with gravel and small boulders, and it would be difficult to say in which of these soils it flourishes best. It never forms a close turf, and is rarely found intermixed with other grasses. Hence it never yields a great bulk of hay, but this bulk weighs very heavily, so that the hay from an acre will weigh a ton or a ton and a half. We have often cut this amount from land on which a person unacquainted with the grass would not expect to get half a ton. It is certain that cows that feed upon it both in pasture and in hay give more milk and keep in better condition than when fed on any other grass. Horses fed on this hay will do as well as when fed on timothy hay and oats combined. This we have verified abundantly. The crops are remarkably even; it rarely suffers from excessive wetness or dryness. Sinclair says that heavy manuring very slightly increases the crop. This differs from our experience. We never, indeed, succeeded in making a thick sod, but we have by manuring caused the culms to approximate more closely than they did before, and their length has been increased to two feet, while the diameter has been at the same time enlarged. The objection to the wide interspaces between the plants may be obviated by sowing the seeds of some other grass flowering about the same time with it. Perhaps *P. trivialis* would be found to answer the purpose. It is one of the hardiest grasses known, and will grow in many places where no no other species will flourish. Sheep fatten astonishingly when fed upon it, and all grazing animals eat it with avidity. It keeps green and succulent after the seeds are ripe, even until the heavy frosts of winter. It loses less weight in drying than any other species. It is objected in some quarters that it is very difficult to exterminate from the soil, and probably in some cases the objection is well founded; but there is no difficulty in raising goed corn from its sod with the free use of the cultivator.

BLUE STONE AND BLUE VITRIOL. The sulphate of copper. It is used as a caustic to sores, and as a steep for wheat, to save it from smut.

BOG. This term is commonly used in agriculture to designate a slough or morass containing much vegetable mud or muck; often the deposits are extensive, and many feet deep. A peat bog contains peat chiefly. When bogs become consolidated or compressed, they are called peat mosses.

BOG EARTH. This earth often contains twenty or thirty per cent. of vegetable matter, and when well broken, with lime, and by exposure to air, forms a rich soil.

BOIL, or BILE. A tumor containing matter, or pus. It is the result of local inflammation. It should be brought to a head by poultices of flour or linseed, and when soft and fluctuating, opened freely with a lancet. The wound should be kept clean, and healing induced by simple dressings, after the matter is exhausted.

BOILING POINT. The temperature at which fluids boil. Thus, water at 212°, alcohol 176°, oil of turpentine 316°, ether 96°, mercury 662° Fahrenheit.

BOLE, or BOLL. In Scotland, once a common measure of grain, containing four bushels. In the old measure of Scotland, for oats and barley, four lippies made one peck; four pecks made one firlot; four firlots made one boll; sixteen bolls made one chalder. The boll of oatmeal weighs 140 pounds. For wheat, peas and rye, three oat firlots make one boll. English measures are now used. The bole of a tree is the trunk.

BOLETUS. A genus of mushroom, of which several species, subjected to analysis, have been found to yield bolitic acid.

BOLTING FOOD. Swallowing food without proper chewing; a prolific cause of indigestion in animals as well as in man. It may be hindered by feeding the animal at short intervals, and using chopped food, meal mixed with cut straw. It is often brought about by irregular feeding in connection with exhausting work until bolting becomes a habit.

BOMBAX. A genus of large trees producing a cottony substance.

BONE EARTH. (See Bones.)

BONES. The importance of bones is generally underestimated. They form the framework of all verterbrate animals, are of great value in many of the arts, and crushed, form one of the most valuable of manures. They consist in 100 parts—of mineral matter, fifty-six, the balance being gelatinous and other destructable matter. The mineral portion—the valuable part—contains about fifty per cent. of phosphate of lime, of which twenty-four per cent. is phosphoric acid. The gelatinous part of the bone consists of carbon, hydrogen, oxygen, nitrogen, and sulphur. One hundred parts of gelatine of bones produce, when fermented, twenty-two pounds of ammonia, together with carbonic acid. Sulphur is also an ingredient of plants. Phosphate of lime is soluble in all acids, and we may say that all the the phosphates are soluble in an excess of acid. When bones are surrounded by fermenting organic matter, such as is offered in a manure or compost heap, the phosphate of lime is dissolved in the humidity by the carbonic acid which is constantly being evolved by the fermenting mass. This operation is more or less prompt, according to the activity of the fermenting heap. In the field, where carbonic acid is always present, this process is constantly going on; but, owing to the presence of the cartilaginous or gelatinous portion which surrounds the particles of phosphate, the action is less apparent on a large bone than if it were in powder, and the finer the powder the more rapid the decomposition. Bones vary much in their composition, according to the age or variety of the animal. The amount of mineral matter is less in a young animal than in an old one, and the quantity increases gradually with age. Schreger found that the bones of a child contain one-half of phosphate in the entire mass of earthy matter, while those of a full-grown person give four-fifths, and an aged person not less than seven-eighths. The bones of adults contain less water than those of children. When a bone is sufficiently digested in muriatic acid, the mineral part is dissolved, leaving the gelatine, or cartilage, intact, which retains the original form of the bone. Large amounts of gelatine, or glue, are thus made. That portion of the bone dissolved in the acid consists of phosphate of lime and magnesia, fluoride of calcium, and carbonate of lime, with small quantities of salts of potash and soda. All who work the soil know that bones are most valuable applied to all cereal crops, and the grasses and in root crops. The following method of preparing bones on the farm, is from Mr. Pusey, a practical English farmer: The process depends upon the fact that bones consist, to the amount of one-third their weight, of cartilage or animal matter, which, under the influence of warmth and moisture, readily decomposes (ferments or decays) and loses its texture, so that the bones fall to dust. From the closeness and solidity of the bony structure, decay is excited and maintained with some difficulty. A single bone, or a heap of bones, never decays alone, but dries and hardens on exposure. If, however, bones in quantity be brought into close contact with some easily fermentable moist substance, but little time elapses before a rapid decay sets in. So, too, if fresh crushed bones are mixed with sand soil, or any powdery matter that fills up the spaces between the fragments of the bone, and makes the heap compact, and then are moistened with pure water, the same result takes place in warm weather, though more slowly. The practical process may be as follows: The bones, if whole, should be broken up, as far as convenient, by a sledge-hammer, and made into alternate layers with sand, loam, saw-dust, leached ashes, coal ashes, or swamp muck, using just enough of any one of these materials to fill compactly the cavities among the bones, but hardly more. Begin with a thick layer of earth or muck, and as the pile is raised pour on stale urine or dung heap liquor enough to moisten the whole mass thoroughly, and finally, cover a foot thick with soil or muck. In warm weather the decomposition goes on at once, and in from two to six or more weeks the bones will have entirely or nearly disappeared. If the fermentation should spend itself without reducing the bones sufficiently, the heap may be overhauled and built up again, moistening with liquor manure and covering as before. By thrusting a pole or bar into the heap, the progress of decomposition may be traced, from the heat and odor evolved. Should the heap become heated to the surface, so that ammonia escapes, as may be judged by the smell, it may be covered still more thickly with earth or muck. The larger the heap, the finer the bones, and the more stale urine or dung-liquor they have been made to absorb, the more rapid and complete will be the disintegration. In the heaps, horse dung or other manure may replace the ashes, etc., but earth or muck should be used to cover the heap. This bone compost contains the phosphates of lime in a finely divided state, and the nitrogen of the cartilage, which has mostly passed into ammonia or nitrates, is retained perfectly by the absorbent earth or muck. When carefully prepared, this manure is adapted to be delivered from a drill-machine with seeds, and, according to English farmers, fully replaces in nearly every case the super-phosphate made by help of acid. And this we can indorse. As showing the value of bone phosphate in restoring fertility to soils worn under successive croppings of wheat, we append the following from the report, the results as stated by a committee of experts: An analysis of the grain of wheat, that part of the plant which is not again returned to the soil, shows that nearly fifty per cent. of the ash constituent is phosphoric acid, and this is equally true of nearly all the cereal crops. When it is considered that our most fertile soils contain a very small percentage of this essential element, and that in many soils there is scarcely a trace, its real importance in an agricultural point of view can not be questioned. Under our system of cropping, the mineral elements first exhausted are the phosphates, and while conceding that no special manure can be regarded as a substitute for barn-yard manure, the question arises, can the farm be made to sustain its productiveness by the use of manures made solely from the products of the farm? Every bushel of grain and roots; every pound of cheese, butter, and wool; every ton of hay and straw sold, carries away a portion of the organic mineral elements of the soil; and, if something is not added to supply this deficiency beyond the ordinary accumulations of the barn-yard, gradual but certain deterioration of the soil must necessarily follow. The largely increased yield of wheat by the use of clover and plaster on fields partially exhausted by tillage, the clover being plowed under as a green crop, has led some to suppose that nothing else is needed to retain or restore the fertility of their land. Without doubt there are important benefits derived from the use of clover and plaster as fertilizers; indeed, a soil may have an available supply of minerals for a wheat crop of forty bushels per acre, but if deficient in ammonia, the crop, depending solely upon the atmosphere for its supply, the yield will not exceed eighteen or twenty bushels, under the most favorable circumstances of weather, ammonial manures being necessary to increase the yield. Yet, valuable as is the clover crop in furnishing this essential organic matter to the cereal crop, it adds no mineral matter to the soil. The clover crop and the ordinary accumulations of the barn-yard are not sufficient to restore the mineral elements of which the soil is deprived by successive grain crops, and it is necessary to resort to other fertilizers to restore this deficiency. The phosphates, among the mineral elements, necessarily first disappearing on a wheat farm, the value of bone-dust and super-phosphates can not be questioned, the former containing about fifty per cent. of phosphoric acid. But it will not do to rely upon this alone, as will be apparent when the constituents of bone-dust are considered. One hundred pounds of raw bones may be estimated to contain eleven pounds of water, forty-five pounds phosphate of lime, thirty-eight pounds fat and gelatine, of which about five pounds are nitrogen; of the phosphates about fifty per cent. are phosphoric acid. If all the nitrogen is preserved, 100 pounds of bones would furnish the amount expended in growing a bushel of wheat; an application of 400 pounds per acre would furnish only twenty pounds of nitrogen, about one-third the quantity contained in clover, equalling one ton of hay. The committee think, that in connection with a proper use of clover as an organic fertilizer, the wheat crop may be largely and profitably increased on impoverished soils by an application of 300 to 400 pounds of bone-dust per acre; on soils not greatly impoverished a smaller quantity may be used. It is sometimes the case that bone-dust, when no other manures are used, fails to materially benefit the wheat crop to which it is immediately applied. This is attributed chiefly to a deficiency of ammonia; and when the wheat crop, under such circumstances, is only slightly benefited, the clover sown the succeeding spring, which obtains a large proportion of its ammonia through its broad leaves from the atmosphere, will be largely increased by the decomposing phosphates applied in the fall, thus accumulating ammonia for the succeeding wheat crop. The failure of bone-dust to benefit the crop to which it is first applied is owing also to its undecomposed condition. In one instance given, 500 pounds per acre was applied to corn without benefit; the second year it helped the corn, and the third year after the application, the yield of wheat was four bushels per acre greater than the product of land in the same field not so dressed. On soils where no phosphates have been applied, an immediate fertilizer being needed for a summer crop, a well-prepared super-phosphate is recommended as preferable to undecomposed phosphate. The effects of a properly-prepared super-phosphate upon a turnip crop are frequently almost magical, the crop being increased four or five fold by an application of 400 to 500 pounds per acre. When used for wheat and clover, it should be well mixed with the surface soil, in a partially fermented condition, before the wheat is sown. Ample time will thus be given for a portion of the phosphates to be decomposed, and taken up in solution by the roots and plants, and organized in the grain. After the wheat crop has matured, the clover sown in the spring will be still further benefited by the gradual decomposition. Ashes, both leached and unleached, are highly valuable as additional fertilizers in furnishing potash and other minerals for the cultivated crops. In closing their report, the committee state, that under the system of cropping, so widely prevalent, the most careful preparation and use of all the available bones in Michigan will not replace the phosphates withdrawn from the soil by the frequent recurrence of the wheat crop; and that, to increase the productiveness of their lands, farmers must lessen the proportion of acres annually devoted to wheat, keep more stock, and thus manure more highly from the products of the farm, and with other valuable fertilizers. One of the best means the editor of this work has ever found for making super-phosphate is in the bone-black, or animal charcoal, used in refining surgars, and for filtering any substances requiring refining. Bone-black is made by burning bones in a closed vessel, by which they are converted into bone charcoal. They are then ground and used in the refineries. The waste bone-black—about twenty-five to forty per cent. of the quantity used—which accumulates in twelve months, is no longer of value in the refining. This is treated with sulphuric acid and converted into super-phosphate of lime and sold for fertilizing purposes. Bone ash is obtained by burning bones with access of air or oxygen. Thus the organic matter, gelatine, etc., is burned out, and the friable residue is easily acted on by sulphuric or other acids. When mills for crushing are not available, and bones and sulphuric acid are cheap, this is an easy way of obtaining bone ash, which may be converted for use by means of sulphuric acid.

BONE SPAVIN. A disease of the hock joint in horses, brought on by over exertion. While forming there is continued lameness. (See Spavin.)

BORAGE. *Borago officinalis.* A rough weed growing two feet high. It is used as a fallow crop in Germany, and, according to Lampadius, contains nitre. It seems to be admirably adapted for this purpose.

BORAX. Borate of soda, used as a flux in welding steel, in washing clothes, etc. Borax is now extensively prepared in California.

BORDER. In gardening, the edges of beds. They should be well spaded and manured, so as to be made the richest parts of the garden; thus, when we are directed to plant in borders, it is usually meant that deep, good soil, and free space are required. The word is also used to designate a bed specially prepared and protected, for assisting the early growth of plants that require some forcing to enable them to mature before the autumnal frosts, and also used for hardening plants before their transplanting, for ripening in the rows where they are to stand.

BORECOLE. *Brassica oleracia* (called by the Scotch, Kale) is one of the many varieties of the cabbage family. It is distinguished by a large open head, and generally by curled or wrinkled leaves, and is almost hardy. It is thought very valuable for cultivation in the Southern States, because it requires little or no protection during the winter months. The principal sub-varieties are—Scotch Kale, Green Curled, Cæsarian Kale, and Thousand-headed Cabbage. Sow the seed—one ounce of which will furnish four thousand plants, or about that number—about the time of sowing late cabbage seed. Transplant in July into rich, mellow soil, and cultivate as cabbage. For preservation in the open air through the cold weather, the plants should be set quite close together in a trench, with the earth drawn up to the lower leaves and covered with straw or litter; when a head is wanted, it is only necessary to remove the covering and cut off the stalk with a knife, leaving the stump in the ground, where it will produce fine greens in the following spring, south of the latitude of 39° and even up to 40°, with protection.

BORERS. The larvæ of a class of beetles—the Long-horned, or Capricorn beetles (*Cerambycidæ*), although there are many borers or wood-eating larvæ which do not belong to this tribe. They will be treated under their appropriate names. The Short-horned Wood-borers (*Scolytidæ*) do comparatively little damage to the agriculturist.

BOS. The generic name of ruminating quadrupeds, having the characters of the ox and buffalo. (See Cattle.)

BOTANY. Botany has been defined as being the science which treats of the structure of plants, the functions of their parts, their places of growth, their classification, and the terms which are employed in their description and denomination. Economic botany may be defined as teaching to distinguish between useful and noxious plants, and a correct knowledge of those plants necessary in daily life. Botany, in a strict sense of the term, is the science which teaches the arrangement of the members of the vegetable kingdom in a certain order or system, by which we are enabled to ascertain the name of any individual plant with facility and precision. Such arrangement is only to be considered as useful in proportion as it facilitates the acquirement of a knowledge of their economical and medicinal qualities, which cannot be perfectly ascertained without an acquaintance with vegetable physiology, the parts of plants, their functions and uses. Botany, in its most comprehensive form, teaches us the names, arrangement, parts, functions, qualities and uses of plants. It will not be necessary here to go into structural botany. It will be interesting, however, to become acquainted with leaf forms. Consequently we give a series of carefully prepared illustrations, showing the various shapes they assume. The cuts, Figs. 1 and 2, show the apex and bases of leaves, with their forms and names. Coming now to the forms of leaves, the accompanying cut, Fig. 3, will show, *a*, repand leaf of Enchanter's Nightshade; *b*, double serrate leaf of Elm; *c*, undulate leaf of Shingle Oak (*Q. imbricaria*); *d*, crenate leaf, Catmint; *e*, dentate leaf of Arrow-wood (*Viburnum dentatum*); *f*, serrate leaf of Chestnut; *g*, lobed leaf (*Chrysanthemum*). Leaves, it may be remarked, are described by their forms, patterns of the borders, or margins. These are various, and always beautiful to the educated eye. Some are hairy, some are smooth, and others covered with an enamel of silex, presenting a glistening surface. The quince and lily have their margins entire and even. The willow is notched in the margin like a saw, but the teeth all point one way, like those of a saw for ripping boards. Thus they are serrate, or if the notches are very fine, serrated. If the teeth point neither forward or backward, but outward, they are dentate, or like teeth; and again, if the teeth are quite small they are denticulate. But the teeth themselves may be again toothed. Then they are doubly dentate; or, the serratures of a leaf may be notched. They are then doubly serrate, as in the elm, Fig. 3. So, in the apex of leaves there is something to learn. The apex may be *acuminate*, ending in a long, tapering point; or *cuspidate*, suddenly contracted to a sharp slender point; *mucronate*, tipped with a spiny point; *acute*, simply ending with an angle; *obtuse*, blunt. Or the leaf may end without a point, being *truncate*, as if cut square off; *retuse*, with a rounded and slightly depressed end where the point should be; *emarginate*, having a small notch at the end; *obcordate*, having a deep indentation at the end. This may seem to some readers of but little practical value, nevertheless, it is one of the important things upon which the study of botany rests, and valuable to every child who studies botany, even from a purely practical standpoint. Thus we have delineated something of the more simple form of leaves. In the scope of this work, while giving condensed information from an experience of over a quarter of a century, of manual labor on the farm, supplemented by constant reading of the best authorities, careful experiment, and the close application of all to the practical working of the farm, we have followed authorities only so far as they do not conflict with the practical application of science. Scientific names are of value to a large class of readers, and for the reason that the Latin has been adopted where civilization

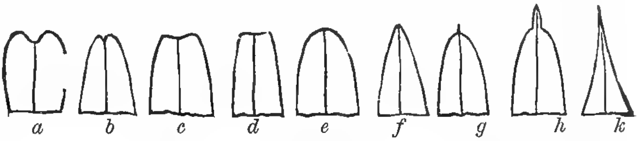


FIG. 1.

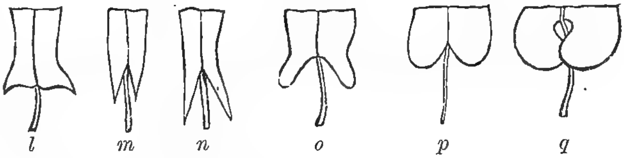


FIG. 2.

FIG. 1. Apex of leaves: *a*, obcordate; *b*, emarginate; *c*, retuse; *d*, truncate; *e*, obtuse; *f*, acute; *g*, mucronate; *h*, cuspidate; *k*, acuminate.

FIG. 2. Bases of leaves: *l*, hastate; *m*, *n*, sagittate; *o*, auriculate; *p*, cordate; *q*, reniform.

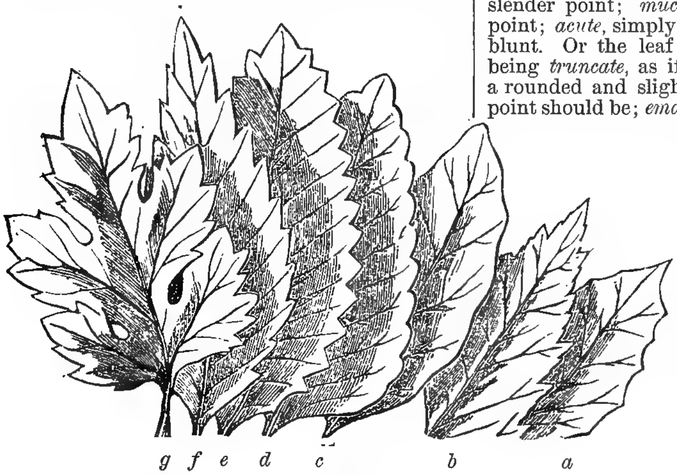


FIG. 3.

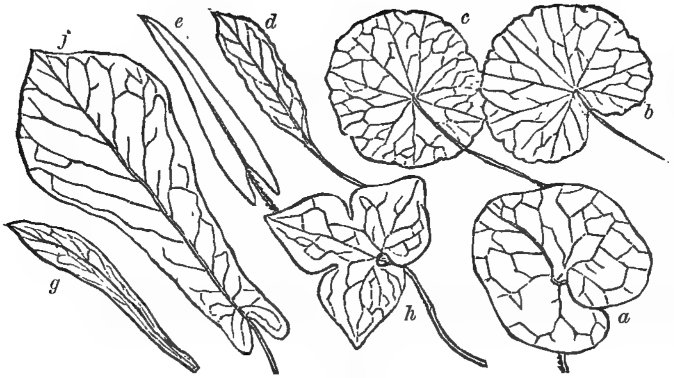


Fig. 4.

extends, as a language with which scholarly men are acquainted, and hence is a medium used which all readily understand. Thus, whatever common names may be used for one and the same object, its true name is always expressed scientifically by a name, synonyms scarcely ever being allowed, except inserted in parenthesis. In the above cut, Fig 4, are shown at *a*, reniform leaf of Wild Ginger; *b*, reniform leaf of Pennywort; *c*, peltate leaf of Pennywort; *d*, oblong leaf of Toothed Arabis; *e*, arrow-shaped leaf of Scratch Knot-grass; *f*, obovate-spatulate, articulate at base, Fraser's Magnolia; *g*, spatulate leaf of Silene Virginica; *h*, three-lobed leaf of Liverwort. In the next cut, Fig. 5, the form shown at *a*, runcinate leaf of Wild Lettuce; *b*, pinnatifid leaf of Celandrine; *c*, pinnatisect leaf of Fennel-flower. The next series of leaves, Fig. 6, shows *a*, ovate leaf of Pear-tree; *b*, lanceolate leaf of Flowering Almond; *c*, narrow lanceolate leaf; *d*, deltoid leaf of White Birch. The next series, Fig. 7, shows *a*, obovate leaf of Smoke-tree (*Rhus cotinus*); *b*, orbicular leaf of Winter-green (*Pyrola*); *c*, oval leaf of Plum-tree; *d*, elliptical leaf of Black Haw; *e*, oblong leaf of willow. In the next illustration, Fig. 8, are still other forms, as *a*, leaf with five cut lobes, almost guinate (*Potentilla anserina*); *b*, ternate, with palmate, three-toothed leaflets (*Potentilla tridentata*); *c*, binate leaf (*Jeffersonia diphylla*); *d*, simple leaf jointed to the petiole, Lemon. Fig. 9, rose leaves (compound leaves); at *a*, in this cut, shows the stipules adnate (a stipule is an appendage at the base of a leaf somewhat resembling a small leaf in texture and appearance); *b*, shows a leaf of violet (*V. tricolor*) with gashed stipule. The next cut, Fig. 10, shows Red Clover; a compound leaf at *a*; *b*, simple leaf, Weeping Willow; *c*, ensiform (sword-shape) leaf of Iris, or Fleur-de-lis; *d*, acerose (needle-shaped) leaf of Scotch Pine. In the next illustration, Fig. 11, still other forms of leaves are given, as *a*, amplexicaul leaves (Aster *lævis*); *b*, perfoliate leaves of Bellwort (*Uvularia perfoliata*); *c*, connate leaves of Honeysuckle (*Lonicera sempervirens*). The next cut, Fig. 12, shows at *a*, an orbicular leaf of Round-leaved Orchis; *b*, a sagittate leaf of Arrowhead; *c*, a cordate leaf of Pond-weed; *d*, lanceolate leaves stem and flower of Lily of the Valley; and *e*, linear leaves of Blue-eyed grass (*Sisyrinchium*). The next illustration, Fig. 13, will show forms of leaves, including some of the oaks and other curious forms, as *a*, bi-pinnatifid leaf of Pig-weed (Goose-foot family); *b*, sinnate-lobed leaf of White Oak; *c*, undulate-

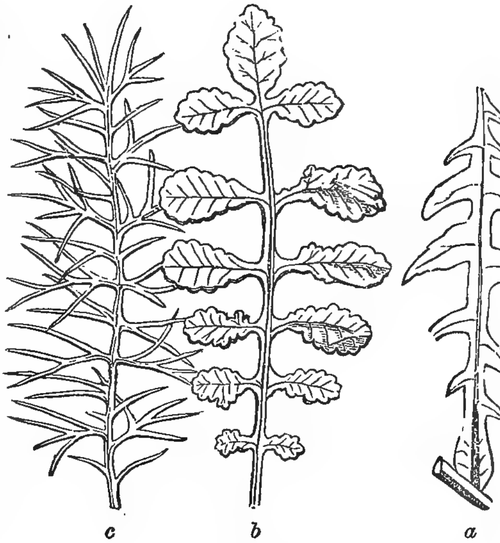


Fig. 5.

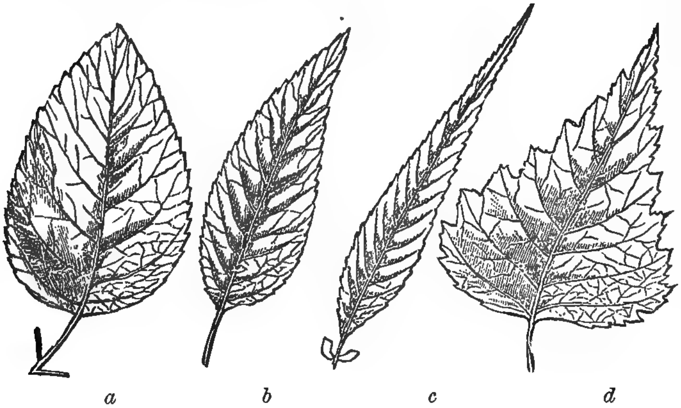


Fig. 6.

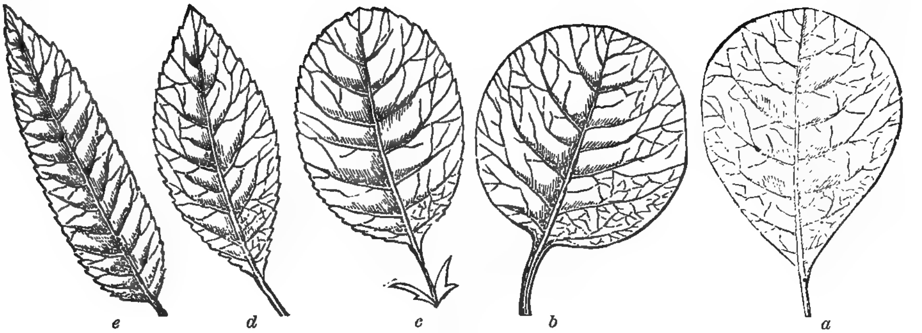


FIG. 7.

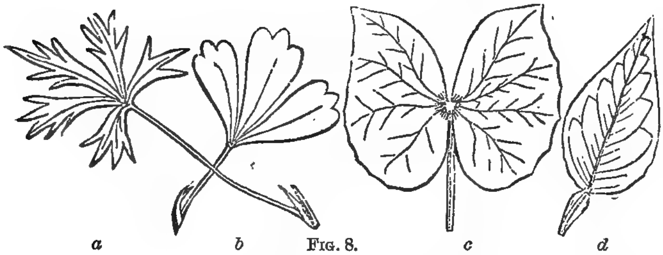


FIG. 8.

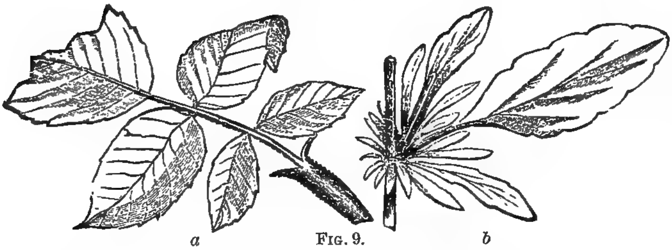


FIG. 9.

lobed leaf of Jack Oak; *d*, lyrate leaf, Moss-cup Oak; *e*, lobed leaf of Blue Milk-weed (*Mulgedium*). The two figures in the next illustration, Fig. 14, will close the forms of leaves exhibited. They are, *a*, tri-pinnate leaf of Honey Locust; *b*, tripinnate leaf of Poison Hemlock. The very complete glossary of botanical terms appended to this article, will explain not only the meaning of the terms used, but also, others in general use among botanists. They are given, as are the forms of leaves, not as constituting a text work to the student in botany, but as helps to those who wish to acquire practical knowledge in the science, as brought into the every day life of the worker of the soil, and especially as a means of initiating the young into a love of this important and interesting study. That every farmer should know something of the history and characteristics of plants is certainly necessary. Indeed, there is no farm laborer, however ignorant, but what acquires a very considerable knowledge in this direction, simply by observation. To assist all who have not pursued botany as a study, this article and its object-lessons will be of value. The history of the development of the seed, and the essentials in the biography of the plants is contained as follows: The shell of a seed may be of any color, as white, black, yellow, red, etc.; may be polished and shining, or dull and rough; may be of any shape, as round, or oval, or egg-shaped; may be winged, as in Catalpa, or may be clothed with long hairs, called coma. The silk of Silk-grass (*Asclepias*) is the coma of the seed, and cotton is the coma of cotton seed. The seed of poplar (cotton-wood) or willow is also furnished with coma. The first stage of growth is called germination. (See article on Germination.) As to how it grows, the water which the plant imbibes by its roots becomes sap in the stem, and circulates in every part as the blood circulates in the animal frame The leaves, by their broad, thin forms, serve as lungs, to bring all the sap passing through them into contact

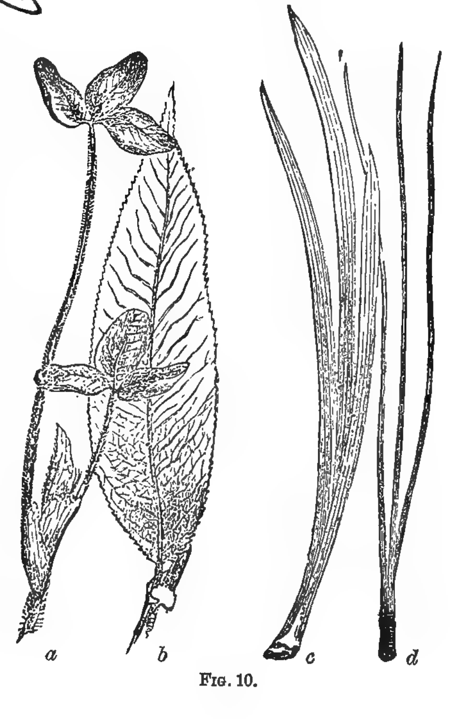


FIG. 10.

with the air and light. By this means the sap is changed into a nourishing food, fitted to sustain the growth of the plant in every part. Thus the leaves are designed, not only as an ornamental robe, but as organs of breathing and digestion. In the second stage of growth, when the plant depends no longer upon the seed for nourishment, it goes on increasing in stature and multiplying its leaves and branches. It now consists of three parts, viz: root, stem and leaves. These are called the organs of vegetation. The third stage of plant-life is the period of flowering. Before this period all its activity was devoted to its own nourishment and growth. Now it begins to live and act for the continuance of its own kind after it upon the earth, according to the Divine decree in Genesis, 1. 11. Some of its buds undergo a striking change, and open each a flower instead of a leafy branch. A flower is therefore a leafy branch transformed having its axis undeveloped, its leaves in crowded circles, moulded into more delicate forms and tinged with brighter colors, not only pleasing to the eye, but also as a means of attracting insects to assist fertilization to prepare the way for fruit. (See illustration) The fourth stage of plant-life is the period of its fruit-bearing. The flowers have gradually faded and disappeared, but the pistil, having received the quickening pollen, remains in its place, holds fast all the nourishing matter which continues to flow into it through the flower-stem, grows, and finally ripens into the perfected fruit and seed. The fifth and last stage in the biography of the plant is its hibernation, the winter cessation of growth, or its death. If the event of flowering and fruit-bearing occur within the first or second year of the life of the plant, it is generally followed by its speedy death. In all other cases it is followed by a state of needful repose, wherein it is commonly stripped of its leaves, and gives few, if any, indications of life, until awaked, with renewed vigor, in the

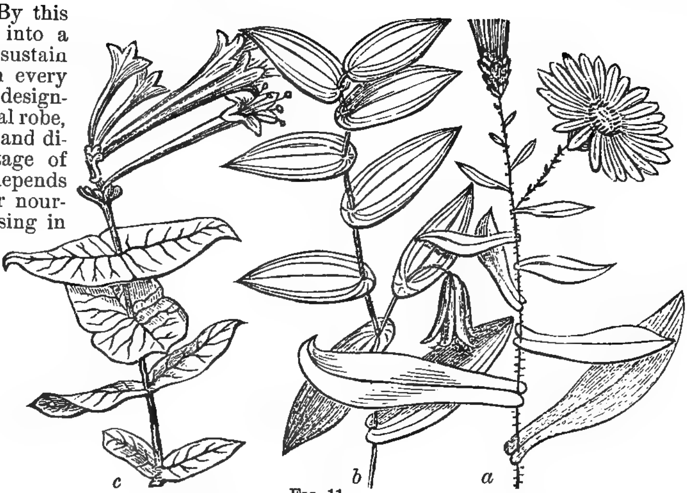


FIG. 11.

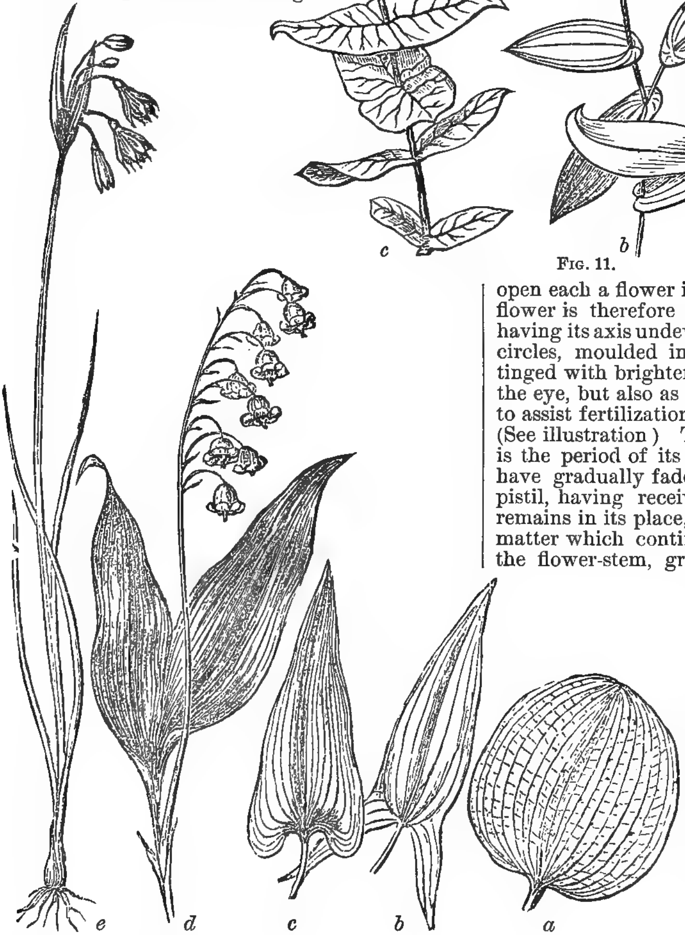


FIG. 12.

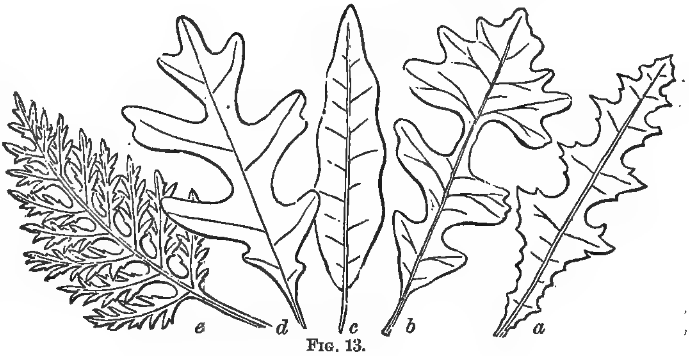


FIG. 13.

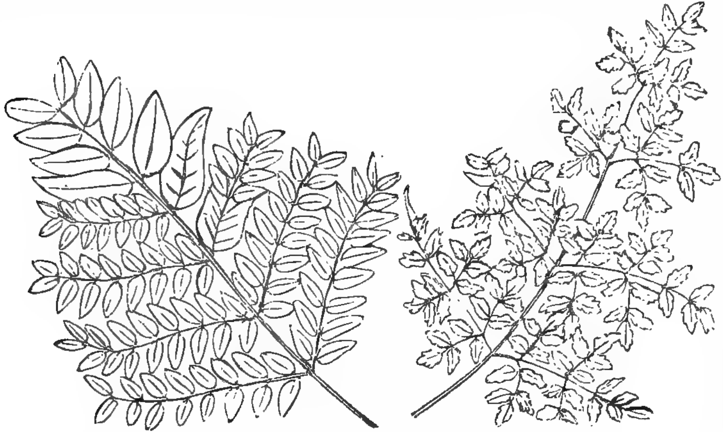


Fig. 14.

following spring. According to their different terms of life, we distinguish plants as annuals, biennials, and perennials. An annual herb completes its whole history in one year. In the spring it germinates; in summer it grows, blooms, bears fruit; and in autumn its work and life are ended. The mustard, maize and morning-glory are such. A biennial herb lives two years. During the first it germinates, grows, and bears leaves only; and in its second year it blossoms, bears fruit and dies. Such is the beet and radish. A perennial plant survives several or many years. There are herbaceous perennials and woody perennials. The herbaceous perennials, or perennial herbs, are such as survive the winter only by their roots or their parts which grow underground. These in spring send up leaves, flowers, and often stems, all of which perish in autumn, leaving only the parts under the ground alive as before. Such are the hop, asters, violets. Woody perennials survive the winter by their stems as well as roots, and usually grow for several years before flowering, and then flower annually during their existence. According to their size, such plants are trees, shrubs, undershrubs. A tree is the largest among plants, having a permanent, woody stem, usually unbranched below, and dividing into branches above. The oaks, elms and pines are familiar examples. A shrub is smaller than a tree, usually growing in clusters from one underground mass of roots. The lilacs, roses, alders, are shrubs. Small shrubs, about of our own stature, as the currants, brambles, we call bushes. Very low shrubs, as the blueberries, box, etc., are undershrubs. Plants are divided into phænogamous or flowering plants, or cryptogamous or flowerless plants; the first comprise the more noble; the second having spores instead of flowers. To these belong the Scouring Rush, Ferns, Club-moss, Mushrooms, etc. Flowering plants are vegetables bearing proper flowers, having stamens and pistils, and producing seeds which contain an embryo. They are *dicotyledonous* or exogenous, and *monocotyledonous* or endogenous plants. *Dicotyledonous* or exogenous plants have the stems formed of bark, wood and pith; the wood forming a layer between the other two, increasing, when the stem continues from year to year, by the annual addition of a new layer to the outside, next the bark. Leaves netted-veined; embryo with a pair of opposite cotyledons, or rarely several in a whorl; flowers having their parts usually in fives or fours. *Monocotyledonous*, or endogenous plants, have stems with no manifest distinction into bark, wood and pith; but the woody fibre and vessels collected into bundles or threads, which are irregularly imbedded in the cellular tissue; perennial trunks destitute of annual layers; Leaves mostly parallel-veined (nerved) and sheathing at the base, seldom separating by an articulation, almost always alternate, or scattered and not toothed. Parts of the flower commonly in threes. Embryo with a single cotyledon (and the leaves of the plumule alternate). Indian corn, the other grasses, etc., are examples of the latter; the oak, elm, apple-tree and many others, are of the former. Species of plants are comprised of all individuals of the same kind, and are

FLOWERS OF THE MAGNOLIA SPECIOSA. (ONE-FOURTH NATURAL SIZE.)

descended from a common stock. A genus is an assemblage of species which are much alike, especially in their flowers and fruit. Thus, flax is a genus made of similar species. Clover is a genus composed of 150 species. Pine is a genus, embracing as species White Pine, Yellow Pine, Pitch Pine, Long-leaved Pine, and many others. Individuals of the same species may differ somewhat among themselves, and these differences constitute varieties. Thus apple trees differ in their fruit, and there are hundreds of varieties although only one species. Roses differ in their form, color, and fragrance of their flowers, forming many varieties under each species. Natural orders are made up of genera. Just as similar species form a genus, so similar genera form natural orders. Thus individuals, form species, species form genera, and genera form orders. These, as previously stated, are again divided into the two sub-kingdoms—flowering plants and flowerless plants. The first called *Phænogamia* and the latter *Cryptogamia.* Exogens have the wood in concentric rings or layers, formed year by year, the outer the newest. By counting these, one may form a definite idea of the age of the tree. The leaves of this class are net-veined, the flowers seldom or never completely three-parted, and the seed two-lobed. The endogens have their wood, if any, confused, the inner portion being the newest. Their leaves are parallel-veined, flowers three-parted, and seeds one-lobed. Exogens are of two forms, vessel seeded, called *angiosperms,* and naked seeded called *gymnosperms.* Exogens generally have pistils to the flowers, with young seeds inclosed in their ovaries. The pines, yews, etc., have no pistils, or at least no stigmas to their inflorescence, and produce naked seeds, and hence are called *gymnosperm,* from the compound Greek word signifying naked-seeded. The grasses, endogens, have their flowers enveloped in green alternate scales, glumes, instead of the circle of pistils common to other flowers. Thus the division is made into glume plants and glumeless plants, called *glumiferæ* and *petaliferæ.* Thus, all flowering plants are divided into four classes, as follows: *Angiosperms;* exogens bearing stigmas and seed-vessels. *Gymnosperms;* exogens with no stigmas, and with naked seeds, as the pines, firs, larches, cedars, cypresses, yews, etc. *Petaliferæ;* endogens with no glumes and ordinary flowers. *Glumiferæ;* endogens with glumes instead of petals, as the Grasses, Sedges, Grains. *Angiosperms* may be readily distinguished from *gymnosperms,* from the fact that nearly all the latter are cone-bearing, as the Pine, Cedar, Larch, etc. Below we give a tabular view of the natural system of classification of plants:

Kingdom.	Sub-kingdoms.	Provinces.	Classes.	Cahorts.
Vegetables..........	Phænogamia..........	Exogens..........	Angiosperms............	Dialypetalous. Gamopetalous. Apetalous.
			Gymnosperms..........	=Conoids.
		Endogens..........	Petaliferæ..............	Spadicifloræ. Florideæ.
			Glumiferæ..............	=Graminoida.
	Cryptogamia..........			

1. Flowering plants. (See No. 2)..... Phænogamia.
1. Flowerless plants. (See No. 9)........Cryptogamia.
2. Leaves net-veined. Flowers never quite three-parted..........................Exogens.
2. Leaves parallel-veined. Flowers three-parted..............................Endogens.
3. Stigmas present. Seeds in seed-vessels.Angiosperms.
3. Stigmas none. Seeds naked. Pines, spruces, etc..........................Gymnosperms.
4. Flowers without glumes, having petals, etc..................................Petaliferæ.
4. Flowers with green, alternate glumes, no petals..............................Glumiferæ.
5. Petals distinct and separate............Polypetalæ.
5. Petals united more or less.............Gamopetalæ.
5. Petals none.............................Apetalæ.
6. The cone-bearing plants; as cedars, larches..................................Conoids.
7. Inflorescence a spadix..................Spadicifloræ.
7. Inflorescence not a spadix ....Florideæ.
8. Grass-like plants......................Graminoids.
9. Ferns, mosses, lichens, sea-weeds, mushrooms.

Abbreviations and scientific signs, often used in descriptive botany (omitting contractions for signs of the compass, the months and the States, as being generally understood) are as follows:

ach., achenia.
æst., æstivation.
alter., alternate.
anth., anther.
axill., axillary.
c., common.
cal., calyx.
caps., capsule.
cor., corolla.
decid., deciduous.
diam., diameter.
emarg., emarginate.
f. or *ft.*, feet.
fil., filament.
fl., flower; *fls.*, flowers.
fr., fruit.
hd., head; *hds.*, heads.
hyp., hypogynous.
imbr., imbricate.
inf., inferior.
invol., involucre.
irreg., irregular.
leg., legume.
lf., leaf; *lvs.*, leaves.
lfts., leaflets.
ova., ovary.
pet., petals.
r., rare, uncommon.
recp., receptacle.
reg., regular.
rhiz., rhizome.
rt., root.
sds., seeds.
seg., segments.
sep., sepals.
st., stem.
sta., stamens.
stig., stigmas.
sty., styles.

f. (with or without the period) a foot.
′ (a single accent) denotes an *inch* (a twelfth of one foot).
″ (a double accent) a second, a *line* (a twelfth of an inch).
⊙ An annual plant.
⊙ A biennial plant.
♃ A perennial plant.
♄ A plant with a woody stem.
♂ A staminate flower or plant.
♀ A pistillate flower or plant.
☿ A perfect flower, or a plant bearing perfect flowers.
⚥ Monœcious, or a plant bearing staminate and pistillate flowers.
♀ ♂ Diœcious; pistillate and staminate flowers on separate plants.
♀ ☿ ♂ Polygamous; the same species, with pistillate, perfect, and staminate flowers.
0 (a cipher) signifies wanting or none, as "Petals 0."
§ (placed after) a naturalized plant.
† (placed after) cultivated for ornament.
‡ (placed after) cultivated for use.
∞ Indefinite or numerous.

The very complete glossary, compiled by the late and lamented Dr. Darlington, will be found important and very interesting in connection with botany in its relation to agriculture. The reader will bear in mind, that where compound descriptive terms are employed the last member of the compound word is intended to give the predominant character, and that the word or syllable prefixed merely indicates a modification of that character; as for example. Ovate-lanceolate signifies lanceolate, but inclining somewhat to ovate; while lance-ovate means ovate with something of the lanceolate form, etc. So of colors: yellowish-green, bluish-green, signify that green is the prevailing hue, but that it is tinged with a shade of yellow, blue, etc. Terms indicative of the size of any organ, or portion of plant as large, small, or middle-sized, are of course, relative, and have reference to the usual or average size of such parts, or organs, in other species of the same genus, or family.

A; at the commencement of a word, signifies the absence of some part; as apetalous, destitute of petals. When the word commences with a vowel, an is prefixed.

Abnormal; different from the regular or usual structure.

Abortion; an imperfect development of any organ.

Abortive; not arriving at perfection; producing no fruit.

Abrupt. Not gradual; sudden.

Abruptly acuminate; suddenly narrowed to an acumination.

Abruptly pinnate. (See Even-pinnate.)

Acaulescent; apparently stemless.

Accessory; additional, or supernumerary.

Accumbent cotyledons; having the radicle applied to the cleft, or recurved along the edges of the cotyledons (represented by this sign, o=), as in some Cruciferous plants.

Acerose; linear and needle-like, as Juniper leaves, etc.

Achenium. (See Akene.)

Achlamydeous; applied to flowers that have no floral envelopes.

Acicular; needle-shaped.

Acotyledonous; destitute of cotyledons, or seed-leaves.

Acrogenous plants. Plants which grow or develop from the apex or summit, only, of the stem.

Acrogens; Apex-growers, or acrogenous plants.

Aculeate. Prickly; armed with prickles.

Aculeolate; armed with little prickles.

Acuminate; ending in a produced tapering point.

Acumination; An extended tapering point.

Acute; sharp; ending in an angle, or point not rounded.

Adherent; attached to, or united with another different organ, as the calyx-tube to the ovary, etc.

Adnate; adhering laterally; fixed or growing to.

Adventitious; happening irregularly; not produced naturally or usually.

Æquilateral. Equal sided; not oblique.

Æstivation. The mode in which sepals and petals are arranged in the flower-bud before they expand.

Aftermath. The second growth of the grasses in the same season, after being cut off.

Aggregated; crowded, or standing together on the same receptacle.

Akene, or *achenium.* A one-seeded fruit with a dry indehiscent pericarp; often bony or nut-like.

Alæ. Wings, or membranous expansions.

Alate. Winged; having a membranous border.

Albumen. A deposit of nutritive matter, distinct from the embryo, found in many kernels, and sometimes (as in the grasses) constituting their chief bulk.

Albuminous seeds; furnished with, or containing albumen.

Alternate. Not opposite; placed alternately on the axis, or receptacle.

Alveolate; having pits or cells like a honey-comb.

Ament. A slender spike of naked and usually separated flowers, with imbricated scales or bracts.

Amorphous; without definite form.

Amplexicaul; embracing or clasping the stem.

Amphitropous ovule; when it is half inverted and stands across the apex of the stalk or funiculus.

Amylaceous; starch-like.

Analogue. A body or organ resembling, substituted for, or equivalent to, another body or organ.

Anastomosing; applied to branching vessels which inosculate, or unite again, like net-work.

Anatropous ovule or seed. Turned; inverted on the funiculus, so that the orifice or apex points towards the placenta.

Ancipital. Two-edged; somewhat flatted with opposite edges.

Andrœcium; a term employed to designate the staminate portion of a flower; the stamens or fertilizing organs in the aggregate.

Androgynous; having staminate and pistillate flowers distinct, but on the same spike, or plant.

Angiospermous; having the seeds contained in a distinct pericarp, or seed-vessel.

Angulate; having angles, or corners, mostly of a determinate number.

Annotinous; applied to leaves, etc., which are annual, or renewed every year.

Annual; living or enduring but one year.

Annular; in the form of a ring.

Annulate; having a ring or belt.

Anomalous. Not according to rule or system; forming an exception to usual appearances, or structure.

Anterior; in front, as that part of a flower next to the bract, or farthest from the axis of inflorescence.

Anther. The knob, or capsule, containing the pollen, usually supported on a filament.

Antheriferous; bearing anthers.

Antrorse, or *antrorsely;* pointing forwards or upwards.

Apetalous. Destitute of petals; not having a corolla.

Apex; the summit, upper or outer end.

Aphyllous; destitute of leaves.

Apiculate; tipt with a minute abrupt point.

Appendiculate; having some appendage annexed.

Appressed; pressed to, or lying close against.

Approximate; growing or situated near each other.

Aquatic; growing naturally in water, or in wet places.

Arachnoid; resembling a spider's web.

Arborescent; approaching the size or height of a tree.

Arcuate; curved or bent like a bow.

Areola. A small cavity, as in the base of some akenes.

Arid; dry, as if destitute of sap.

Arillate; having an arillus.

Arillus; An expansion of the funiculus or seed-stalk, forming a loose (and often fleshy) coating of the seed.

Aristate; Awned; having awns, or bristle-like processes.

Armed; having thorns or prickles.

Aromatic; having a spicy flavor or fragrance.

Articulated. Jointed; connected by joints, or places of separation.

Articulations. Joints; the places at which articulated members are separable.

Ascending; rising from the ground obliquely.

Assurgent; rising in a curve from a declined base.

Attenuated; tapering gradually until it becomes slender.

Auriculate; having rounded appendages at base, like ears.

Awn. A slender bristle-like process, common on the chaff of grasses; sometimes on anthers, etc.

Awned; furnished with awns, or bristle-like appendages.

Awnless; destitute of awns.

Axil. The angle between a leaf and stem, or branch on the upper side.

Axillary; growing in, or proceeding from, the axil.

Axis; A central stem, or peduncle; or, a real or imaginary central line extending from the base to the summit.

Baccate. Berried; becoming fleshy or succulent, like a berry.

Bald akenes. Naked at summit; destitute of pappus or crown.

Banner. The broad upper petal of a papilionaceous flower; called, also, the vexillum.

Barb. A straight process, armed with one or more teeth pointing backwards.

Basal; originating at, or affixed to, the base of another organ.

Beak. A terminal process, like a bird's bill.

Beaked; having, or terminating in a beak.

Bearded; crested or furnished with parallel hairs; the term is applied, also, to awned wheat, etc.

Berry. A pulpy valveless fruit, in which the seeds are imbedded.

Bi; in composition, meaning two or twice; as—

Bibracteate; having two bracts.

Bibracteolate; having two small bracts, bractlets, or bracteoles.

Bicarinate; having two keels.

Bicuspidate; ending in two sharp points or cusps.

Bidentate; furnished with two teeth.

Biennial; living two years (in the second of which the flowers and fruit are produced), and then dying.

Bifarious; in two series, or opposite rows; pointing in two directions.

Bifid; two cleft, or split into two segments.

Bifoliate; having or producing two leaves.

Bifurcate. Forked; ending in two equal branches.

Bi-gibbous; having two haunches, or gibbous productions.

Bi-glandular; having or producing two glands.

Bi-labiate; having two lips.

Bilamellate; having two lamellæ, or thin plates.

Bilocular; having two cells.

Bipartible; separable into two parts.

Bipartite; two-parted.

Bipinnate leaf. Twice pinnate; the common petiole having opposite branches, and those branches bearing opposite articolated leaflets.

Bipinnatifid leaf. The common petiole bearing opposite pinnatifid segments.

Bi-rostrate; having two beaks.

Bi-setose; having two bristles.

Bisulcate; having two grooves or furrows.

Biternate leaf. Twice ternate; the common petiole three-parted, and each division or branch bearing three leaflets.

Bivalved; having two valves.

Biventricose; having two-bellied, or distended portions.

Bloom. A fine powdery coating on certain fruits, etc., as the plum.

Border; the summit or upper spreading part of a calyx or corolla.

Bowl-shaped; hemispherical and concave, or hollow, like a bowl.

Brachiate; having the branches spreading, opposite and decussate.

Bract. A floral leaf; a modified leaf, from the axil of which arises the flower-branch, or peduncle.

Bracteate; furnished with bracts, or modified leaves among or near the flowers.

Bracteoles, or *bractlets.* Small bracts.

Bractless; destitute of bracts.

Branchlets. Small branches, or subdivisions of branches.

Bristles. Stiffish elastic hairs, straight or hooked.

Bud. A growing point, or undeveloped axis covered with the rudiments of leaves.

Bulb. A kind of bud, formed of fleshy scales, or coats, and usually under ground—sometimes in the axis of the leaves.

Bulbiferous; bearing or producing bulbs.

Bulbous; formed of, or like a bulb.

Bullate leaf; having bubble like convexities on the upper surface, with corresponding cavities beneath.

Caducus; falling off immediately, or earlier than usual for such organs.

Calcarate. Spurred; having a process like a horn, or spur; usually hollow.

Callous; firm and gristle-like.

Callus. A compact, gristle-like tubercle, or substance.

Calyciform; shaped like a calyx.

Calyculate; having an additional (usually small) outer calyx.

Calyptra. The cap or hood (resembling the extinguisher of a candle), on the fructification of the mosses.

Calyx. The flower-cup, or outer (and sometimes the only) covering of a flower, usually green.

Campanulate; in the form of a bell.

Campylotropous ovule, or seed. Where the ovule curves upon itself, and thus brings the orifice, or apex, near to the funiculus.

Canaliculate; channelled or furrowed.

Candicant; whitish.

Canescent. Hoary; clothed with a whitish or grey pubescence.

Capillaceous, or *capillary;* long and fine, or slender, like a hair.

Capitate. Head-form; growing in a head, or globular mass.

Capsular; resembling, or being, a capsule.

Capsule. A dry, hollow seed-vessel, usually opening by regular valves and definite seams.

Carina; keel.

Carinate; keeled; having a ridge on the back, like the keel of a boat.

Carnose. Fleshy; more firm than pulp.

Carpel. A little fruit; usually a partial pistil, or constituent portion of a compound fruit.

Carpophore. A slender central axis, bearing the carpels, as in *Umbelliferæ.*

Cartilaginous; hard, yet somewhat flexible, like gristle.

Caruncle. A fleshy excrescence, sometimes found at the hilum of seeds.

Caryopsis. A fruit where the pericarp is very thin, indehiscent, and closely adherent to the surface of the seed, as in the grasses, *Cyperaceæ,* etc.

Catkin; (See Ament.)

Cauda; a tail. *Caudate;* having a tail, or tail-like appendage.

Caulescent; having an evident or true stem.

Cauline; belonging to, or growing on, the main stem.

Cellular; made up of little cells, or cavities, formed of membranaceous sacs.

Cellular plants. The lower order of plants (including the mosses, and those below them), composed exclusively of cellular tissue.

Centrifugal inflorescence; where the central flower of a cyme precedes the others; *i. e.* the flowering commences at the centre and extends successively to the circumference.

Centripetal inflorescence; where the outer flowers of a corymb, or umbel precede the inner ones; *i. e.* the flowers expand in succession, from the circumference to the centre.

Cephaloid; head-shaped.

Cereal. Pertaining to Ceres; belonging to those farinaceous grains, or seeds, of which bread is made, and over which the goddess Ceres was supposed, by the ancients, to preside.

Cernuous. Nodding; the apex or summit drooping, or turned downwards.

Cespitose; having many stems growing from the same root, forming a tuft or tussock.

Chaff. A dry membrane, usually the small husks, or seed-covers of the grasses; also the bracts on the receptacle of many compound and other aggregate flowers.

Chaffy. Bearing chaff; also resembling chaff.

Channels. Longitudinal grooves; the interstices between the ribs on the fruit of umbelliferous plants.

Chanelled; grooved or furrowed.

Character. In natural history, the features of objects, or classes of objects, by which they are known, and distinguished from each other.

Chartaceous; a texture resembling that of paper.

Cicatrice. A scar, such as that left at the place of articulation, after the fall of a leaf, etc.

Cilia. Hairs arranged like eye-lashes along the margin of the surface.

Ciliate; fringed, or edged with parallel hairs, like eye-lashes.

Ciliate-serrate; having serratures resembling cilia, or short eye-lashes.

Cilifolæ. Diminutive of *cilia;* hairs like miniature eye-lashes.

Cinereous; of the color of wood ashes.

Circinate; with the apex rolled back on itself, like the young fronds of a fern.

Circumscissed; cut round transversely, or opening horizontally, like a snuff box.

Cirahose; bearing tendrils, or terminating in a tendril.

Cirrhus. A tendril; which see.

Class. One of the higher or primary divisions of plants, or other natural objects; in a systematic arrangement.

Clavate. Club-shaped; thicker towards the summit, or outer end.

Clavellate. In the form of a little club; *i. e.* larger at the summit.

Claw of a petal. The slender tapering portion at the base or below the middle.

Cleft; split or divided, less than half way to the base; sometimes the division itself is called a cleft.

Clypeate; in the form of an ancient shield or buckler.

Cortaneous flowers; appearing at the same time with the leaves.

Coarctate; contracted, or crowded into a narrow compass.

Coccus (plural, *cocci*). A kind of semi-baccate indehiscent carpel.

Cochleate; coiled like a snail-shell.

Coherent; united with an organ of the same kind, as stamens coherent with each other, etc. (See Adherent.)

Collateral; placed side by side; or on the same side of another organ.

Colored; of any other color than green.

Columella; a little column.

Column. The axis or central pillar of a capsule; or the combined filaments, and style of a *Gynandrous* or *Orchidaceous* plant.

Coma; a terminal tuft of hair, bracts, etc.

Commissure. The line of junction of two bodies, as the face of the carpels (or mericarps) in *Umbelliferæ.*

Common (petiole, peduncle, etc.); belonging to, or sustaining, several similar subordinate parts.

Comose; having a tuft or topknot of hairs, bracts or leaves, at the summit or at one end.

Compact; condensed or pressed together.

Complete flower; having both calyx and corolla.

Compound; not simple, but made of similar simple parts.

Compound flower. An aggregated cluster, or head of syngenesious florets, seated on a common receptacle, and embraced by an involucre, or many-leaved common calyx.

Compound leaf. Consisting of several leaflets, or laminæ, each articulated with the common petiole, and ultimately falling from it.

Compound pistil. Consisting of two or more carpels, or simple ovaries, cohering together.

Compound umbel. An umbel in which each primary peduncle, or ray, bears a small umbel at summit.

Compressed; flatted, as if squeezed or pressed.

Concave; presenting a hollow or depressed surface.

Concentric layers, or circles. Circles of different sizes, or diameters, with a common centre.

Concrete; grown together, or united.

Conduplicate; double lengthwise, or folded together like a sheet of paper, or the leaves of a book.

Cone. The woody ament of the pines.

Conic, conical, or *conoid;* having the figure of a cone.

Confluent; blended, or running together; forming a junction.

Congener. A plant belonging to the same genus; nearly related.

Conglomerate; clustered or heaped together.

Conjugate. In pairs; coupled.

Connate-perfoliate leaves; their bases united round the stem.

Connate; growing together, or cohering.

Connective, or *connectivum.* The organ which connects the two cells of an anther, conspicuous in some of the *Labiatæ.*

Connivent; the summits meeting, or bending towards each other.

Constant; invariable; also never failing, or wanting.

Contiguous; so near as to seem to touch.

Continuous; without interruption, or articulation.

Contorted; twisted; or obliquely overlapping.

Contracted; narrowed, or reduced into a smaller compass.

Contrary; dissepiment; not parallel, but at right angles, or nearly so, with the valves of the pericarp.

Convex; presenting an elevated rounded surface.

Convolute; rolled into a cylindrical form.

Cordate; heart-shaped, with the sinus, or notch, at the base.

Cordate-oblong; oblong, with a cordate base.

Coriaceous; tough and leather like.

Corm, or *Cormus.* A fleshy subterraneous stem, of a round or oval figure, and an uniform compact texture, as in *Arum*, or Indian Turnip.

Corneous; having the consistence or appearance of horn.

Corniculate; having little horns or spurs.

Cornute; having appendages like horns.

Corolla. The delicate inner covering of the flower, between the calyx and stamens, mostly colored.

Coroniform; in the shape of a crown.

Corrugated; contracted into wrinkles.

Cortical; belonging to the bark.

Corticate; clothed with bark.

Corymb. A mode of flowering; a kind of raceme, with the lower peduncles elongated so as to form a level top.

Corymbose; in the manner of the Corymb.

Corymbulose; having the flowers in little corymbs.

Costate; ribbed.

Cotyledons. The seed lobes, or first crude leaves of a plant; formed in the seed, and sometimes becoming green leaves in vegetation.

Crateriform; in the form of a cup or bowl, or hemispherical cup.

Creeping; running along the ground, and putting forth small roots.

Crenate; notched on the edge, with the segments rounded, and not inclining towards either extremity.

Crenulate; very finely crenate.

Crested; having an appendage resembling a cock's comb.

Crisp; curled, or wavy at the edges.

Cristate; crested; having a crest.

Cross; or *cross-breed.* A hybrid or mule, produced by the mixing of two nearly allied species.

Crowded; thickly set; standing in close order.

Crown. A circular series of petaloid appendages at the throat of a corolla; also of chaffy scales at the summit of an akene.

Crowned; having appendages resembling a crown.

Cruciate, or *cruciform;* having four petals arranged in form of a cross.

Crustaceous; having a dry brittle shell.

Cryptogamous plants. Plants which are destitute of visible genuine flowers.

Cucullate; in the form of a cowl; the edges rolled in so as to meet at base, and spreading above, like a hood thrown back.

Culm; The stem of the grasses, and cyperaceous plants.

Cuneate, or *cuneiform;* wedge-shaped; tapering with straight edges to the base.

Cupule. The cup-like involucre of the acorn, etc.

Cusp. A stiffish, tapering sharp point.

Cuspidate; tapering to a straight stiffish sharp point.

Cuticle. The outer skin, usually thin and membranaceous.

Cyathiform; top shaped and hollowed at the summit like a cup.

Cylindric; long, round and of uniform diameter.

Cyme. A kind of panicle, depressed nearly to the form of an umbel with the principal peduncles rising from the same centre, but the subdivisions irregular.

Cymose; with the flowers in cymes, or approaching that form.

Cymules. The reduced cymes, or cymose clusters, of the *Labiatæ*; sometimes called *Verticillasters.*

Decandrous; having ten distinct stamens.

Deciduous; falling off at the usual time, or at the end of the season; more durable than *Caducous*; which see.

Declinate, or *declined;* bent off horizontally; or curved downwards.

Decompound; several times compound.

Decumbent; leaning upon the ground, with the base only erect.

Decurrence. A running or extending down, or backwards.

Decurrent leaf. When the two edges are continued down the stem, like wings.

Decussate; growing in opposite pairs and alternately crossing each other.

Definite; clearly defined, or limited; also of a constant or determinate (and not large) number.

Deflected; bent off, or downwards.

Dehiscent; gaping or opening naturally by seams, at maturity.

Deltoid; triangular in the outline, like the Greek letter *Delta.*

Demersed; growing or being under water.

Dense; closely arranged; compact.

Dentate; toothed; edged with tooth-like projections.

Denticulate; having very small teeth.

Depauperate; with a starved or stunted inflorescence; few-flowered.

Depressed; flatted vertically, or pressed down at summit.

Depressed-globose; globular, with the base and apex flatted.

Di; in composition, two.

Diadelphous; having the filaments united in two parcels, usually nine and one, with a papilionaceous corolla.

Diandrous; having two stamens.

Diaphanous; transparent; permitting light to pass through.

Dichotomal flower. Situated in the fork of a dichotomous stem or branch.

Dichotomous; forked; regularly divided and subdivided, in two equal branches.

Diclinous; having the stamens and pistils in distinct flowers, whether on the same or different plants.

Dicotyledonous plants. Where the embryo has two lobes, or cotyledons.

Didymous; twin; growing in pairs, and more or less united.

Didynamous; having two long and two shorter stamens, mostly in a bilabiate, ringent, or personate corolla.

Diffuse; spreading widely in a loose irregular manner.

Digitate leaf. Where a simple petiole connects several distinct leaflets, finger-like, at its summit, as in the Horse Chestnut.

Digynous; having two pistils, or two distinct stigmas.

Dilated; made wider; stretched or expanded.

Dimerous; composed of two parts, as a dimerous calyx or corolla, when there are two sepals or petals.

Dimidiate; halved, as if one side, or half, had been cut off.

Dingy; of a dull, soiled, smoky, or leaden-brown color.

Diœcious, or *dioicous*; having staminate and pistillate flowers on distinct plants.

Diœciously, or *dioicously polygamous;* having perfect and imperfect flowers on different plants.

Dipetalous; having two petals.

Discoid flower, or head. A disk of compound flowers, without ray-florets.

Disepalous; having two sepals.

Disk. The surface of the leaf; also the face, or central part of a head of compound flowers.

Dissected; cut into segments, or lobes.

Dissepiment. The partition between the cells of seed-vessels.

Distant; having a larger intervening space than usual.

Distichous; two-rowed; bearing leaves, flowers, etc., in two opposite rows.

Distinct; separate; not connected with each other, nor with any contiguous organ.

Divaricate branches. Spreading so as to form more than a right angle with the stem above.

Divergent; spreading widely; making a right-angle, or nearly so, with the stem.

Divided; separated, or cleft to the base, or to the midrib, if a leaf.

Dorsal; belonging to, or growing on, the back.

Dorsalsuture. The line or seam on the back of a carpel, or folded leaf, being at the place of the midrib; the opposite of ventral suture; which see.

Dorsally compressed; flatted on the back.

Dots. Minute tubercles, or specks.

Dotted; covered with dots, specks, or minute and slightly elevated points.

Downy; clothed with soft fine hairs.

Drooping; inclining downwards; more than nodding.

Drupaceous; drupe-like; of a structure resembling a drupe, or what is usually called stone-fruit.

Drupe. A fleshy, succulent, or spongy pericarp, without valves, containing a one or two seeded nut, or stone.

Drupel. A little drupe; a constituent portion of a compound berry, such as that of *rubus.*

E, or *Ex;* in composition, destitute of, not furnished with.

Ebracteate; destitute of bracts.

Embracteolate; destitute of bractlets.

Ecaudate; destitute of a *cauda*, or tail.

Echinate; hedghog-like; covered with prickles.

Elaters. Minute, club-shaped filaments, which are coiled round the spores of certain cryptogamous plants, and by unrolling assist in dispersing those spores.

Elliptic, or *elliptical;* oval; longer than wide, with the two ends narrowing equally.

Elongated; exceeding the usual or average length.

Elongating; becoming gradually and finally elongated.

Emarginate; having a notch or sinus at the end.

Embryo. The young plant in the rudimentary state, as it exists in the seed.

Emersed; raised out of water.

Endocarp. That membranous or bony portion of the per carp which lines the cavity or forms the cells for the seeds (*ex. gr.* the stone, or hard shell, in a drupe).

Endogenous plants. Those which have a single cotyledon, and grow by central deposits of new matter, distending or pushing the older deposits outwards.

Endogens. Inside growers; plants which increase by central or internal deposits of new matter.

Enneandrous; having nine stamens.

Ensiform; sword-shaped; two-edged and tapering from base to apex.

Entire; having a continuous even margin; without incision, notch or tooth.

Envelope. An integument, or covering.

Ephemeral; diurnal; enduring one day only.

Epicarp; the outer coating of the pericarp, or fruit.

Epidermis; the outer skin or cuticle.

Epigæan; situated, or rising, above ground.

Epigynous; adnate to the ovary so that the upper portion is apparently inserted on its summit, as sepals, petals, and more especially stamens; exemplified in *Umbelliferæ* and *Araliaceæ.*

Epipetalous; inserted on the petals.

Equal; similar parts equal among themselves, as calyx-segments, sepals, petals, stamens, etc.

Epiphytes; air plants having no immediate connection with the earth, but growing on the stem of other plants.

Equitant leaves. When alternate distichous leaves are infolded lengthwise and towards each other, the outer ones inclosing or embracing the inner.

Erect ovules, or seeds. When they arise from the bottom of the ovary, or base of the cell, and point upwards.

Eroded, or *erose;* irregularly notched, as if gnawed by insects.

Esculent; eatable; fit or safe to be eaten.

Etiolation; the blanching of plants, or rendering them white by the exclusion of light; as practiced with celery, endive, etc.

Evanescent; disappearing; speedily vanishing.

Even-pinnate leaf. With the leaflets all in pairs or without a terminal odd one; often termed abruptly-pinnate.

Evergreen; continuing green, and persisting all the year.

Exalbuminous; destitute of albumen.

Excentric; deviating from the axis, or centre.

Exfoliate; to throw off layers or plates, as bark, etc.

Exogenous plants. Those which have two (or sometimes more) cotyledons, and grow by annual layers of wood (or new matter) on the outside, between the old wood and bark.

Exogens; outside growers; plants which increase by annual additions to the outside.

Exsert, or *exserted;* projecting or protruding out, as stamens from the tube of the corolla.

Exstepulate; destitute of stipules.

Extrorse anthers. Having the cells turned outwards, or from the pistils, and the filament, or connective, extended up the inner side.

Falcate; sickle shaped; curved like a sickle, or scythe.

Family of plants. A definite group of kindred plants, called also an Order; sometimes of numerous genera and species; sometimes comprising but a single genus.

Fan shaped; cuneate below, and spreading above, like a lady's fan.

Farinaceous; mealy; reducible to a meal-like powder

Fascicle; a little bundle, or bunch, of flowers, leaves, etc., originating from nearly the same point.

Fascicled, or *fasciculate;* growing in bundles, or bunches from the same point.

Fastigiate; level-topped; the summits of the branches all rising to the same height.

Favose; deeply pitted; somewhat like a honey-comb.

Feather-veined leaf. Where the lateral veins (or nerves) diverge regularly from each side of the midrib, like the plumage of a quill.

Ferruginous; of the color of rust of iron; reddish-brown.

Fertile; having perfect pistils, and producing fruit.

Fibrous; composed of fibres, or thread-like processes.

Fide; on the faith, or authority, of.

Filament; that part of the stamen (usually thread-like) which supports the anther.

Filiform; very slender and terete, like a thread.

Fimbriæ; fringes, or fringe-like processes.

Fimbriate; finely divided at the edge, like a fringe.

Fimbrillate; clothed with *fimbrillæ* (*i.e*,, membranaceous, linear or subulate filaments)—as the receptacle of thistles, etc.

Fissure; a slit, crack, or narrow opening.

Fistular, or *fistulous;* hollow and terete, like a pipe, tubular.

Flabelliform; fan-shaped, which see.

Flaccid; so limber as to bend by its own weight.

Flagelliform; long, slender and pliable, like the thong of a whip.

Flexuose; serpentine, or with a succession of short alternating curves.

Floccose, or *flocculent;* covered with flocks, flakes, or little matted bunches of partly detached omentum.

Floral; belonging to, or situated near, a flower.

Floral envelopes; the verticils, or coverings of flowers, usually known as calyx and corolla; sometimes as chaff.

Floret; a little flower; usually one of the number in compound or aggregated flowers.

Floriferous; bearing flowers.

Foliaceous; of a leaf-like form and texture; resembling a leaf.

Foliole; a leaflet in a compound leaf.

Follicle; a capsular fruit, opening longitudinally by a suture on one side.

Follicular; resembling, constructed like, or being, a follicle.

Foramen (plural, *foramina*); a roundish hole, or opening.

Foreolate; pitted.

Free; not adhering to each other, nor to any adjacent organ.

Frondose; leafy, or with leaf-like appendages.

Fructification; the flower and fruit, with their parts.

Fruit; the mature ovary or seed-vessel, and its contents.

Frutescent; becoming shrubby, or hard and woody.

Fruticose; shrub-like, or shrubby.

Fruticulose; like a little shrub.

Fugacious; fleeting; of short duration.

Fulvous; tawny, fox or tan-colored.

Fungous; of rapid growth and soft texture, like the *fungi.*

Funiculus; the little cord by which seeds are attached to the placenta.

Funnel form; tubular below, and expanding above like a funnel.

Furcate; forked.

Furfuraceous; scaly, or scurfy, like bran or dandruff.

Fuscous; greyish brown, or deep brown, with a tinge of green.

Fusiform; spindle-shaped; terete and tapering to a point.

Galea; a helmet; the arched upper lip of a ringent corolla.

Galeate; helmeted; resembling a casque, or helmet.

Gamopetalous; having the petals all more or less united, forming what is called (rather incorrectly) a monopetalous corolla.

Gamosepalous; having the sepals all more or less united, forming a monosepalous calyx.

Geminate; in pairs.

Generic; pertaining or relating to a genus.

Geniculate; forming an angle at the joints, like a bent knee.

Genus (plural, *genera*); a group of species which agree with each other in the structure or essential characters of the flower or fruit; sometimes a genus comprises but a single species.

Germ; the growing part of a bud.

Germen; the old name for the ovary.

Germination; the sprouting, or incipient growth, of a seed.

Gibbous; hunched, or swelled out, on one or both sides.

Glabrous; very smooth, without any roughness or pubescence.

Gland; a small roundish organ, or appendage, which often secretes a fluid.

Glandular; furnished with glands.

Glandular-hispid, or *glandular-pubescent;* hairy or pubescent, and the hairs tipped with glands.

Glaucescent; inclining to, or becoming, glaucous.

Glaucous; silvery; pale-bluish, or greenish-white; covered with a greenish-white mealiness.

Globose, or *globular;* spherical; round on all sides.

Glomerate; densely clustered in small heaps, or irregular heads.

Glomerules; small, dense, roundish clusters.

Glumaceous; chaff like; resembling chaff or glumes.

Glumes; the bracts, or outer chaff, embracing the spikelets of the grasses (calyx of Linn). (See Palea.)

Glutinous; viscid; covered with an adhesive fluid.

Grain; fruit of the true grasses, sometimes called a *caryopsis.*

Gramineous; grass-like; resembling grasses.

Graniferous; bearing a grain, or grains.

Granular; formed of grains or small particles.

Gymnospermous; having the seeds naked; *i. e.* not inclosed in a pericarp.

Gynandrous; having the stamens growing on, or adhering to, the pistil.

Gynæcium; a term designating the pistillate portion of the flower, or the seed-bearing organs, collectively.

Gynostegium; the pistil-cover or tube formed by the connate filaments, in the *Asclepias* family.

Habit of plants. Their general external appearance and mode of growth, by which they are recognized at sight.

Habitat, or ***habitatio;*** the natural or native place of growth.

Halved; one sided, as if one half had been cut off.

Hastate; shaped like a halbert; lanceolate, with a divaricate lobe on each side of the base.

Head; a dense roundish cluster of sessile flowers.

Heptandrous; having seven stamens.

Herbaceous; not woody; of a tender consistence, and usually destructible by frost.

Herbarium; a collection of dried specimens of plants.

Herbs; plants which are not woody—of more tender structure than trees and shrubs, and usually killed by frost.

Heterogamous heads; heads of Syngensious flowers, containing florets of different structure and sexual character.

Heterophyllous; having leaves of different forms.

Hexamerous; consisting of six parts.

Hexandrous; having six stamens of equal length.

Hilum; the scar left on a seed, at the point of attachment to the funiculus.

Hirsute; rough-haired; clothed with stiffish hairs.

Hispid; bristly; beset with rigid, spreading, bristle-like hairs.

Hoary; covered with a white or whitish pubescence.

Homogamous heads; heads of Syngensious flowers, in which all the florets are of similar structure and the same sexual character.

Hooded. (See *Cucullate.*)

Horizontal ovules; when they project from the side of the cell, pointing neither to base nor apex.

Horn; a process or elongation resembling a horn. (See Spur.)

Horny; of a texture or consistence like horn. (See Corneous.)

Humus. The mould, or soil formed by the decomposition of vegetable matter.

Hyaline; transparent, like glass.

Hybrid; a mule; a cross-breed between two varieties, or nearly allied species, partaking of each but different from both.

Hypogæan; situated, growing, or remaining under ground.

Hypogynous; inserted beneath the ovary; *i. e.* on the receptacle, and free from the surrounding organs.

Icosandrous; having about twenty stamens, which are perigynous, *i. e.*, growing to, or apparently inserted on the rim of the calyx.

Imbricate, or ***imbricated;*** the edges lying closely and regularly over the next series, like shingles on a roof, or scales on a fish.

Imperfect flower; when either stamens or pistils are deficient.

Incised; cut or gashed; separated by incisions.

Inclinate, or ***inclined;*** bent over towards the ground, or some other object.

Included; wholly contained within a tube, or cavity; the opposite of exserted.

Incomplete flower; when either calyx or corolla is wanting.

Incrassate; thickened upwards or towards the summit.

Incumbent; lying upon, against, or across.

Incumbent anther; attached at or near its middle, and lying horizontally across the summit of the filament.

Incumbent cotyledons; having the radicle bent over and applied to the back of one of the cotyledons (represented by this sign o=).

Incurved; bent or curved inwards.

Indefinite; not distinctly limited, or defined; numerous, and of no constant or determinate number.

Indehiscent; not opening at maturity.

Indigenous; native, growing naturally, or originally in a country.

Induplicate; folded inwards.

Indurated; hardened; become hard.

Inferior calyx. Having the ovary above, and free from the calyx.

Inferior ovary. Situated apparently below the calyx, or rather its segments; *i. e.*, adnate to the tube of the calyx, and consequently bearing the segments (if any) at its summit.

Inflated; distended or swelled like a blown bladder.

Inflected, or ***Inflexed;*** bent suddenly inwards.

Inflorescence; the disposition or arrangements of flowers and their footstalks on a plant; such as umbel, panicle, raceme, etc.

Innate anther; erect, having its base resting directly on the apex of the filament.

Inserted; fixed upon, or growing out of.

Internode. That portion of a culm, or stem, between the nodes or joints.

Interpetiolar stipules; situated or originating between the petioles of opposite leaves.

Interrupted; having intervals, or the continuity broken.

Interruptedly pinnate; having smaller pinnæ, or leaflets, between each pair of larger ones.

Intra-petiolar stipules; situated within and above the petioles; usually sheathing the branch above the axil of the leaf, as in *Platanus.*

Introrse anthers; having the cells turned inwards, or towards the pistils, and the filament, or connective, extending up the outer side.

Inversely; in a contrary position; end for end, or upside down.

Involucel. The verticil of leaflets at the base of an umbellet.

Involucellate; having involucels.

Involucrate; having an involucre.

Involucre. An assemblage of modified leaves accompanying certain forms of inflorescence, usually verticillate at the base of an umbel, or in imbricated series beneath or around the heads of aggregated flowers.

Involute; rolled inwards.

Irregular; the component parts differing in size and shape.

Keel. A longitudinal central ridge on the back of a leaf, sepal, etc., resembling the keel of a boat; also, the lower pair of united petals in a papilionaceous flower.

Keeled; having a keel. (See Carinate.)

Kernel. The nucleus or seed contained in a nut.

Knot. A node; a solid, inseparable, and often swelling joint, as in the stem of the grasses, etc.

Lacerate; divided into irregular segments as if torn.

Laciniate; jagged; the margin irregularly cut into unequal segments.

Lactescent; milky; containing a milky or whitish juice.

Lacunose; pitted, furrowed, or having little cavities.

Lamellate; divided or diluted into thin plates.

Lamina; a thin layer or plate; the expanded or flat portion of a leaf or petal, as distinguished from the petiole, or claw.

Lanate; woolly; clothed with wool.

Lanceolate; tapering gradually from near the base to the apex, like the head of an ancient lance, or spear.

Lance-linear, ***Lance-ovate***, etc.; linear, ovate, etc., with something of the lanceolate form.

Lance ovoid; egg-shaped, with a swelling base and tapering apex.

Lanuginous; clothed with a loose wool.

Lateral; at the side.

Laterally compressed; flattened on the sides; the lateral edges pressed towards each other.

Lax; loose, or limber; not compact.

Leaflets. Partial leaves; the constituent leaves of a compound leaf.

Leaf-like (*foliaceous*); having a texture and expansion resembling a leaf.

Leafy (*foliosus*); furnished or abounding with leaves.

Legume. A bean, or fruit formed of a single carpel of two valves, with the seeds affixed along the upper suture only.

Leguminous; having the structure of a legume; bearing or producing the fruit called a legume, or bean.

Lenticular; having the form of a lens; orbicular and compressed, but convex on both faces.

Ligneous; woody; of a firm woody texture.

Lignescent; becoming somewhat woody.

Ligulate; strap-shaped or riband-shaped; flat and linear.

Ligule; the usually membranous appendage at the base of the leaf or summit of the sheath in the grasses.

Limb; the summit of a monosepalous calyx; or the upper spreading part of a monopetalous corolla.

Line; the twelfth part of an inch.

Linear; of a uniform width; long and narrow with parallel sides.

Linear lanceolate, etc.; partaking of both forms, but more of the latter.

Lip; the upper or under division of a labiate flower; or the lower perianth segment of many orchidaceous flowers.

Lobe; the division or segment of a petal or leaf; the free portion of a gamopetalous corolla.

Lobate, or ***lobed;*** cut or divided into lobes.

Loculicidal dehiscence; when the pericarp opens naturally on the back of a cell (*i. e.* at the dorsal suture) directly into the cavity.

Loment; an indehiscent two or several-seeded legume, contracted between each seed, and finally separating at the joint-like contractions.

Lomentaceous legume, or pod; a pod of two or more seeds, with a joint-like contraction, or transverse partition, between the seeds.

Longitudinal; lengthwise, parallel with the axis, or in a direction from the base towards the summit or apex.

Lunate, or ***lunulate;*** having the figure of a new moon.

Lutescent; yellowish.

Lyrate; lyre-shaped, pinnatifid, with the terminal segment largest and mostly rounded.

Mamillate; conical, with a rounded apex.

Marcescent; withering and shriveling on the stem, instead of falling off.

Margin. The edge or circumference of a leaf or other expansion; also, the thin wing-like border of certain seeds, etc.

Marginal; belonging to, or situated at the margin.

Marginate, or *margined;* having a border or edging of a texture or color different from that of the disk; surrounded by a wing-like expansion, or narrow membrane.

Medullary rays. Bands or thin plates of cellular tissue, which pass from the pith to the bark in woody stems.

Melliferous; producing or containing honey.

Membranaceous, or *membranous;* thin, flexible, and often slightly translucent.

Mericarp; a name given to the indehiscent carpel of the *Umbelliferæ*.

Micropyle; the small foramen or opening in the proper coats of a seed, to which the radicle always points.

Midrib. The main central nerve of a leaf, apparently a continuation of the petiole.

Monadelphous; having the filaments all united in one set, usually forming a tube.

Monandrous; having a single stamen.

Mono; in composition: one or single.

Moniliform; arranged like, or resembling the beads of a necklace.

Monoclinous; having the stamens and pistils in the same flower.

Monocotyledonous plants. Where the embryo has but a single lobe or cotyledon.

Monograph. A description (usually ample and elaborate) of a single thing, or class of things, as of a genus, tribe, or family, etc.

Monogynous; having but one pistil.

Monœcious, or *monoicous;* having staminate and pistillate flowers distinct, but on the same plant.

Monœciously, or *monoicously polygamous;* having perfect and imperfect flowers on the same plant.

Monopetalous; having but one petal; or more correctly, the petals united into one. (See Gamopetalous.)

Monophyllous; consisting of a single leaf.

Monosepalous; consisting of one sepal, or rather, several sepals united more or less completely. (See Gamosepalous.)

Mucronate; terminated by a mucro, or small projecting point, usually the prolongation of the midrib, in leaves.

Mucronulate; having a small mucro, or terminal projecting point.

Multifid; many-cleft; cut into numerous segments.

Multiple. A number containing another number several times without a fraction, or remainder; as nine is a multiple of three.

Multiple fruits. When there is a combination of several flowers into one aggregate mass, as in the pine-apple, mulberry, etc.

Muricate; armed or covered with short spreading points or acute excrescences, like a murex.

Mutic, or *muticous;* awnless or pointless; the opposite of mucronate.

Naked; destitute of the usual covering or appendage, as a stem without leaves or scales, leaves without pubescence, corolla without a calyx or crown, seeds without a pericarp, a receptacle without chaff or hairs, an umbel without an involucre, etc.

Napiform; turnip-shaped.

Natural Order, family, or tribe. An association or group of kindred genera, or of plants which are nearly related in their structure, and most important characters.

Nectariferous; producing honey.

Nectary. That organ, or portion of a flower which secretes honey; a term formerly applied to all disguised or modified forms of petals and stamens.

Nerved; having nerves or coarse rib-like fibres.

Nerves. Rib-like fibres (in leaves, etc.) which usually extend from the base to, or towards, the apex.

Neuter, or *neutral* flower. Having neither stamen nor pistil.

Nodding; turning downwards; somewhat drooping.

Node. The knot, or solid and often tumid joint of a stem or branch.

Nodose; having numerous nodes or tumid joints.

Normal; according to rule; agreeing with the pattern or type.

Nuciform; nut-like; resembling a nut.

Nucleus. A central body; the seed or kernel of a nut.

Nucules. Little nuts or nut-like fruit.

Nut. A hard one-celled indehiscent fruit, usually containing a single seed.

Ob; a preposition which inverts the usual meaning of the word to which it is prefixed.

Obcompressed akenes (in the *compositæ*). Flattish, with the greatest diameter from right to left, or with the flatted side to the front, or periphery of the head.

Obconic; inversely conical; *i. e.* with the point or apex downwards.

Obcordate; heart-form, with the sinus at summit, and the narrowed point at the place of insertion

Oblanceolate; inversely lanceolate, or with the widest part above the middle, and tapering gradually to the base.

Oblique; a position between horizontal and erect; also descriptive of the base of a leaf, etc., when it is unequal or produced on one side.

Oblong; longer than wide, with the sides parallel, or nearly so.

Obovate; inversely ovate, or with the broadest end above.

Obovoid; inversely ovoid.

Obsolete; indistinct, as if worn out.

Obtuse; blunt, or rounded.

Obversely; turned contrary to the usual position.

Ochrea. A membranous stipular sheath, embracing the stem like a boot-leg; as in polygonum, etc.

Ochroleucous; yellowish-white or cream colored.

Octandrous; having eight stamens.

Odd-pinnate leaf. Having the leaflets in opposite pairs, with a terminal odd one; often termed impari-pinnate.

Officinal; used in, or belonging to, a shop, or medical office.

Oleraceous; of the nature or quality of pot-herbs.

Opaque; not transparent.

Opercular; opening like a lid that is fixed by a hinge at one side.

Opposite; situated directly against each other, or at the same height, on contrary sides of the stem.

Orbicular; circular and flat, like a coin; the length and breadth equal and the circumference an even circular line; a term applied to leaves, or flatted bodies. (See Terete.)

Order. A family or group of allied natural objects; a subdivision of a class, embracing kindred genera.

Ordinal; belonging to the orders, or to an order.

Ordinal names. The names of the natural orders, or families of plants.

Orthotropous ovule or seed. Straight; not curved, or turned from its original or natural direction.

Oval; longer than broad, with the two ends of equal breadth and curvature, and the sides curving from end to end.

Ovary. The young seed-vessel, or fruit; the hollow portion at the base of the pistil, containing the ovules, or bodies destined to become seeds.

Ovate; flat, with the outline of a longitudinal section of an egg; a somewhat oval figure but broader near the base.

Ovate-lanceolate; lanceolate, inclining to ovate at base.

Ovate-oblong; oblong, with an ovate dilatation near the base.

Ovoid; egg-shaped; terete, and swelling near the base; *i. e.* having the outline of an entire egg.

Ovoid-oblong; the ovoid form lengthened out.

Ovules. The rudiments of future seeds, contained in the ovary, or young fruit.

Palate. The prominence in the lower lip of a personate corolla.

Palea (plural *paleæ*). Chaff; a term applied to the inner, or immediate floral covering of the grasses. (Corolla of Linn.) (See Glumes.)

Paleaceous; chaffy; of a chaffy texture, or furnished with chaff-like scales.

Palmate; hand-shaped; deeply divided, with the segments nearly equal and spreading like fingers on the open hand.

Palmately veined, or cleft; having the veins or segments divergent, like the spreading fingers of an open hand.

Panduriform; fiddle-shaped; oblong, with the sides contracted, like a violin.

Panicle. A loose, irregular, compound raceme, in which the peduncles are unequally elongated, and variously and irregularly subdivided, as in oats, etc.

Panicled, or *paniculate;* disposed in the form of a panicle.

Papilionaceous corolla. Butterfly-shaped; when complete, consisting of five petals, the upper one (mostly largest) called the vexillum or banner, the two lateral ones termed the alæ or wings, the two lower ones more or less cohering by their lower margins, and, from their form, denominated the keel.

Papillate, or *papillose;* having the surface covered with fleshy dots, or points, like minute teats.

Pappus. The crown of the fruit, being the segments, or free portion of an adherent calyx, in the *compositæ*, and some other plants, usually hairy-like or plumose, sometimes in the form of minute chaff or scales.

Parasite. A plant growing on, or deriving sustenance from, another plant; as dodder, mistletoe, etc.

Parasitic; being, or relating to, a parasite.

Parenchyma. The soft, spongy, cellular tissue (often green) which forms the pith of stems, the pulp of leaves and young fruit, and fills the interstices of woody or vascular fibres.

Paries (plural, *parietes*). The outside wall, or inclosing shell, which circumscribes the cavity of a pericarp.

Parietal; affixed to, or belonging to, the paries or outer wall of the seed-cell of a pericarp.

Parietal placentæ. When the placentæ are borne upon the walls, instead of the axis, of the ovary or pericarp.

Parted; divided deeply, almost to the base.

Partial; a term applied to constituent portions of a compound whole.

Partition. (See Dissepiment.)

Patelæform; in the form of little plates or dishes.

Pectinate; finely, regularly and deeply cleft, so as to resemble the teeth of a comb.

Pedate leaf. Like a bird's foot; divided nearly to the petiole in narrow segments, with the lateral ones diverging.

Pedicel. A partial peduncle; the ultimate branch or division (next to the flower, or fruit) in a compound inflorescence.

Pedicellate; having, or being supported on a pedicel.

Peduncle; a simple flower stem; also the common foot stalk of a compound inflorescence.

Pedunculate; having a peduncle; not sessile.

Pellucid; transparent; pervious to light.

Pellucid punctate; having punctures which permit light to pass through.

Peltate; like a shield; having the foot stalk affixed to the under surface, and not to the margin.

Pencil-form; resembling a painter's pencil or little brush.

Pendulous; hanging down; attached at one end, and swinging loosely.

Pendulous ovules or seeds; when their direction is downwards.

Penicillate; tipped or tufted with hairs, like a painter's pencil.

Penni-nerved leaf. Having the lateral nerves pinnately arranged, or feather-like. (See Feather-veined.)

Pentagonal; having five angles or corners.

Pentagynous; having five pistils.

Pentamerous; composed of five parts.

Pentandrous; having five stamens.

Pentapetalous; having five petals.

Penultimate; next to the last; the one next to the terminal one.

Pepo; an indehiscent, fleshy or internally pulpy fruit, usually composed of three carpels invested by the calyx tube, and with a firm rind, as the melon, etc.

Percurrent; extending or running the whole way through.

Perennial; living more than two years, and for an indefinite period.

Perfect flower; having both stamen and pistil (one or more of each), and producing fruit.

Perfoliate; having the stem apparently pierced through the leaf.

Perianth; a term for the envelopes of a flower, where the calyx and corolla are not clearly distinguishable.

Pericarp; the seed-vessel, or fruit; the ovary in a mature state.

Perigonium; a name for the envelope of the flower; said to be double when there is both calyx and corolla, but often used synonymously with *Perianth*, which see.

Perigynium; the sac (formed by the union of two bractlets) which incloses the ovary of the *Carices*.

Perigynous petals and stamens. Inserted on the calyx, or rather, adhering to the inner surface of the calyx tube, and thus surrounding the pistils.

Peripherical; fixed or coiled round the circumference, or periphery.

Perisperm; a deposit in many seeds, affixed to, or surrounding, the embryo; synonymous with albumen, which see.

Peristome; the circle of teeth or bristle-like processes which surround the orifice of the theca or capsule of the mosses.

Persistent; not falling off; remaining beyond the time when similar organs usually fall off

Personate corolla. Masked; having the throat closed by a prominent palate, as in *Linaria*.

Petal. The (usually) delicate colored flower leaf. In a flower of one petal (or united petals), the corolla and petal are the same; in a flower of more than one petal the corolla is the whole and the petals are the parts.

Petaloid; petal-like; delicate and colored, or expanded, like a petal.

Petiolar; seated on, or belonging to, the petiole.

Petiolate; having, or being supported on, a petiole; not sessile.

Petiole The stem or foot-stalk of a leaf.

Petiolulate, having a partial or subdivided petiole.

Petiolule. A little or partial petiole; the foot-stalk of a leaflet.

Phænogamous, or *phanerogamous;* having visible genuine stamens or pistils; bearing true flowers.

Phyllodium. The imitation, analogue, or substitute of a leaf, usually the dilated foliaceous petiole of an abortive compound leaf.

Pilose; hairy; composed of, or clothed with, distinct, straightish hairs.

Pinnæ. The paired or opposite leaflets of a pinnate leaf.

Pinnate leaf; having distinct articulated leaflets in pairs, on opposite sides of a simple petiole.

Pinnatifid leaf, or frond. Cleft in a pinnate manner, but the segments united or confluent at base.

Pinnatifidly; in a pinnatifid manner.

Pinnatisect; pinnately dissected or divided, but the segments not articulated with the petiole.

Pinnules. The leaflets or subdivisions of a bi- tri- or multi-pinnate leaf, or frond.

Pistil. The central organ of a fertile flower, consisting usually of ovary, style, and stigma; sometimes the style is wanting, or, in other words, the stigma is sessile.

Pistillate flowers. Those which have pistils, but not stamens.

Pistilliferous; bearing pistils.

Pitted; having small shallow depressions.

Placenta (plural, *placentæ*). That part of a pericarp to which the seeds are attached; the line or ridge projecting in the cavity of the ovary, which bears the ovules.

Placental; pertaining to the placenta.

Placentiferous; bearing the placenta.

Plane; flat, and with an even surface.

Plano-convex; flat on one side and convex on the other.

Plicate; plaited; folded or crimped, like a fan or ruffle.

Plumose; feather-like. A pappus is plumose, when each hair has other hairs arranged on opposite sides of it; as in cirsium.

Pod. A dry seed-vessel, narrow and more or less elongated, and usually of two valves. The term is often applied indiscriminately to both legumes and siliques.

Pollen; the fertilizing powder contained in the anthers.

Pollen-masses or *Pollinia.* The waxy masses of pollen in the *Asclepias* and *Orchis* families.

Poly; in composition, many.

Polyadelphous; having the filaments united in three or more parcels.

Polyandrous; having more than ten hypogynous stamens.

Polycotyledonous; having many seed-leaves.

Polygamo-diœcious, or *dioicous;* having perfect and imperfect (or fertile and sterile) flowers on distinct plants.

Polygamous; having some flowers perfect, and others either staminate, pistillate, or neuter.

Polygynous; when the pistils are numerous or indefinite.

Polymorphous; variable, assuming, or apt to assume, many different forms.

Polypetalous; having many distinct petals, or at least more than one.

Polysepalous; having many distinct sepals, or more than one.

Pome. An apple; a fleshy fruit formed of several cartilaginous or bony carpels, imbedded in pulp and invested by the tube of the adherent calyx.

Pores; small holes, or tubular openings.

Porous; full of holes, cells, or tubular openings.

Præmorse; end-bitten; ending blunt, as if bitten off.

Precocious flowers; appearing before the leaves.

Prickle. A sharp process arising from the bark only, and not originating in the wood.

Primary; first in a series in order of time, or in importance, opposed to secondary.

Primordial; first in order; usually applied to the first genuine leaves, or those which are next above the cotyledons or seminal leaves.

Prismatic; like a prism; having several angles and intermediate flat faces.

Process. A protuberance, eminence, or projecting part.

Procumbent; lying on the ground without putting forth roots.

Produced; extended, or lengthened out.

Proliferous; producing its like in an unusual way, as lateral bulbs; or putting forth a young and unusual accessory growth, from the centre of an umbel, flower, etc.

Prostrate; lying flat, or close on the ground.

Pruinose; covered with a glaucous mealiness, like a plum.

Pseudo pinnate; falsely or imperfectly pinnate; the leaflets (or rather segments) not articulated at base. (See Pinnatisect.)

Puberulent; covered with a minute, short and fine pubescence.

Pubescence. A general term for the hairy covering of plants.

Pubescent; clothed with hairs, especially with short weak hairs.

Pulp. A soft, fleshy or juicy mass.

Pulverulent; dusty; composed of, or covered with a fine powder.

Punctate; appearing as if pricked full of small holes, or covered with indented points.

Puncticulate; having very minute punctures, or indented points.

Pungent; sharp-pointed, prickly at apex; also acrid.

Pyramidal; tapering upwards; usually applied to four-sided solids which diminish to the apex.

Pyriform. shaped like a pear; largest at the upper end.

Quadrangular; four-angled.

Quadrifarious; in four rows or directions; facing or pointing four ways.

Quadrifid; four-cleft.

Quaternate; four together; arranged in fours.

Quinate; five together; arranged in fives.

Race of plants. A fixed or peculiar form or modification, produced by the crossing or blending of distinct varieties; or sometimes, perhaps, accidental forms rendered permanent by culture or other influences.

Raceme. A mode of flowering, in which the common peduncle is elongated, with the flowers on short lateral simple pedicels.

Racemose; having the flowers in racemes.

Rachis, or *rhachis*. The common peduncles, or elongated receptacle, on which florets are collected in a spike; also the midrib of a pinnatisect frond.

Radiate; having rays (*i. e.* spreading ligulate florets) at the circumference; as the heads of many Compositæ.

Radiate-veined; where the veins of a leaf diverge from a common centre, or point, at the summit of the petiole.

Radiatiform; a term applied to heads of compound flowers in which all the florets are ligulate, and directed towards the circumference.

Radical; belonging to, or growing immediately from, the root.

Radicating; sending out roots, or striking root at the nodes.

Radicle. A little root; the slender fibrous branch of a root.

Rameal; pertaining or belonging to the branches.

Ramification. The branching or division of an organ into several parts.

Ramose; branching.

Rank. A row, or arrangement in a line.

Raphe. The line, or little ridge, on one side of anatropous (*i. e.* inverted) ovules and seeds, formed by the adhesion of a portion of the funiculus.

Ratoon (Span. retono). A sprout from the root of a plant which has been cut off (chiefly used in reference to the sugar-cane.

Rays. The spreading ligulate florets round the disk of a compound flower; also the footstalks, and enlarged marginal flowers of an umbel.

Receptacle. The apex of the peduncle (much dilated in the *Compositæ*,) on which the parts of a flower (or entire florets) are inserted; the seat of the fruit, or of seeds and their equivalents.

Recurved; curved backwards.

Reflexed; bent or doubled backwards.

Regular; having the parts uniform and equal among themselves; as the lobes or petals of a corolla.

Remote; seated or growing at an unusual distance.

Reniform; kidney-shaped.

Repand; having the margin slightly indented with shallow sinuses.

Replicate; folded back on itself.

Replum. A name given to parietal placentæ when separated from the valves; also, the persistent border of a fallen legume.

Resupinate; turned upside down.

Reticulate; netted; having veins or nerves crossing each other, or branching and reuniting like network.

Retrorse, or ***retrorsely;*** pointing backwards or downwards.

Retuse; having a shallow sinus at the end.

Revolute; rolled backwards or outwards.

Rhizoma. A root-stock, or root-like subterraneous stem.

Rhombic, or ***rhomboid.*** rhomb-shaped; having four sides, with unequal angles.

Ribbed; having ribs, or longitudinal parallel ridges.

Ribs. Parallel ridges, or nerves, extending from the base to, or towards, the apex.

Rigid; stiff, inflexible, or not pliable.

Ringent; gaping, with an open throat.

Root-stock. (See Rhizoma.)

Rostrate; beaked; having a process resembling the beak of a bird.

Rosulate; in a rosette; arranged in circular series, like the petals of a double rose.

Rotate corolla. Wheel-shaped; monopetalous (or gamopetalous) and spreading almost flat, with a very short tube.

Rough; covered with dots, points, or short hairs, which are harsh to the touch.

Round; circular, or globular; not angular. (See Globose, Orbicular, and Terete.)

Rudiment. An imperfectly developed organ.

Rufescent; becoming reddish-brown, or rust-colored.

Rufous; reddish-brown, or rust colored.

Rugose; wrinkled.

Rugulose; finely wrinkled.

Ruminated; a term applied to a variegated albumen; *i. e.*, when its substance is wrinkled or plicate, and the investing membrane prolonged within the folds.

Runcinate; resembling the teeth of a mill-saw; somewhat pinnatifid, with the segments acute and pointing backwards.

Runner. A slender shoot, producing roots and leaves at the end, only, and at that point giving rise to another plant; exemplified in the strawberry plants.

Sac. A membranous bag, or boundary of a cavity.

Saccate; having, or being in the form of, a sac, or pouch.

Sagittate; arrow-shaped; notched at base, with the lobes (and frequently the sinus) acute.

Salver-form, or ***salver-shaped;*** tubular; with the limb abruptly and flatly or horizontally expanded.

Samara. A kind of akene, or dry indehiscent pericarp, having a winged apex, or margin, as the maple, ash, elm, etc.

Samaroid; winged or margined like a samara.

Sarcocarp. The fleshy portion of a pericarp (ex. gr. of a drupe) between the epicarp and the endocarp.

Sarmentose; having, or sending forth, or being in the form of runners.

Scabrous; rough, with little points, or hairs.

Scales. Small thin plates, or leaf-like processes; also the leaflets of the involucre, in the *Compositæ*.

Scandent; climbing, usually by means of tendrils.

Scape. A peduncle proceeding directly from the root, and mostly naked.

Scarious; dry and skinny, generally transparent.

Scattered; disposed or distributed thinly, without any regular order.

Scorpioid inflorescence; rolled back from the apex (circinate) before development.

Scrobiculate; having the surface excavated into little pits, or hollows.

Scutellate; shaped like, or resembling, a target or shield.

Seam. (See Suture.)

Secund; one ranked; all seated on, or turned to, the same side.

Seed; the matured ovule, with the embryo, or young plant, formed within it.

Segment. The division, or separated portion, of a cleft calyx, leaf, etc.

Semi; half; as semi-bivalved, half-two-valved, semi-terete, half round, etc.

Sempervirent; always green; living through the winter, and retaining its verdure.

Sepal. The leaflet, or distinct portion of a calyx.

Sepaloid; resembling sepals; green and not petal like.

Septicidal dehiscence. When a compound pericarp opens by splitting the dissepiments; *i. e.* the carpels separate from each other, and open to the seeds by the ventral suture.

Septiferous; bearing a septum.

Septifragal dehiscence. When the dissepiments remain attached to the axis, while the valves break away from them.

Septum. The partition which divides the cells of fruit.

Sericeous; silky; covered with soft, smooth, glossy appressed hairs.

Series. A division or comprehensive group of objects in natural history; also, a continued succession of things of the same order.

Serrate; sawed; having sharp teeth on the margin, pointing towards the apex.

Serratures. The teeth, or sharp segments of a serrate margin.

Serrulate; finely serrate; having small teeth or serratures.

Sessile; sitting closely; without any foot stalk or pedicel.

Seta (plural, *setæ*). A bristle; a stiffish elastic hair. Any slender or bristle-like body.

Setaceous; bristle-like; resembling a bristle in size and figure.

Setose; bristly; having the surface covered with bristles.

Sheath. A membranous expansion which is tubular, or convolute, and inclosing or embracing a stem.

Sheathed; inclosed or embraced by a sheath.

Sheathing; embracing the stem with a sheath.

Shining; glossy, smooth and bright.

Shrub. A small woody plant, branching near the ground, often without any principal stem.

Shrubby; hard and woody; of the texture and size of a shrub.

Silicle. A little or short silique, nearly as wide as long.

Silique. A long slender pod, or membranous seed-vessel of two valves, having the seeds fixed alternately along both sutures.

Siliquose; having siliques, or resembling a silique.

Simple; undivided; not branched; not compound.

Simple umbel. When each ray terminates in a single flower, instead of a secondary or partial umbel.

Sinuate; having sinuses, scallops, or gashes which are open and rounded at bottom.

Sinuate-dentate, Sinuate-serrate; having teeth, or serratures, with the clefts or openings rounded at bottom.

Sinus. An open notch; a rounded incision, or scallop.

Solitary; standing alone; one only in a place.

Spadix. A sort of dense flowered, fleshy or club-like spike, usually enveloped by, or proceeding from, a sheathing involucre called a spathe.

Span; a measure of nine inches.

Spathaceous; having a spathe, or resembling a spathe.

Spathe. A sheathing kind of bract, common calyx, or involucre, open on one side, often containing the spadix.

Spathulate, or *spatulate;* like a spatula; obovate-oblong, or larger and rounder at the end, and tapering to the base.

Species. The lowest permanent division of natural objects, in a systematic arrangement; a group comprising all similar individuals.

Specific; belonging to, or distinguishing the species.

Sphacelate; dark colored, as if gangrenous, or dead.

Sphagnous; full of bog-moss, or sphagnum.

Spicate; in the form, or after the manner of a spike.

Spike. Inflorescence in which the flowers are sessile on the sides of a long common peduncle, or rachis.

Spikelet. A little spike, or subdivision of a compound spike.

Spindle-shaped; (See Fusiform).

Spine. A thorn; a sharp process originating in the wood, *i. e.* pointed abortive branch.

Spinellose; armed with minute spines.

Spinescent; becoming thorny, or inclining to be thorny.

Spinose; horny; armed with thorns.

Spinulose; covered with small spines.

Spores, or *sporules.* The seminal equivalents, or analogues of seeds, in cryptogamous plants.

Spur. A tapering hollow production of the base of a petal, or sepal, usually called a nectary.

Spurred; having a spur, or spur-like elongations.

Squamose; scaly; covered more or less with scales.

Squarrose; jagged; having spreading tips, or divaricate points, all round, as the scales of some involucres.

Stamen. The organ of a flower which prepares the pollen, usually consisting of a filament and anther, and situated between the corolla and pistils.

Staminate flower. Having stamens, but not pistils.

Staminiferous; bearing or supporting the stamens.

Staminodia. Imperfect organs occupying the position of, and resembling stamens, being the transition stage betwéen petals and stamens.

Stellate; like a star; arranged like the rays of a star.

Stellular; radiating after the manner of little stars.

Stellular pubescence. Compound or fasciculate hairs, with the branches spreading like rays.

Stem. The main axis or body of a plant, the common supporter of branches, leaves, flowers and fruit.

Stemless; having no visible or aërial stem; applied to plants where the stem is suppressed, or so short as to be apparently wanting.

Sterile; barren, or unproductive; applied to flowers which produce no fruit.

Stigma. The summit of the style, or that portion of the pistil through which the pollen acts.

Stigmatic; belonging, or relating to the stigma.

Stigmatiferous, or *stigmatose;* bearing, or belonging to, the stigma.

Stipe. A little pedicel, or footstalk, of seeds, etc.

Stipellate; furnished with stipelles; *i. e.* the stipules of leaflets, in compound leaves.

Stipelles. The stipular appendages, or little stipules, of leaflets, in compound leaves.

Stipitate; having a stipe; supported on a little pedicel.

Stipitiform; resembling a stipe.

Stipular; belonging, or relating, to stipules.

Stipulate; furnished with stipules.

Stipules. Leaflets, or leaf-like appendages, at the base of a petiole, or leaf.

Stoles (*i. e.*, stolons—corruptly stools). The shoots, suckers, or off-sets, from the base of the stem, or roots of plants; usually applied to young winter grain, as wheat, etc. (See Tiller.)

Stoloniferous; having suckers, off-sets, or running shoots (stolones), from the base of the stem, or crown of the root.

Striæ. Fine parallel ridges or lines.

Striate; marked with longitudinal lines, or stripes.

Striate-sulcate; scored with minute longitudinal grooves and ridges.

Strict; straight and rigidly upright.

Strigose; armed with spreading bristly hairs, which taper from base to apex.

Strobile. The cone, or collective fruit, of Pines, Firs, etc.

Strophiole. A little crown, or fungous appendage to the hilum of a seed.

Style. The columnar (usually slender) portion of the pistil, between the ovary and the stigma, sometimes wanting.

Styliferous; bearing or producing a style, or styles.

Stylopodium. The foot or thickened base of the style (or united styles), at the junction with the epigynous disk, as in *Umbelliferæ.*

Sub; a preposition signifying under, or a division, as a sub-class, sub-order, etc.; also employed as a diminutive, or qualifying term, equivalent to almost, somewhat, or about, as sub-sessile, nearly sessile, etc.

Suberose; of a texture resembling cork.

Subulate; shaped like an awl-blade; linear or cylindric below; angular and tapering to a sharp point at summit.

Succulent; juicy; full of juice.

Sucker. A shoot, or off-set, from the root, or base of the stem.

Suffrutescent; almost shrubby.

Suffruticose; somewhat shrubby; shrubby at base.

Sulcate; furrowed, or grooved.

Super, or *supra;* a preposition signifying above or upon, beyond or more than, as super-axillary, situated above the axil.

Super, or *supra-decompound;* more than decompound many times subdivided, or compound.

Superior; above; a term applied to the ovary when it is above the calyx, or free in the flower; also to the calyx, when the tube is adherent to the ovary, and the segments borne on its summit.

Suppression; the non-production, or failure in the development of an organ.

Surculose; bearing suckers, or off-sets.

Suspended ovules, or seeds. When they are attached to the summit of the ovary, or pericarp, and hang perpendicularly in the cavity.

Suture. The the line or seam, formed by the junction of two margins.

Symmetrical flower. When there is an equal number of parts in each series, or verticil.

Syngenesious, having the anthers united, as in the *Compositæ.*

Synonym. Another name for the same thing.

Tenacious; sticky or adhesive; also holding on by means of very small hooked points.

Tendril. A filiform twining branch, or appendage, by which some plants climb, or sustain themselves; in the grape vine, it is an abortive raceme.

Terete; round, like a column, and either cylindric or tapering; applied to stems, or stem-like bodies. (See Orbicular.)

Terminal; situated at, or proceeding from, the end or summit.

Ternary; arranged in threes; consisting of three parts, or elements.

Ternate; three-fold; three together, as the leaflets of clover, etc.

Tessellated; resembling mosaic work; in little squares, or checkers, like a chess-board.

Testa. The outer integument, or proper coat, of a seed.

Tetradynamous; having four long and two short stamens, in a cruciate flower.

Tetragonous; four cornered, or having four angles.

Tetramerous; consisting of four parts, or constituent portions.

Tetrandrous; having four stamens of equal length.

Thorn. A sharp process from the woody part of a plant, being a stunted or abortive branch.

Throat. The orifice or passage into the tube of a corolla.

Thyrsoid; resembling, or being in the form of a thyrsus.

Thyrsus. A kind of contracted, or dense, ovoid panicle, as in the lilac, horse-chestnut, etc.

Tiller. A sucker, or young shoot of wheat, rye, etc.

Tiller, or *tillow;* to put forth suckers, or new shoots, from the root, or base of the stem, as wheat, etc. (See Stole, or Stool.)

Tissue. Web, or fabric; the intimate organic structure, or composition of bodies; especially those which are, or have been, alive.

Tomentose; covered with a curled, or matted, cottony pubescence.

Tomentum. A matted downy or cottony pubescence.

Toothed; (See Dentate).

Torose, or *torulose;* swelled out in obtuse ridges.

Tortuous; bent in different directions.

Torus. The bed, or receptacle at the apex of a flower-stalk, on which are inserted all the parts of the flower.

Translucent; clear, or transmitting light faintly.

Transverse, transversely; across; crosswise; at right angles with lengthwise.

Triadelphous; having the filaments united in three parcels.

Triandrous; having three stamens.

Triangular; having three angles, corners, or points.

Tribes. Groups of kindred plants, intermediate between orders and genera.

Tribracteate; having three bracts.

Trichotomous; three-forked; dividing by three equal branches.

Tricoccous; composed of three separable indehiscent carpels (or cocci).

Tricuspidate; having, or terminating in, three sharp points.

Trifarious; facing, or pointing, in three directions.

Trifid; three cleft; partially cut or divided into three segments.

Trifoliate; having three leaves; or the leaves arranged in threes.

Trifoliolate; three leaflets together.

Trigonous; three-cornered.

Trigynous; having three pistils.

Trilobate; three-lobed.

Trimerous; consisting of three parts.

Tripartite; three-parted.

Tripetalous; having three petals.

Tripinnate; thrice pinnate; the common petiole three times divided, or with bi-pinnate divisions on each side.

Tripinnatifid; pinnately dissected, with the primary divisions twice pinnatifid.

Triplinerved; having three principal nerves from the base.

Triquetrous; having three angles and three flat sides, as the culms of many *cyperaceæ.*

Trisepalous; having three sepals.

Triternate leaf. When the petiole is twice divided ternately, and each final branch bears three leaves.

Truncate; having the end blunt, as if transversely cut off.

Tube. A pipe or hollow cylinder.

Tuber. A solid fleshy knob attached to roots.

Tubercle. A small excrescence, knob, or point on a surface, making it rough or uneven.

Tuberculate; covered with tubercles.

Tuberiferous; bearing or producing tubers.

Tuberous, consisting of, or fleshy and solid like tubers.

Tubular; having a tube, or constructed like a tube.

Tuft. A bunch or fascicle growing from the same root, or originating nearly at the same point.

Tumid; swelled, or enlarged like a swelling.

Tunicate. Coated; having concentric coats, or thin layers.

Turbinate. Top shaped; resembling an inverted cone.

Turf. The green sward, or grassy soil.

Turgid; swelled, but not inflated.

Turion. A thick, tender, young shoot of a plant, as of asparagus, hop, etc.

Tussock. A dense tuft or bunch formed at the root, as in some species of carex, grasses, etc.

Twin; two of the same kind connected, or growing together.

Twining; winding round and ascending spirally.

Two-ranked, or *rowed.* (See Distichous.)

Type. A model or form; a pattern individual which unites in itself most completely the characters of a group.

Umbel. A kind of inflorescence, in which the flower stalks proceed from a common centre, like rays, or the braces of an umbrella. Umbels are simple or compound; which see.

Umbellate; in the form or manner of an umbel.

Umbellet. A partial umbel; one of the subdivisions of a compound umbel; which see.

Umbelliferous; bearing the flowers in umbels.

Umbilicate. Navel like; having a central pit, or depression.

Umbonate; protuberant, having a boss or elevated point in the centre.

Unarmed; without thorns or prickles.

Uncinate. Hook-shaped; hooked at the end.

Undulate. Wavy; curved, or rising and depressed, like waves.

Unequal; the parts not corresponding in length, size, form or duration.

Unguiculate; having a slender or narrow base, like an *unguis*, or claw.

Uniform, or uniformly. In one form, or manner; equally and alike.

Unilateral. On one side; growing, or inserted, all on one side of a stem, or common peduncle.

Unisexual. Of one sex; *i. e.* staminate or pistillate, only.

Urceolate. Pitcher-shaped, or urn-shaped; swelling below, and contracted to a neck above.

Utricle. A little sac, or thin membranaceous pericarp, which encloses, but does not adhere to, the seed. (See Caryopsis.)

Valvate æstivation. When the sepals or petals are folded together, and fit by their edges, without overlapping.

Valves. The several parts of a regularly dehiscent pericarp, especially of a capsule; also, the scales which close the tube in some corollas; and the chaffy pieces which cover the flowers of the grasses.

Var (varietas); a variety or modification of a species.

Variety. A new or unusual form, or modification of a plant, produced by accidental causes, such as crossing, soil, climate, culture, etc., but not permanently, or at least, not specifically, distinct.

Vascular plants. The higher orders of plants (including all above the mosses), composed more or less of woody fibres, and elongated cells or vessels, in the form of slender tubes.

Vaulted; arched over, like the roof of the mouth.

Veins. The elongated vessels of leaves; often synonymous with nerves.

Veined; having the vessels variously branching over the surface.

Venation of a leaf. The distribution of the veins, or frame-work, in the lamina or blade.

Ventral; contained in, or belonging to, the belly.

Ventral suture. The line or seam of a carpel, or folded leaf, formed by the union of its margins; the opposite of dorsal.

Ventricose. Bellied; swelling out in the middle, or below it.

Vernation. The mode in which young leaves are folded and packed in a bud.

Verrucose. Warty; covered with wart-like excrescences.

Versatile anther. When it is fixed by the middle on the point of the filament, and moves round lightly and readily, as in the grasses, etc.

Vertical, or vertically; in a perpendicular direction; from the zenith, or highest point, directly downwards.

Vertical leaves. When they stand edge up, or present their margins - and not their faces—to the earth and sky; indicative rather of phyllodia, than of true leaves.

Verticil. A whorl; flowers, leaves, or other organs, arranged in a horizontal ring, round a stem, or at its summit.

Verticilalster. A spurious verticil; a condensed cyme, or cluster resembling a verticil, as in many *Labiatæ.*

Verticillate; growing or arranged in a verticil, or whorl, or horizontal ring.

Vesicles. Little bladder-like vessels.

Vesicular, or *vesiculose;* made of, or resembling little bladders.

Vespertine flowers. Those which expand in the evening.

Vexillum. The banner, or broad upper petal of a papilionaceous corolla.

Villose, or *villous.* Velvety; clothed with numerous, and rather long, soft hairs.

Villus (plural, *villi*). The velvet-like pubescence on a villous plant.

Virescent; inclining to, or becoming green.

Virgate. Wand-like; long, slender, and straight.

Viridescent; greenish.

Viscid. Clammy; covered with a sticky or adhesive moisture.

Viscid pubescent; with a clammy pubescence.

Vittæ. Fillets; linear receptacles of oily matter on the carpels of umbelliferous plants.

Viviparous; producing a collateral offspring by means of bulbs; or having the seeds to germinate before they are detached from the parent plant.

Volubile; ascending spirally, or climbing by embracing another object. (See Twining.)

Wavy. (See Undulate.)

Whorl. (See Verticil.)

Winged; having a thin, extended margin.

Wings. The side petals of a papilionaceous corolla; also, the membranous expansion at the summit or margin of certain pericarps, and on the sides of some petioles.

Wooly; clothed with a long curled or matted pubescence, resembling wool.

BOTS. These are the larvæ of the two-winged dipterous insects, of the family *Œstridæ*, named from the principal genus in the family. Harris says of these: Bot-flies do not seem to have any mouth or proboscis; for although these parts do really exist in them, the opening of the mouth is extremely small, and the proboscis is very short, and is entirely concealed in it, so that these insects, while in the winged state, do not appear to be able to take any nourishment. They somewhat resemble the Syrphians in form and color, and in the large size of their heads; but the eyes are proportionally small, and there is a large space between them. The face is swollen or puffed out before. The antennæ are very short, and almost buried in two little holes, close together, on the forehead. The winglets are large and entirely cover the poisers. The hind body of the females ends with a conical tube, bent under the body, and used for depositing the eggs, which the insect lays whilst flying (poised). The larvæ or young of bot-flies live in various parts of the bodies of animals. They are thick, fleshy, whitish maggots, without feet, tapering towards the head, which is generally armed with two hooks; and the rings of the body are surrounded with rows of smaller hooks or prickles. When they are fully grown, they drop to the ground and burrow in it a short distance. After this, the skin of the maggot becomes a hard and brownish shell, within which the insect turns to a pupa, and finally to a fly, and comes out by pushing off a little piece like a lid from the small end of the shell. Many farmers suppose that the bot-flies infesting various animals are all one species. Such, however, is not the fact. More than twenty different kinds of bot-flies are already known, and several of them are found in this country. Some of them have been brought here with our domesticated animals from abroad, and have here multiplied and increased. Three of them attack the horse. The large bot-fly of the horse (*Gasterophilus equi*) has spotted wings. She lays her eggs about his knees; the small, Red-tailed species (*G. hæmorrhoidalis*) on his lips; and the Brown Farrier Bot-fly (*G. veterinus*) under his throat, according to Dr. Roland Green. By rubbing and biting the parts where the eggs are laid, the horse gets the maggots into his mouth, and swallows them with his food. The insects then fasten themselves, in clusters, to the inside of his stomach, and live there till they are fully grown. The following are stated to be the symptoms shown by the horse when he is much infested by these insects. He loses flesh, coughs, eats sparingly, and bites his sides; at length he has a discharge from his nose, and these symptoms are followed by a stiffness of his legs and neck, staggering, difficulty in breathing, convulsions, and death. No sure and safe remedy has yet been found sufficient to remove bots from the stomach of the horse. Bracy Clark, who has published some very interesting remarks on the bots of horses and of other animals, maintains that bots are rather beneficial than injurious to the animals they infest. The maggots of the *Œstrus bovis*, or Ox Bot-fly, live in large, open boils, sometimes called wornils or wormals, that is, worm-holes, on the backs of cattle. The fly is rather smaller than the Horse Bot-fly, although it comes from a much larger maggott. The Sheep Bot-fly (*Cephalemyia ovis*) lays its eggs in the nostrils of sheep, and the maggots crawl from thence into the hollows in the bones of the forehead. Deer are also afflicted by bots peculiar to them. Our native hare, or rabbit, as it is commonly called, sometimes has very large bots, which live under the skin of his back. The fly (*Œstrus buccatus*) is as big as our largest bumblebee, but is not hairy. It is of a reddish-black color; the face and the sides of the hind body are covered with a bluish-white bloom; there are many small black dots on the latter, and six or eight on the face. This fly measures seven-eighths of an inch or more in length, and its wings expand about three-quarters of an inch. It is rarely seen. The larvæ, when hatched in the stomach of animals, fasten themselves by the hooks or tentacles, and when mature are expelled with the dung of the animal. The bots infesting horses are the larvæ of four species of gadfly. The various species lay their eggs in the hairs of horses on the breast, shoulders and fore limbs. The animal in licking itself swallows the eggs, or else when deposited between the gums, they fall in the food and are swallowed, or else are taken when the animals lick each other. They are hatched, grow, mature and are expelled as we have stated, when they burrow in the soil to again transform into the perfect fly. When the bots have once fastened themselves to the stomach and acquired their hard, horny coating, they can not be dislodged, since they resist the strongest acids, alkalies, narcotics and mineral poisons. In autumn and early winter they are yet soft, and if suspected, in numbers sufficient to reduce the animal, give the following vermifuge: Two drachms powdered assafœtida, one and a half drachms powdered savin, one and a half drachms calomel, thirty drops oil of Male Shield Fern. Make into a ball with molasses. Follow this at the end of twelve hours with a purge of four drachms of Barbadoes aloes. Or, in lieu of the above, give one-quarter ounce of sulphate of copper, made into a ball, for three or four mornings in succession, and follow with the aloes purge, and repeat at the end of a week, if necessary. If the bots produce colic, give four drachms of tobacco, and repeat if necessary, following with a mild laxative. Say one ounce of rheubarb and one-quarter pound of epsom salts. Feed liberally to support the strength of the animal. In the summer when the bots are being expelled, this may be aided by a purge of aloes. To prevent the entrance of bots, trim off the long hairs in which the eggs are attached, or wash the places infested with soap suds. A daily application of oil will prevent the eggs from being fastened.

BOTTOM HEAT. In horticulture, heat produced by fermenting dung, leaves, bark, etc., for raising or forcing plants requiring a temperature higher than that of air.

BOUND. In veterinary medicine, a term applied to the bowels, to indicate want of natural action; to the skin (as hide-bound) or hoof (as hoof-bound) indicating tightness or constriction. A tree is said to be bark-bound when the bark cracks and is constricted.

BOUT. In plowing, one course of the plow.

BOWLDER. A massive rock, dissimilar from the adjacent rocks in mineral character, and supposed to have been transported by great floods, icebergs, glacial action, etc.

BOX DRAIN. A drain with square sides, presenting the section of a box.

BOX ELDER. (See articles Acer and Maple.)

BOX TREE. The *Buxus sempervirens* and *balearica* produce the dense yellow wood used by engravers, and also for making rules, combs, buttons, etc. The Dwarf Box is a variety of *B. sempervirens.*

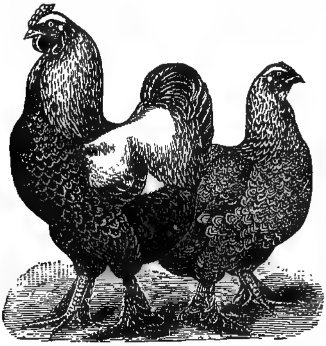
BRACCATE. Bracca, *Breeches*. In ornithology, when the feet are concealed by long feathers descending from the tibiæ.

BRACHALYTRA. The name of an extensive group of coleopterous insects, including all such as have the elytra so short as not to exceed one-third the length of the abdomen.

BRACHIUM. The lower portion or forearm of the fore extremities.

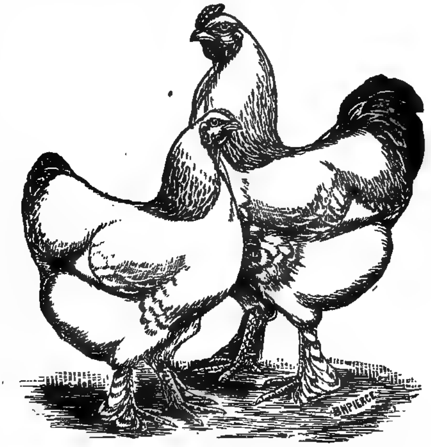
BRACT. In botany, the small leaflet situated under the flower. The flowers of grasses, sedges, etc., are bracts which receive the names of glumes and paleæ.

BRAHMA-POOTRA FOWLS. The Brahmas have long been favorite fowls with farmers, from their quiet habits, large size, and the quickness with which they grow to a marketable size for frying. In all the original breeds the deaf ears, fell below the wattles, and this characteristic has constantly been sought to be perpetrated. The hackles should be full and spread well and evenly over the back and shoulders. Vulture hacks, especially, should be well avoided. The backs should be well furnished with soft curling feathers, and the legs booted (feathered) quite down to the toes. This to apply to pure bred birds. In the farm yard, where birds are grown simply for market, nice qualifications are not



DARK BRAHMA.

essential, nevertheless the general characteristics should be preserved. As illustrating the two prominent breeds of Brahma-Pootra fowls, we give two cuts one of dark Brahmas, and one of light Brahmas. In relation to the two varieties Lewis, in his Practical Poultry Book, says: The Dark Brahmas are claimed by many breeders to be the best of the Brahma variety, but we opine there are just as many who stand ready to claim that the light are equally as good, if not a better breed. Still some breeders claim that the flesh of the dark is richer and more palatable than that of the light. Our opinion is that the difference between the two colors is all fancy, one proving just as good as the other, under similar management. Having bred both colors, we have yet to learn the distinctive difference between them. The plumage of the dark does not show the same mussiness of feather as the light; still, if kept in a clean, dry hennery, as fowls always should be, the difference is imaginary. So far as our individual opinion may go we like the dark fowls best, as bred to-day. The head of the cock should be surmounted with what is termed a "pea-comb" This resembles three small combs running parallel the length of the head, the centre one the highest; beak strong, well curved; wattles full; ear-lobes red, well rounded and falling below the wattles. The neck should be short, well curved; hackle full, silvery white striped with black, flowing well over the back and sides of the breast; feathers at the head should be white. Back very short, wide and flat, rising into a nice, soft, small tail, carried upright; back almost white; the saddle feathers white, striped with black, and the longer the better. The soft rise from the saddle to the tail, and the side feathers of the tail to be pure lustrous green-black (except a few next the saddle), slightly tipped with white, the tail feathers pure black. The breast should be full and broad, and carried well forward; feathers black, tipped with white. Wings small, and well tucked up under the saddle-feathers and thigh fluff. A good black bar across the wing is important. The fluff on the hinder parts and thighs should be black or dark gray; lower part of the thighs covered with soft feathers, nearly black. The markings of the hen are nearly similar to those of the cock. Both sexes should have rather short yellow legs (those of the hen the shorter) and profusely feathered on the outside. The carriage of the hen is full, but not so upright as that of the cock. The markings of the hen, except the neck and tail, are the same all over, each feather having a dingy white ground, closely penciled with dark steel gray, nearly up to the throat on the breast. Coming now to Light Brahmas, a cut of which we give below. The following are the characteristics given for those pure bred. They should be chiefly white in color of plumage, but if the feathers are parted, the bottom of the plumage will appear of a bluish-gray, showing an important distinction between them and White Cochins, in which the feathers are always white down to the skin. The neck-hackles should be distinctly striped with black down the center of each feather. The plume of the cock is often lighter than that of the hen; the back should be quite white in both sexes. The wings should appear white when folded, but the flight feathers are black; the tail black in both cock and hen; in the cock, however, it is well developed, and the coverts show splendid green reflections in the light; it should stand tolerably upright, and open well out laterally, like a fan; the legs should be yellow and well covered with white feathers, which may or may not be very slightly mottled with black; ear-lobes must be pure red, and every bird should have a perfect pea-comb, though fine birds with a single comb have occasionally been shown with good success; but, as a general thing, the pea-comb fowl shows off to the best advantage, and attracts universal commendation by both the amateur and breeder. The Chittagong breed of fowls was looked upon as possessing a great deal of merit, but in these latter days of Brahma and Cochin fever they have been lost sight of, and we scarcely hear the name of Chittagong mentioned; though we firmly believe the Buff and White Cochins owe their parentage to a cross with the Chittagong and Shanghæ breed. Kerr's Ornamental Poultry Breeder says the plumage of the Chittagong is very showy and of various colors; the birds being exceedingly hardy. In some, gray predominates, interspersed with lightish yellow and white feathers in the pullets; the legs being of a reddish flesh-color, and more or less feathered; the comb large and single; wattles very full, wings good size; the model is graceful, carriage proud and easy, and action prompt and determined. The flesh of this breed is delicately white. The cocks, at eight or nine months of age, weigh from nine to ten pounds,



LIGHT BRAHMA.

and the hens from eight to nine pounds. They do not lay as many eggs during the year as smaller hens, but they lay as many pounds as the best breeds. The red variety of Chittagongs are smaller than the gray; legs being yellow and blue; the wings and tail short; comb single and rose-colored. An ordinary pair will weigh from sixteen to eighteen pounds. In the dark-red variety the cock is black on the breast and thighs; the hens yellow or brown, with single serrated comb; legs yellow and heavily booted with black feathers. The Chittagongs, as a breed, are quite leggy, in many instances, the cock standing twenty-six inches high, and the hens twenty-two. The Cochin China breed is becoming more and more favorites with the general breeder, not only in England, but also in this country. They are deservedly high in the standard of merit among farmers on account of their hardiness and good laying qualities. In fact, although all the Asiatic breeds are persistent sitters in summer, they lay plenty of eggs in winter and early in spring. The Brahmas, however, are generally kept by farmers. They will average about 100 eggs per year, and furnish these at a season when eggs are scarce, and consequently high.

BRAMBLE. The genus *Rubus.* (See Blackberry.)

BRANDY. Liquor distilled from the dregs of wine. It contains fifty per cent. alcohol; the color is fictitious, as the spirit is nearly transparent. Burned sugar (caramel) is the usual coloring matter.

BRASSICA. The generic name of the cabbage, rape, broccoli family, etc. They belong to the *Cruciferæ* of Jussieu.

BREAD. There are three varieties extensively used in the United States—wheat, corn, and brown or Graham bread. Wheat bread is leavened, or rendered light and spongy by yeast, which is worked into the dough, and communicates to the starch of the flour, at a temperature above 60° Fahrenheit, a fermentation called the panary fermentation, in which sugar and alcohol are formed in small quantity, and the gluten of the flour diminishes even to two per cent. In these changes, carbonic acid gas is given off, and, rising through the dough, produces the cellular texture. When the process goes on too long, vinegar is produced, and the dough becomes sour. The heat of the oven stops the panary fermentation, and hinders further change. Town bakers, by using every expedient to accumulate gas in their loaves, produce a spongy, tasteless bread. Corn bread contains no gluten, and will not rise with yeast. It is sometimes mixed with enough water to be almost as soft as sticking paste, and baked at once, but the best bakers use eggs as a means of rendering it light. Graham bread is commonly made of whole flour, or containing the bran.

BREAKING. The old term for the training of horses and other animals. At the present day the term training is a more proper word since intelligent trainers do not so much use brute force now as formerly.

BREAKING UP. The plowing of meadows or other sod land.

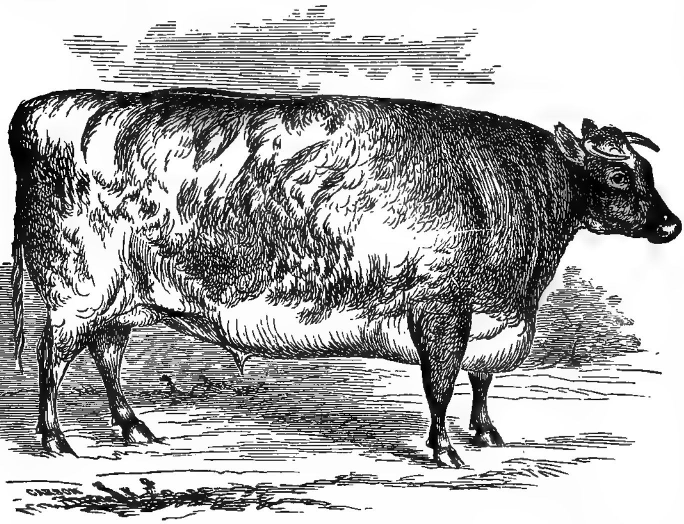
BRECCIA. A conglomerate formed with angular fragments of stones; some are calcareous, others silicious.

BREECHING. That part of the horse's harness which enables him to push back the vehicle to which he is harnessed.

BREECH WOOL. The coarse short wool of the breech of common sheep.

BREED. A variety among animals.

BREEDING. Breeding, in agriculture, is the art of so coupling animals and of so rearing them as best to fit them for the purposes for which they are intended. The fact early became known that characteristics of the parents were transmitted to the offspring; hence the saying, true enough among wild animals, that like produces like. In natural selection among gregarious animals the strongest male takes the pick of the herd, during the years of his vigor, to be again and again succeeded by other strong males. Hence, among such animals we shall often find the same sire for two or three generations. This has now come to be a pretty well established law in breeding up, to breed in twice, and once out. This rule, however, is only a general one, and requires close study of individuals to enable the breeder to arrive at the definite results he seeks. This rule however, coupled with that other rule founded on common sense, to breed only from the best, and aided by a close study of the peculiarities and excellencies of the several animals, both in constitution and physical development, is what makes the difference between the successful and progressive, because intelligent breeders, as against he who breeds at hap-hazard A critical study of the form and proportions of an animal with a view to their adaptation to the desired end, so that in animals intended for human food in connection with symmetry and physical excellence, the prime parts may be fully developed, as in animals for speed or draft, great heart and lung power, with corresponding development of bone, muscle and sinew, is necessary to any one who seeks to excel in the art of breeding animals. Early maturity is essential in all animals, but especially so for those intended as human food. In animals intended for speed, it is of secondary moment, since precocity in every case tends to early decay of the natural powers. If the reader will turn to the article on cattle, several cuts of improved breeds of the last century, Ayrshire, Durham and New Leicester, will be found. Taking the difference in the engraver's art as being 100 years ago and the present time, they may be taken as fair representations of the breeds as then existing. It will be seen that the New Leicester would be accepted to-day as a good steer. The others would now be called very bad. The model Short-horn cow, here shown, and that of the Ayrshire of the present day in the article Ayrshire Cattle, will form a good study, and will show the great stride in improved cattle, true of all other farm stock, and more eloquent than pages of descriptive writing. Therefore, in breeding any class of animals, a close and perfectly trained eye, and a correct knowledge of the animal organization is what makes the successful breeder. Bakewell, who lived about the middle of the last century, may be called the father of scientific breeding. During the present century he has been followed by a host of correct breeders both in England and North America, in the several departments of horses, cattle, sheep, swine and poultry; and again, in the subdivisions, that arise as to the special use which the animals are intended. Thus, among horses, we now have those intended for speed in running and trotting, for style in the carriage, the heavy draft horse, and the horse for general utility. In cattle we have those eminently adapted to the production



MODEL SHORT-HORN COW.

of beef, for labor and for the dairy. These again being broken up into classes, as in dairy cattle, those giving milk, rich in butter, while the milk of others are as well fitted for the production of cheese. However much the breeder may understand of physiology, and the excellencies of the animal make up, if he fail as a feeder he fails entirely. A starved animal of any kind is a losing investment to its owner. Especially is this the case with he who seeks to breed up, or keep up to the standard those already excellent in their finish. The object of breeding being to improve the animals bred in such qualities as have a definite value in the market, as the production of animals capable of labor, or of producing superior meat, milk, or wool. The breeder must work strongly to obtain high development in some particular quality. The time has long since passed when mediocrity in several essentials, and excellence in none will be accepted by the buyer. Occasionally two or more excellencies may be perpetuated. Thus, the Devons are noted for the excellence of their beef, and their value as beasts of draft; yet their lack of early maturity, and the moderate weights of beef they attain has carried the Short-horns and Hereford's far ahead of them, since, now-a-days, beef and not labor is what is desired in the steer. So the Short-horns were once fair milkers and fair beef-makers. Some families are so to-day. Yet, those sub-families, that are eminently beef-makers, will far out-sell the others in any sale ring, and for the reason that we now have cattle eminently adapted to the production of milk. In breeding, heredity, or the power of transmitting characteristics should be studied and the transmitting of useless or injurious abnormal characters guarded against. Dr. Miles, in his work, Stock Breeding, has collected many instances of acquired and abnormal characters and illustrations of heredity in the transmission of highly artificial qualities, in many and various improved breeds of animals. As illustrating our meaning we excerpt the following: The tendency to lay on fat rapidly and to mature early is inherited in the best families of the Short-horns, the Devons, the Herefords, and other meat-producing breeds, as we have shown, while the ability to secrete an abundant supply of milk is, in like manner, perpetuated in the Ayrshires, the Jerseys, and other dairy breeds. The certainty with which these acquired qualities are transmitted constitutes one of the most valuable peculiarities of a breed. The American trotting-horse furnishes another illustration of the inheritance of acquired characters. The various breeds of dogs have peculiarities that have been developed by a long course of training, which are transmitted with a uniformity that is surprising. Young setters, pointers, and retrievers, that have never been in the field, will often "work" with as much steadiness and ability as those that have had a long experience in sporting. In such cases, however, it will be found that the ancestors, immediate or remote, have been well trained in their special methods of hunting. The Shepherd-dog is remarkable for its sagacity and the persistence with which it carries out the wishes of its master; and it would be difficult, if not impossible, to train dogs of any other breed to equal them in their special duties. The Greyhound runs by sight, and the Bloodhound by scent, and their offspring all inherit the same peculiarities. The curious fact was observed by Mr. Knight, that the young of a breed of Springing Spaniels which had been trained for several successive generations to find woodcocks, seemed to know as well as the old dogs what degree of frost would drive the birds to seek their food in unfrozen springs and rills. A new instinct or peculiar characteristic has also become hereditary in a mongrel race of dogs employed by the inhabitants of the banks of the Magdalena almost exclusively in hunting the White-lipped Peccary. The address of these dogs consists in restraining their ardor and attaching themselves to no individual in particular, but keeping the whole in check. Now, among these dogs some are found which, the very first time they are taken to the woods, are acquainted with this mode of attack, whereas a dog of another breed starts forward at once, is surrounded by the peccaries, and, whatever may be his strength, is destroyed in a moment. A race of dogs employed for hunting deer in the plateau of Sante Fe, in Mexico, is distinguished by the peculiar mode in which they attack their game. This consists in seizing the animal by the belly and overturning it by a sudden effort, taking advantage of the moment when the body of the deer rests only upon the forelegs, the weight of the animal thus thrown being often six times that of its antagonist. Now, the dog of pure breed inherits a disposition to this kind of chase, and never attacks a deer from before while running; and even should the deer, not perceiving him, come directly upon him, the dog steps aside, and makes his assault upon the flank. On the other hand, European dogs, though of superior strength and general sagacity, are destitute of this instinct, and, for want of similar precautions, they are often killed by the deer on the spot, the cervical vertebræ being dislocated by the violence of the shock Mr. Lewes had a puppy taken from its mother at six weeks who, although never taught to "beg" (an accomplishment his mother had been taught), spontaneously took to begging for everything he wanted; when about seven or eight months old, he would beg for food, beg to be let out of the room, and one day was found opposite a rabbit-hutch apparently begging the rabbits to come out and play. A dog, owned by myself several years ago, inherited the same accomplishment from his mother, who had been trained to sit in an erect position and hold a stick in imitation of a soldier with a musket. This dog was taken from his mother when but a few days old, and before it had an opportunity of learning any tricks by imitation. Without any training, when a few months old, he assumed the erect position whenever anything was wanted, and, if that did not attract attention, he would "speak" with a short bark, as his mother had been in the habit of doing. Dr. H. B. Shank, of Lansing, informs me that a cat owned by him, had learned to open doors that were secured with a latch, and all of her descendants inherited the same peculiarity; while another family of cats, brought up with them, did not learn the trick, although they had sufficient intelligence to ask the assistance of their more expert friends when they wanted a door opened. Girou de Buzarringues reports the frequently-quoted case of a man who had the habit, when in bed, of lying on his back and crossing the right leg over the left. One of his daughters had the same habit from birth, and constantly assumed that position when in the cradle. Darwin reports the interesting case of a boy who had the singular habit, when pleased, of rapidly moving his fingers parallel to each other, and, when much excited, of raising both hands, with the fingers still moving, to the sides of his face on a level with his eyes; this boy, when almost an old man, could hardly resist this trick when much pleased, but, from its absurdity, concealed it. He had eight children. Of these a girl, when pleased, at the age of four and a half years moved her fingers exactly in the same way, and, what is still odder, when much excited, she raised both her hands, with her fingers still moving, to the sides of her face, in exactly the same manner her father had done, and sometimes still continued to do when alone. The handwriting of members of the same family is said to frequently present a marked resemblance; and it has been asserted that English boys, when taught to write in France, naturally cling to their English manner of writing. There are families in which the special use of the left hand is hereditary. Girou mentions a family in which the father, the children, and most of the grandchildren, were left-handed. One of the latter betrayed its left-handedness from earliest infancy, nor could it be broken of the habit, though the left hand was bound and swathed. Dr. Eugene Dupuy states that he owed to his friend, Dr. Gibney, the opportunity of observing a family consisting of father and mother, five children and one grandchild. Of this family the father and mother were semi-ambidextrous. All the children and the grandchild are ambidextrous to an annoying degree; all of the movements which they perform with one hand are simultaneously performed by the other hand. The girls are obliged to use only one hand when dressing themselves, or when cutting patterns, and hold the other hand down by their side, because the two hands perform the same movements at the same time, and would interfere with each other. Attention was called to the fact that the father of the grandchild is not semi-ambidextrous. Dr. Dupuy has made experiments upon these persons, and has found that, if the skin of the forearm on one side be kept well dry, and a rapidly-interrupted electrical current be used, so as only to call forth reflex actions, it is possible to induce synchronous movements in the fingers of both hands, and also muscular contraction in the lumbrical muscles of the fingers, which are too rapid to be carried on by the will. Wild animals, living on islands not often visited by man, do not fear him, but allow the closest approach without hesitation. When the Falkland Islands were first visited by man, the large, wolf-like dog (*Canis Antarcticus*) fearlessly came to meet Byron's sailors, who, mistaking this ignorant curiosity for ferocity, ran into the water to avoid them. Even recently, a man, by holding a piece of meat in one hand and a knife in the other, could sometimes stick them at night. On an island in the sea of Aral, when first discovered by Butakoff, the Saigak Antelopes, which are generally very timid and watchful, did not fly, but, on the contrary, looked at the visitors with a sort of curiosity. So, again, on the shores of the Mauritius, the Manatee was not, at first, in the least afraid of man, and thus it has been in several quarters of the world with seals and the morse. Quadrupeds and also birds which have seldom been disturbed by man, dread him no more than do our English birds, the cows or horses, grazing in the fields. Dr. Kidder, in his description of the "Sheath-bill" (*Chionis minor*), on Kerguelen Island, says: When I sat down upon a rock and kept perfectly still for a few moments, they crowded around me like a mob of street boys around an organ-grinder, and all seemed perfectly fearless and trustful. That the descendants of such animals, inheriting the accumulated experience of their ancestors, become wild, is shown in the instinctive dread of man exhibited by the young of the same and allied species that are frequently brought into contact with him. G. Leroy observes, that in districts where a sharp war is waged against the fox, the cubs, on first coming out of their earths, and before they can have acquired any experience, are more cautious, crafty and suspicious, than are the old foxes in places where no attempt is made to trap them. Knight, who for sixty years devoted himself to systematic observation of this class of facts, says that during that time the habits of the English woodcock underwent great changes, and that its fear of man was considerably increased by its transmission through several generations. The same author discovered similar changes of habit, even in bees. The marked heredity of habits has led some modern writers to claim that the instincts of animals are but the experiences of past generations, that are accumulated and established through inheritance. Many of the most valuable characteristics of the various improved breeds of animals have been produced by the inheritance of habits of the system, arising from the conditions and treatment to which they have been subjected. The remarkable records recently made by the American trotting-horse are the result of training and inheritance. The dairy breeds of cattle inherit a marked functional activity of the lacteal glands, which is but a modified habit of the system. Pritchard, in his Natural History of Man, states that the peculiar ambling pace to which the horses bred on the table-lands of the Cordilleras are trained, has, by inheritance, resulted in a race in which the ambling pace is natural and requires no teaching. The Norwegian ponies, descended from animals that have been in the habit of obeying the voice of their riders and not the bridle, are said to inherit the same peculiarity, so that it is difficult to break them to drive in the ordinary way. The habit of migration at particular seasons of the year is inherited, and I have often observed it in Mallard Ducks bred for several generations in a state of domestication. It must be admitted, however, that acquired habits are not in all cases hereditary, but it would be difficult, perhaps, in the present state of our knowledge of the subject, to fix a limit to their inheritance, so far, at least, as a predisposition is concerned. Acquired habits and the original traits of animals appear to be conflicting elements in their constitution, either one of which may, from its intensity, predominate in hereditary transmission. Pigs have been taught to point game and to perform various tricks, but, in the hereditary transmission of their characters, nature has had a stronger influence than culture possibly could have done. Carpenter, in discussing the heredity of acquired habits, says. There seems to be reason to believe that such hereditary transmission is limited to acquired peculiarities which are simply modifications of the natural constitution of the race, and would not extend to such as may be altogether foreign to it. From a practical point of view, however, the inheritance of acquired characters, so far as they are of any value, is, fortunately, without any apparent limit. Abnormal characters are frequently hereditary, but they are not so likely to be transmitted as acquired habits that are in harmony with the original peculiarities of the animal. The following examples will sufficiently illustrate this form of inheritance: Gratio Kelleia, the Maltese, was born with six fingers upon each hand, and a like number of toes to each of his feet. He married when he was twenty-two years of age. The result of that marriage was four children; the first, Salvator, had six fingers and toes like his father; the second was George, who had five fingers and five toes, but one of them was deformed, showing a tendency to variation; the third was Andre—he had five fingers and five toes, quite perfect; the fourth was a girl, Marie—she had five fingers and five toes, but her thumbs were deformed, showing a tendency toward the sixth. These children grew up, and, when they came to adult years, they all married, and of course it happened that they all married five-fingered and five-toed persons. Now let us see what were the result. Salvator had four children—they were two boys, a girl, and another boy—the first two boys and the girl were six-fingered and six-toed like their grandfather; the third boy had only five fingers and toes. George had only four children; there were two girls with six fingers and six toes, there was one girl with six fingers and five toes on the right side, and five fingers and five toes on the left side, so that she was half-and-half. The last, a boy, had five fingers and five toes. The third, Andre, you will recollect, was perfectly well formed, and he had many children whose hands and feet were all regularly developed. Marie, the last, who of course married a man who had only five fingers, had four children: the first, a boy, was born with six toes, but the other three were normal. In a paper contributed to the Edinburgh New Philosophical Journal, for July, 1863, Dr. Struthers gives several cases of hereditary digital variations. Esther P——, who had six fingers on one hand, bequeathed this malformation along some lines of her descendants, for two, three, and four generations. A—— S—— inherited an extra digit on each hand and each foot, from his father; and C—— G——, who also had six fingers and six toes, had an aunt and a grandmother similarly formed. A deficiency in the number of fingers, or in the number of the phalanges or joints of the fingers and toes, may likewise be transmitted, as shown in the following cases in Mr. Sedgwick's paper on the Influence of Sex in Hereditary Disease: A pastry-cook at Douai, named Augustin Duforet, had but two phalanges to all his fingers and toes. This defect he inherited from his grandfather, who had three children with the same malformation; the eldest of them (a son) had three sons all with the same defect; the second (a daughter) has had five children, two daughters with three phalanges, and three sons who have only two; the third who is the father of Augustin, had eleven children; five daughters normally formed, and six sons, in all of whom there is a phalanx wanting in both fingers and toes. The mother of Augustin also had two male, still-born children, with the same deformity. Dr. Lepine reports the case of a man who had only three fingers on each hand, and four toes on each foot; his grandfather and son had likewise the same deformity. Bechet records the case of a woman (Victorie Barré) who, instead of hands, had on each arm one finger only, the other fingers and their metacarpal bones, with the exception of imperfect rudiments of two of the latter, being entirely wanting; while on each foot there were but two toes, apparently the first and fifth, but both very defective. She was twice married: by her first marriage she had a healthy and regularly-formed male child, and by her second marriage two daughters malformed like herself; and her sister and father were also deformed in a similar manner. Another case is on record of the hereditary absence of the two distal phalanges, in which the transmission of the defect for ten generations had been effected by the females only of the family. A supernumerary organ, when inherited, may occupy a different position from that observed in the parent, as in the case of a woman with three nipples, published by Adrien de Jussieu. The additional nipple was placed in the groin, and served ordinarily for suckling, while in the mother of this woman, who was born also with three nipples, they were all placed on the anterior region of the thorax. The fifth toe of Dorking fowls, which is one of the characteristics of the breed, has been inherited, it is claimed, from a five-toed variety introduced into Britain by the Romans. Whether this is true or not, it is now impossible to determine, but the constancy of this peculiarity, even in the produce of other breeds crossed with the Dorking, would seem to indicate that it is a character which has been fixed by long-continued inheritance. In the Houdan fowls, when first introduced into England from France, a fifth toe was rarely seen; but at the present time it is nearly as constant in this breed as in the Dorkings. Mr. Wright says: The abnormal structure of the Dorking foot is very apt to run into still more abnormal forms, which disqualify otherwise fine birds for the show-pen. Birds are not unfrequently produced which possess three back-toes, or have an extra toe high upon the leg; or in the case of the cock, with supernumerary spurs which have been known to grow in every possible direction. This tendency to an increase in the development of an abnormal character that has become hereditary has been observed in other cases, but we are as yet unable to present a satisfactory explanation of them. In the case of the Dorking, the practice of breeding only those birds that have the abnormal peculiarity might be expected to intensify the tendency to its production, by making it a dominant character; but, in the following case given by Dr. Struthers, it will be safe to presume that only one parent had the abnormal character, and yet we find the same tendency to its increase. In the first generation an additional digit appeared on one hand, in the second on both hands, in the third, three brothers had both hands, and one of the brothers a foot, affected; and in the fourth generation all four limbs were affected. In a family, says Sir H. Holland, where the father had a singular elongation of the upper eyelid, seven or eight children were born with the same deformity, two or three other children having it not. Dr. Osborne reports the case of John Murphy, aged fifty-two years, a native of County Wexford (Ireland), who had fifteen brothers and five sisters, all of whom possessed the family peculiarity of tortoise-shell-colored eyes. The inheritance was derived from the mother. She had three sisters and one brother, who were all similarly affected, and who inherited the peculiarity from their mother, whose maiden name was F——. It is to this latter family that the peculiarity belongs, insomuch that in the part of the country where they resided they have been commonly recognized by this distinction, and celebrated for communicating it to their posterity. In this case, for three generations the transmission of the defect has been restricted exclusively to the female sex. In the year 1770, as we learn from D'Azara, a hornless bull was produced in Paraguay, which has been the progenitor of a race of hornless cattle that has since multiplied extensively in that country. The polled breeds of Great Britain undoubtedly had a similar origin. According to Dr. Randall, a ram having ears of not more than a quarter of the usual size appeared in a flock of Saxon sheep in Germany. He was a superior animal, and got valuable stock. These were interbred, and a little-eared sub-family created. Some of these found their way into the United States, between 1824 and 1828. One of the rams came into Onondaga county, N. Y. He was a choice animal, and his owner, David Ely, valued his small ears as a distinctive mark of his blood. He bred a flock by him, and gradually almost bred off their ears entirely. His flock enjoyed great celebrity and popularity in its day, but has been long broken up, and many years have doubtless elapsed since any of the surrounding sheep owners have used a little-eared ram; yet nearly every flock that retains a drop of that blood—even coarse-mutton sheep bred away from it, probably for ten or fifteen generations, insomuch that all Saxon characteristics have totally disappeared—still continues to throw out an occasional lamb as distinctly marked with the precise peculiarity under consideration as Mr. Ely's original stock. The Ancon, or Otter breed of sheep, that originated in Massachusetts in 1791, were characterized by the length of their bodies and the extreme shortness of the legs, which also turned out in such a manner as to render them rickety. They can not run or jump, and even walk with difficulty. This deformed breed is said to be descended from a ram in which the malformation was congenital. It is stated, on the authority of Colonel Humphreys, that this defect became so fixed by inheritance that it was uniformly transmitted. The Niata cattle, on the northern bank of the Plata, described by Darwin, have a peculiar malformation of the skull, that undoubtedly has been developed by the inheritance of a deformity of some of the ancestors. In this breed the forehead is very short and broad, with the nasal end of the skull, together with the whole plane of the upper molar teeth, curved upward. The lower jaw projects beyond the upper, and has a corresponding upward curvature. A very singular abnormal peculiarity is hereditary in some families of pigs—the tail, which is perfectly formed at birth, having a tendency to waste away and drop off when the animals are a few weeks old. Cases are reported of families with a single lock of hair of a different color from the rest of the hair, which in one generation may be upon the right side, and in the next on the left. A family of my acquaintance have several abnormal peculiarities that are transmitted with great uniformity. The little toes lap over the adjoining toes, and the nails have a longitudinal groove that gives them a bifid termination, so that when the nail is trimmed the part cut off is in two pieces. This same character of the nail is seen, also, on the index-fingers. In addition to these peculiarities, a cartilaginous projection on the back of the ear is inherited. The paternity of an illegitimate child, in one instance, was traced to this family, from its inheritance of the peculiarities above mentioned. Dr. Anderson says a gentleman of his acquaintance chanced to find a rabbit among his breed that had only one ear; he watched the progeny of that creature, and among these he found one of the opposite sex that had only one ear also; he paired these two one-eared rabbits together, and has now a breed of rabbits with one ear only, which propagate as fast, and as steadily produce their like, as the two-eared rabbits from which they originally were descended. The same author gives the case of a bitch that was born with only three legs. She has had several litters of puppies, and among these several individuals were produced that had the same defect with herself. He also states that a cat belonging to Dr Coventry, of Edinburgh, which had no blemish at its birth, lost its tail by accident when it was young. It had many litters of kittens, and in every one of these there was one or more of the litter that wanted the tail, either in whole or in part. Blumenbach affirms that a man whose little-finger of the right hand had been nearly demolished and set awry had several sons, all of whom had little fingers of the right hand crooked. In his experience with Guinea-pigs, Dr. Brown-Séquard observed that, in those subjected to a particular operation, involving a portion of the spinal cord or sciatic nerve, a slight pinching of the skin of the face would throw the animals into a kind of epileptic convulsion. When these epileptic Guinea-pigs bred together, their offspring showed the same predisposition, without having been themselves subjected to any lesion whatever; while no such tendency showed itself in any of the large number of young which were bred from parents that had not been operated on. Prof. Tanner says he knew a very striking instance of the loss of milk in a flock (previously celebrated for their supply of milk) being traced entirely to the use of a very well-formed ram, bred from a ewe singularly deficient in milk. It is stated on good authority that animals that have been branded in the same place for several successive generations, transmit the same mark to their offspring. From the many cases of inherited habits and abnormal peculiarities on record, we have quoted a sufficient number to show the great variety of such characters that are liable to be transmitted. And the many instances in the human family are given because these men seem to be recorded, while in animals only extraordinary cases are noticed. Another point the stock breeder must take into consideration in connection with heredity, or the transmission of peculiarities, is in all stock liability to those diseases and disabilities considered congenital, as dilatation or contraction of the blood vessels, weak lungs, soft and flabby muscular systems, or limbs containing an unusual amount of cellular tissue inclining, in the horse, to swelled legs, weed, grease, etc., or conformation, tending to produce spavin or strains. These in breeding must be especially guarded against. As illustrating this subject in the horse, Mr. Finley Dun, a competent English veterinary authority, says: A disproportion in the width and strength of the leg below the back, to the width and strength above the back predisposes to spavin. A straight back and a short *os calcis* (heel bone) inclining forward, gives a tendency to curbs. Round legs and small knees to which the tendons are tightly bound, are subject to strains. And a predisposition to navicular disease is found in horses with narrow chests, upright pasterns, and turned out toes. From what we have given, the careful reader will see the necessity of informing himself in relation to the physiology of the animals intended to be bred. For defective adjustments or weakness in the several parts of an animal, if transmitted, may take years of breeding to eradicate. Another important point to be observed, is never to breed immature animals or those overworked. A male suffered to copulate unduly always gets weak animals, and a female insufficiently nourished, which has not arrived at a proper breeding age, will prove unsatisfactory. In oviparous animals, the eggs of very young females are less in number and smaller; not only this, they are less fertile, the yolk being deficient. So with all animals; very young dams always produce less young in number at a birth, or those deficient in size and vigor, than those fully developed. The form of heredity termed atavism, and known among breeders as throwing back, breeding back, etc., must not be overlooked. This is shown in color, the lack of some important function or appendage, and may be transmitted, after many years, and from a single coition of ancestors, resulting in peculiar horns, peculiar colored noses, skin diseases, etc., are well established. Mr. Sedgwick, Dr. Struthers, Chadhome, Darwin, Randall, and many others, acute observers, have given so many instances of breeding back, that too much attention can not be given to prevent this reversion, by breeding together animals pure, and without taint. In relation to atavism, Mr. Sedgwick says: No fixed boundaries, recognizable by us, can be expected to limit its operation, for, like other general laws in nature, unity in principle coexists with variety in results; and it is chiefly because we are less familiar with the results of atavism in disease than we are with many other productive phenomena, as for the sake of illustration, with memory, that we hesitate to accept them, although they are not, in themselves, more exceptional or peculiar than some of those are which we not only never hesitate to accept, but with which this phenomenon in morbid development seems to be closely allied. For atavism in disease appears to be but an instance of memory in reproduction, as imitation is expressed in direct descent; and in the same way that memory, as it were, dies out, but in some state always exists, so the previous existence of some peculiarity in organization may likewise be regarded as never absolutely lost in succeeding generations, except by extinction of race. In relation, for instance, to a previous impregnation of a female by a male, in which the peculiarities of the male was shown for years, although no succeeding contact was had, is too well authenticated to be doubted. Besides the celebrated case of a seven-eighths Arabian mare, covered in 1815 by a Quagga, a zebra-like animal, the hybrid not only resembled the sire in color and other peculiarities, but the mare produced successively foals in 1817, 1818 and 1821, by a black Arabian horse, not having seen the Quagga since 1816, yet the foals all have the curious and unequivocal markings of the Quagga. This, of itself should cause breeders to use the greatest care in the breeding of all pure animals, that they have not contact in any way with inferior animals. To still further illustrate this matter, the following statements taken from various sources are authentic: Mr. William Goodwin, veterinary surgeon to Her Majesty, states that several of the mares in the royal stud, at Hampton Court, had foals in one year, which were by Actæon, but which presented exactly the marks of the horse Colonel, a white hind-fetlock, for instance, and a white mark or stripe on the face; and Actæon was perfectly free from white. The mares had all bred from Colonel the previous year. Alexander Morrison, Esq., of Bognie, had a fine Clydesdale mare which, in 1843, was served by a Spanish ass and produced a mule. She afterward had a colt by a horse, which bore a very marked likeness to a mule—seen at a distance, every one set it down at once as a mule. The ears are nine and a half inches long, the girth not quite six feet, and stands above sixteen hands high. The hoofs are so long and narrow that there is a difficulty in shoeing them, and the tail is thin and scanty. A pure Aberdeenshire heifer was served with a pure Teeswater bull, by which she had a first-cross calf. The following season the same cow was served with a pure Aberdeenshire bull; the produce was a cross-calf, which, when two years old, had very long horns, the parents being both polled. Mr. Shaw, of Leochel-Cushnie, put six pure-horned and black-faced sheep to a white-faced hornless Leicester ram, and others of his flock to a dun-faced Down ram. The produce were crosses between the two. In the following year they were put to a ram of ther own breed, also pure. All the lambs were hornless and had brown faces. Another year he again put them to a pure-bred horned and black-faced ram. There was a smaller proportion this year impure; but two of the produce were polled. One dun-faced, with very small horns, and three were white-faced—showing the partial influence of the cross even to the third year. A small flock of ewes belonging to Dr. W. Wells, in the island of Grenada, were served by a ram procured for the purpose—the ewes were all white and woolly; the ram was quite different—of a chocolate color, and hairy, like a goat. The progeny were of course crosses, but bore a strong resemblance to the male parent. The next season Dr. Wells obtained a ram of precisely the same breed as the ewes, but the progeny showed distinct marks of resemblance to the former ram in color and covering. Mr. Darwin cites the following case: Mr. Giles put a sow of Lord Western's black-and-white Essex breed to a wild boar of a deep chestnut color, and the pigs produced partook in appearance of both boar and sow, but in some the chestnut color of the boar strongly prevailed. After the boar had long been dead the sow was put to a boar of her own black-and-white breed—a kind which is well known to breed very true, and never to show any chestnut color—yet from this union the sow produced some young pigs which were plainly marked with the same chestnut tint as in the first litter. Thus, the absolute necessity of care in the proper development of both sires and dams, and their progenitors, has been amply shown. The period of gestation in animals should also be known Youatt records the average period of gestation in the mare at eleven months, but that it may be diminished five weeks or extended six weeks. In twenty-five mares recorded by M. Gayot, the shortest period was 324 days, and the longest 367; the mean period being 343 days. M. Tessier records the period of 582 mares: The shortest period was 287 days, the longest, 419; the average being 330 days. In relation to the gestation of cows, Earl Spencer has recorded the period in 764 individuals, the least period was 220 days; longest period, 313 days; mean, 285 days. He attests that he has not been able to rear a calf produced at an earlier period than 242 days. Four hundred and twenty ewes under the observation of M. Magne, at Alfort, gave as the period of gestation: 149 days for eighty, 148 days for sixty-eight, 150 days for fifty-five, 147 days for fifty-five, 151 days for forty-nine, 146 days for thirty, 152 days for twenty-three, 145 days for twenty-two, 144 days for fifteen, 153 days for thirteen, 154 days for seven, 156 days for three, 143 days for two. Extremes, 143 and 156 days; entire period in three-fifths of the flock, from 147 to 150 days. M. Morel de Vinde has recorded the period of gestation in 462 ewes, as follows: 153 days in 118, 152 days in ninety-seven, 151 days in eighty-one, 150 days in fifty, 154 days in forty-two, 149 days in thirty-one, 155 days in eighteen, 148 days in seven, 156 days in six, 157 days in five, 147 days in four, 146 days in three. In three-fifths of these ewes the duration of gestation was from 151 to 153 days. That Merino and Southdown sheep, when both have long been kept under exactly the same conditions, differ in the average period of gestation, as follows: Merinos 150.3 days; Southdowns, 144.2 days; Half-bred Merino and Southdown, 146.3 days; three-fourths blood of Southdowns, 145.5 days; seven-eighths blood of Southdowns, 144.2. In swine, the average period of gestation is about sixteen weeks. The extremes being according to thirty-five well attested cases from 101 to 123 days. Earl Spencer's table in relation to the gestation of cows, is as follows:

Number of days of gestation.	Cows.	Cow-calves.	Bull-calves.	Twin cow-calves.	Twin bull-calves.	Twin cow and bull-calves.
220	1		1			
226	1	1				
233	1		1			
234	1		1			
235	1	1				
239	1	1				
242	1		1			
245	2	2				
246	2		2			
248	1	1				
250	1	1				
252	2		2			
253	1		1			
254	1	1				
255	2		2			
257	2	1	1			
258	3	1	2			
259	1		1			
262	1		1			
263	2		2			
266	1				1	
268	2	2				
269	2		1			1
270	5	2	1	1		1
271	6	5	1			
272	3	1	1		1	
273	3	2	1			
274	5		5			
275	5	2	2		1	
276	15	7	6		1	1
277	14	10	2	1		1
278	18	11	4	1		2
279	32	16	11	3		2
280	35	15	20			
281	39	20	18			1
282	47	26	20	1		
283	54	30	24			
284	66	33	33			
285	74	29	43			2
286	60	22	38			
287	52	25	27			
288	42	13	28		1	
289	45	20	25			
290	23	10	13			
292	16	5	11			
293	10	1	9			
294	8	1	7			
295	7	3	4			
296	6	2	4			
297	2	1	1			
299	1		1			
304	1	1				
305	1	1				
306	3	3				
307	1	1				
313	1	1				

Thus it will be seen that no person can hope to succeed in the breeding of fine stock of any kind except he carefully study form, action, characteristics, the anatomy and physiology of the animals to be bred, together with the peculiarities desired to be perpetuated or to be avoided. Even in the breeding of cold-blooded animals, misnomer, but which has been used by breeders, to designate especially among horses, those whose pedigrees can not be traced, and which have come of sires and dams of the mixed breed of a country. The careful breeder, may do much to improve the quality of his stock by selecting superior and well formed animals to breed from. Yet in this day, it will be to him a losing game, since breeds of all farm animals are now so superior, that the special characteristics required may be more easily and more cheaply secured, by the purchase of improved sires and dams than to spend generations of time in securing improvement by breeding up from inferior animals.

BREWING. This is the process of obtaining the saccharine solution from malt, or other matters, and converting this solution into spirituous liquors, ale, porter, or beer. There is little doubt of the antiquity of this art. The Egyptians are said to have been the inventors of beer. The early Germans and the Saxon forefathers were as fond of beer as the modern citizens. The English process is as follows: In the grinding of the malt, as in many other parts of brewing, some prefer it ground between stones, others crushed by rollers; some prefer a fine grist, others a coarse one. The mashing may be performed in a vessel of wood, with a false bottom pierced full of holes; on this bottom the malt is laid; the water is then admitted, which, for pale ale, or pale spirits, should be of the temperature of from 170° to 185°, according to the quantity mashed; the heat being increased as the mass diminishes. For porter, not higher than 165°, or lower than 156° For the second mash an increased temperature of 15° or 20° will be advisable. For the first mash, for every quarter, twenty-eight pounds of malt, a barrel and a half of water may be used, and the grist well mixed with the water. The mash is permitted to rest for some time, and then allowed to run off into an under-tank, whence it is pumped into the boiler, where it is raised to the boiling temperature. When the wort is sufficiently drained from the mash-tub, another portion of hot water is added for a second mash. The hops are next added, and the boiling is completed, which in general requires an hour and a half, or until the wort breaks bright from the hops, when a sample is taken from the copper. The wort is let off into coolers—either of wood or iron—where, when sufficiently cooled, or else in proper fermenting tuns, the yeast or barm is added. The fermentation speedily begins, and when it is thought that a sufficient quantity of alcohol is formed, the fermentation is stopped, and the yeast is separated by running it into smaller vessels, and skimming off the barm; or else by allowing it to run off from the bung-holes of the casks, which are, for this purpose, kept completely filled. A small portion of salt is commonly added, and occasionally, especially by the professional brewer, a portion of isinglass or other finings. In all these operations cleanliness is a most essential part, for without this it is impossible to have good beer. The quantity of hops to be added varies with the quality of the beer. Four pounds to the quarter of malt is sufficient for beer for present use, and from this to twenty-eight pounds have been used for beer for long keeping. The temperature of the fermentation should range between 56° and 62°. Not more than 60° for ale wort, nor more than 62° for porter. Great care should be taken to have good, sound, healthy, and new yeast, and of this about two pounds per barrel are commonly needed. Good malt and hops, of course, are requisite; but the quality of the water is not of so much consequence as is very often considered to be the case. Some of the best ales in England are brewed either with soft or with hard water, and from rivers, or springs, or ponds. The quantity of alcohol, upon an average, in brown stout is about 6.80, in ale 8.88, and in small beer from two to three per cent. The specific gravity of the wort, when it is placed in the fermenting vessels, varies from 1.060, when it contains 14 25 per cent. of solid matter, to 1 127, when it contains 28.2 per cent. That of small beer varies from 1.015 to 1.040, the first containing about 3 5 per cent. of solid matter, the latter about 9.5 per cent. The chief use of the hops is to communicate the peculiar bitter flavor from the oil which is contained in them; partly to hide the sweetness of the saccharine matter, and partly to counteract the tendency which wort has to run into acidity. Hops are by no means the only bitter which may be made use of for preparing and flavoring ales. Mixtures, in various proportions, of wormwood, powdered bitter oranges, gentian root, and the rind of Seville oranges, will afford an excellent bitter, and are often used in home brewing, as were grounding by the Saxons before the introduction of hops. Strasburg beer, which is much prized on the continent, owes much of its excellence to the use of avens (*Geum urbanum*). A good beer can be produced from potatoes grated to a pulp, mixed with barley malt. In Ireland beer is made from parsnips. Cane sugar or glucose (fourteen pounds of cane sugar dissolved in ten gallons of boiling water, with one and one-half pounds of hops) is said to make excellent beer. The beer made in this way is pale colored, but color may be given readily by scorched sugar (caramel). Beer has also been made from mangel-wurzel 150 pounds, and one pound of hops in sixteen gallons of water. It may also be made from the various cereal grains, and even from Indian corn.

BRICK. (See Brick Earth.)

BRICK EARTH. Any stiff clay containing fifty to seventy per cent. of real clay, and the rest sand. Bricks are made from various colored clays, the presence of iron making the brick red. Exceeding fine cream-colored bricks are made from a silicious clay found near Milwaukee, Wisconsin.

BRIMSTONE. Roll sulphur, made by melting and casting common sulphur.

BRINING GRAIN. Is the practice of steeping it in pickle, in order to prevent smut and other diseases. The steep is made with common salt and water, of sufficient strength to float an egg; or of sea-water, with salt added to it till it is of the requisite strength. The seed should be well stirred in the brine; thus the light grains rise to the surface, and are skimmed off; the rest is put to drain, and air-slaked lime sifted upon it; after being carefully mixed, and when a little dried, it is sown. Urine, kept until stale, is used in the same manner; but the seed should be sown at once Brining seed-wheat is a prevention of smut—a parasitic fungus.

BRITTLE HOOF. An affection of the horse's hoof, the result of bad stable management. A mixture of one part of oil of tar and two of neatsfoot oil, well rubbed into the crust and the hoof, will restore the natural pliancy and toughness of the horn, and contribute to the quickness of its growth

BRIZA. The generic name of the Quaking-grass (*B. media*). It is of no agricultural value.

BROMINE. A brown fluid extracted from salt-water and sea-weeds. It is very similar to chlorine in its properties

BROMUS. The genus of Brome-grasses (*B. secalinus*) is the well-known Cheat, or Chess. (See Chess; also Grasses.)

BRONCHIA. The ramification of the wind-pipe in the lungs.

BRONCHITIS. A disease in horses. A catarrh extending beyond the entrance of the lungs. The symptoms are quick and hard breathing, peculiar wheezing, and coughing up mucus The chronic form is difficult to cure. Acute bronchitis is relieved by soothing applications to the throat, and such drinks as would be good for a common cold.

BRONCHOTOMY. The operation of opening the trachea low down.

BROOM CORN. A plant of the genus sorghum, a native of India, and cultivated for its branching panicles; almost universally used now in the manufacture of brooms for sweeping and whisks for brushing clothes. The plants of this genus are all more or less rich in saccharine matter. Sugar sorghum, of which broom corn has been said to be a representative type, is now extensively cultivated in many of the States north and south, for its syrup and sugar. The cultivation of broom corn for its heads has of late years become an extensive industry in a number of Western States, principally in Ohio, Indiana, Illinois, Iowa and Kansas. The introduction of broom corn, as a cultivated plant in the United States is attributed to Dr. Franklin. Having seen an imported whisk broom in the hands of a lady of Philadelphia, he found a seed adhering to one of the straws and planted it. From this originated the industry in the United States. The cultivation is principally like that of Indian corn. The hills vary from three feet apart each way, to three and a half feet one way, by two feet the other way. It is also sown in drills; but in the West this is not much practised, since it adds to the cost of cultivation and handling. In the West less hand hoeing is required than in the Eastern States, but in the West the cultivation is not considered remunerative except when raised in large fields, with ample shed-room for drying, and presses for baling, since so much depends upon the manner in which it is placed in the market. The brush must always be cut before the seed is fully formed, usually when in the soft dough state. The *Country Gentleman* describes the manner of cultivation East as follows: Good crops of broom corn may be raised, with proper care and attention, on any clean fertile land where Indian corn will succeed well. River flats are particularly well adapted to it, provided the nature of the soil or the situation gives them a good natural drainage. Uplands should be well underdrained if the subsoil is retentive of water. Drained muck beds are more liable to frost, are not compact enough, and are not well adapted to the culture of this crop. As the plants appear small and feeble at first, and are easily choked by an over-growth of weeds, it is more important that the soil should be clean than for the culture of common corn; and, as complete success depends on fertility, more pains should be taken to have everything just right. A crop of broom corn, it is true, may be raised with a moderate degree of care and attention; but the yield will be moderate, and perhaps it may prove a losing affair In order to obtain the highest net profit, let everything be done in the most perfect manner. If the land is not perfectly clean, the best way will, doubtless, be to plant on a freshly inverted sod—a clover sod being decidedly the best, especially if the land is inclining to be heavy. The roots of the clover will loosen it in a better manner than plowing or harrowing alone can accomplish. An excellent mode is to spread old manure, the seeds of which have been killed by fermentation, or any other manure that is clear of foul weeds, on the clover the previous summer or early in autumn. Late in autumn or early in winter will be better than spreading in spring. The manure will soak into the soil during the several months before plowing, and become better diffused than could be accomplished by any plowing or harrowing. The time for planting is about the same as for common corn—as early as will do to escape spring frosts. Before planting, let the soil be made perfectly mellow, and if to be in hills, mark out so that they may be as near together as will admit of convenient cultivation. The nearer they are together, or in other words, the more evenly and uniformly the plants are distributed over the surface, the greater will be the yield of brush. A common distance of hills is two and a half to three feet one way, and twenty inches to two feet the other. If planted in drills, a larger crop may be obtained, as a greater number of stalks will grow, but they are attended with more labor. The number of plants may be about three times as great as for Indian corn. If a larger quantity of seed is planted, so as to require some thinning out, the crop will be more even and larger, but will need a greater expenditure of work. It is common to plant a dozen or more seeds in each hill, about an inch deep, and thin out to seven or eight—leaving a larger number if the hills stand two by three feet than if twenty by thirty inches. Drills are often placed only twenty-eight inches apart. Many regard the finer and softer brush of thick growth as best. The cultivation of the ground should be commenced as soon as the plants make their appearance. It is very important that they be not allowed to become encumbered or crowded with weeds. Keep the whole surface perfectly clean from the very start. Continue the horse cultivation once a week, as long as the size of the plants will admit. This is not generally attended to, but the constant stirring of the surface and breaking of the crust will make an important difference in the amount of the crop. When the stalks have sufficiently grown, or when the seeds are in the milk state, the breaking back is performed. It is done at a convenient height for the operator, generally so as to leave a foot or two of stalk from the base of the brush. Two rows are broken towards each other, so as to admit a ready passage between the other two. The seed being rather difficult to cure by drying, some cultivators give no attention to saving it, especially as it often fails to ripen at the North except in favorable seasons.

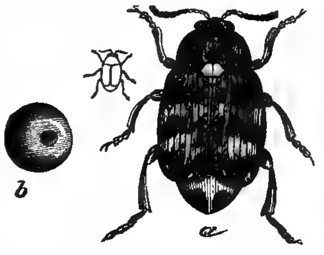
If the stalks are broken back a little earlier, they form a better brush. In a few days they are cut, just above the break, and laid in bunches to dry. These must not be opened, to become wet by rain, as this would injure their value. The seed are removed by hand, with a sort of coarse comb, where the plantations are not large; but when the crop is cultivated on an extensive scale, it is done with a machine driven by horse-power. The brush or tops are dried by laying them on horizontal poles, and successive tiers placed one above the other, leaving spaces for the air between each. Sheds or lofts may be used for this purpose. Temporary structures for drying are made of rails, the brush being laid on pairs of rails placed horizontally, so as to form a structure twelve feet square, or equal to the length of the rails, and each successive tier formed by resting the horizontal rails on an additional rail placed under each of their ends. By selecting the larger rails for one side, this side gradually becomes higher than the other, and admits a board roof for the top when the height has reached eight or ten feet. The quantity of brush yielded from an acre is usually about five or six hundred pounds, but, in rare instances, it has reached as high as a thousand pounds. The price varies from five to ten cents. There is more uncertainty with this crop than with many others—not on account of the difficulty of raising, for with proper care it is reasonably certain, but from the uncertain or fluctuating character of the market. With the seed, especially, this uncertainty is great. Sometimes it is sold as high as three or four dollars per bushel; at other times for not more than fifty cents. The seed may, however, be profitably used as food for horses when mixed with oats or other grain. When the seed is not allowed to mature, several successive crops have been grown on the same ground without detriment, and with moderate manuring.

BROOM-GRASS. *Andropogon purpurescens*, *A. furcatum*, or forked spike-grass, and *A. nutans*, or beard-grass, are well known species. (See Grasses.)

BROWN DYES. The commonest are the decoctions of oak bark, common bastard marjoram, walnut peels, horse-chestnut peels and catechu. Oak bark and walnut give dyes without mordants, but are brightened by alum. Catechu (one pound) combined with blue vitriol (four ounces) gives bronze when used in a boiling solution. The tints of brown are, however, so numerous that it is more common to use madder as a basis for the red tints, fustic for the yellows, and use solution of iron and copper as mordants, and even a gallnut bath afterward, to reach the proper shade. Dyeing is now but little practised as a household art.

BROWSE. The young branches of trees, shrubs, etc., upon which stock sometimes feed.

BRUCHUS. A Linnæan genus of coleopterous insects, which deposit their eggs in the young grains or seeds of leguminous plants; a small family of under-sized beetles, always less than a quarter, and sometimes of one-eighth of an inch in length. Dr. Le Baron, says the only tetramerous beetles with which they could be confounded are the Curculionidæ and the Chrysomelidæ; but they differ from the former by having the labrum and palpi of the ordinary form and the head is but little prolonged anteriorly; and they differ from the great majority of the latter in their short, serrate atennæ, and in having the tip of the abdomen uncovered by the elytra. The family contains but a few genera, and all our injurious species belong to the genus *Bruchus*. The most notorious species are Pea-weevil (*Bruchus pisi*,) the Bean-weevil (*B. obsoletus*,) the Grain-bruchus (*B. granarius*). The latter is a European species which has been imported in small numbers into this country. The time of the hatching of the eggs is when the seeds have approached to maturity, and then the larvæ begin to feed upon them. The pea and bean weevil are well known forms of this genus; also some grain weevils They may be destroyed by fumigating the seed with sulphurous fumes. The cut shows the pea weevil, a beetle, enlarged; the natural size at the left. Also a pea showing the characteristic mark of the insect.



PEA-WEEVIL.

BRUCIA. A vegetable alkaloid, similar to strychnine, and poisonous.

BRUSH DRAINS. Placing bushes or brush in the water-way of drains; the tops should be with the current. It answers well enough for ten or twelve years, but is not so permanent as other means. In laying the brush, the buts should lap over the previous layer, so when pressed down, they will be higher than the ends of the branches.

BRYONY. *Bryonia dioica.* A climbing herb, poisonous, used in medicine.

BUCK. The male of deer, rabbits, etc. The male of sheep is sometimes, but incorrectly, so denominated.

BUCK-BEAN. *Menyanthes trifoliata.* A swamp plant, with handsome flowers and bitter leaves. The latter are used as a substitute for hops, and are a mild tonic.

BUCK-EYE. Two western trees bear this name, the *Pavia lutea* and *Ohioensis;* they belong to the same family as the Horse-chestnut, which see. They are wholly ornamental, the wood being of no value as timber.

BUCK-THORN. *Rhamnus catharticus.* A thorned shrub. The berries are cathartic and griping. The *R. infectorius*, a similar shrub, produces the famous French or Persian yellow berries used in dyeing. The latter is not hardy north of Washington.

BUCKWHEAT. *Fagopyrum esculentum.* A plant delighting in sandy soils, but growing tolerably on quite poor sands, and valued for its flour, of which the well-known buckwheat cakes are made. Its flowers are a favorite resort of the honey-bee from the abundance of saccharine they contain. The seeds are small, dark, and angular, yielding from ten to forty bushels per acre, according to soil and season, since it does not set its seeds until cool nights occur. It is a native of Persia and the first frost kills it. In the North it is sown from the middle of June to July first, according to the latitude, and cut when in full bearing, or immediately at the occurrence of frosts. It is then set up in windrows, without tying in bundles, and threshed immediately when dry. The seed is borne at the end of delicate filaments, and hence it must be handled carefully, when dry, to prevent shelling. The quantity sown per acre varies from two to four pecks, three pecks being the usual quantity. As a fallow crop, buckwheat may be used with economy, since it grows quickly and produces a thick mass of herbage, which should be plowed under as soon as it is in blossom. A crop once sown, and allowed to ripen, often re-seeds the soil, and hence many farmers object to it as a crop. Like peas, it is valuable as a crop to entirely shade the ground, and to be plowed under when in blossom. Buckwheat is rich in starch and albumen, and its ash is rich in potash and lime. In Germany, malt is made of the grain, and it is extensively used, wherever cultivated, as food for fowls. The Silver Hulled, or Silver Skin, all things considered, is the best variety, being prolific and making excellent flour. The composition of the green stalks, by analysis, is as follows:

BUCKWHEAT STALK, FLOWERS AND LEAVES.

Water	82.5
Starch	4.7
Woody fibre	10.0
Albumen	0.2
Gums, etc	2.6
	100.0

The composition of the ripe grain in constituents, and also economically, is as follows:

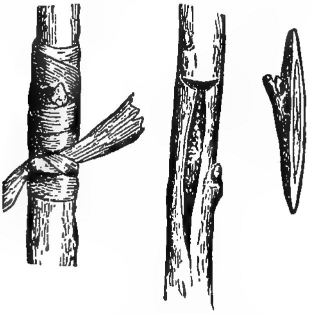
Water	14.0
Gluten	9.0
Starch	48.0
Gum	2.5
Sugar	2.5
Fat	1.6
Woody fibre	20.8
Mineral matter	1.6
	100.0

Or, economically:

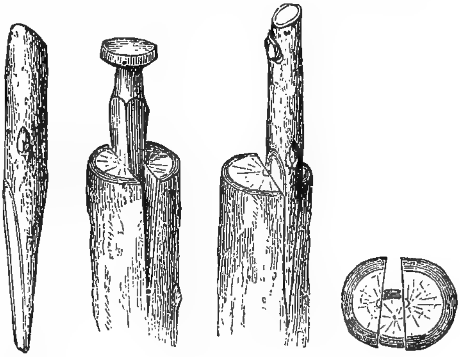
Water	14.0
Flesh-formers	9.0
Fat-formers	52 1
Accessories	23.3
Mineral matter	1.6
	100.0

BUD. A term made use of in some districts of England, for a weaned calf of the first year, from the horns then beginning to bud or shoot. In plants, the germ and envelopes for the succeeding years' growth.

BUDDING. Budding is not now practised to so great an extent as formerly, since with ordinary fruits, especially the pip fruits, grafting is fully as good, and very much faster, especially since the introduction of improved grafting implements. Budding. sometimes called inoculating, is the insertion of a single eye or bud under the bark, and is practised with the peach and other stone fruits, and in the multiplication of varieties, when the economy of buds is an object. It is also practised by florists, more especially with roses and all that class of stock. Among the advantages of this method is, under expert hands, certainty of growth and rapid performance. It may be practised during a long season, according to the variety of trees and plants to be operated upon. Upon this subject Dr. Warder says: It has been claimed on behalf of the process of budding, that trees, which have been worked in this method, are more hardy and better able to resist the severity of winter than others of the same varieties, which have been grafted in the root or collar, and also that budded trees come sooner into bearing. Their general hardiness will probably not be at all affected by their manner of propagation; except, perhaps, where there may happen to be a marked difference in the habit of the stock, such, for instance, as maturity early in the season, which would have a tendency to check the late growth of the scion placed upon it—the supplies of sap being diminished, instead of continuing to flow into the graft, as it would do from the roots of the cutting or root-graft of a variety which was inclined to make a late autumnal growth. Practically, however, this does not have much weight, nor can we know, in a lot of seedling stocks, which will be the late feeders, and which will go into an early summer rest. Mr. A. R. Whitney, of Franklin Grove, Ill., a thoroughly observing man and successful orchardist, holds that certain varieties of our cultivated fruits are found to have a remarkable tendency to make an extended and very thrifty growth, which, continuing late in the autumn, would appear to expose the young trees to a very severe trial upon the access of the first cold weather, and we often find them very seriously injured under such circumstances; the bark is frequently split and ruptured for several inches near the ground. The twigs, still covered with abundant foliage, are so affected by the frost that their whole outer surface is shriveled, and the inner bark and wood are browned; the latter often becomes permanently blackened, and remains as dead matter in the centre of the tree. for death does not necessarily ensue. Intelligent nurserymen have endeavored to avoid losses from these causes by budding such varieties upon strong, well-established stocks, though they are aware that these are not more hardy than some of the cultivated varieties; a given number of seedling stocks has been found to suffer as much from the severity of winter as do a similar amount of the grafted varieties taken at random. In relation to the philosophy of budding, and its similarity to grafting, Dr. Warder says, the latter process is performed when the plant life is almost dormant, and the co-apted parts are ready to take the initiative steps of vegetation, and to effect their union by means of new adventitious cells, before the free flow of sap in the growing season. Budding, on the contrary, is done in the height of that season, and toward its close, when the plants are full of well matured and highly organized sap, when the cell circulation is most active, and the union between the parts is much more immediate than in the graft; were it not so, indeed, the little shield, with its actively evaporating surface, of young bark, must certainly perish from exposure to a hot, dry atmosphere. The cambium, or gelatinous matter, which is discovered between the bark and the wood when they are separated, is a mass of organizable cells. Budding is most successfully performed when this matter is abundant, for then the vitality of the tree is in greatest degree of exaltation. Mr. A. T. Thomson, in his lectures on the Elements of Botany, says: The individuality of buds must have been suspected as early as the discovery of the art of budding, and it is fully proved by the dissection of plants Budding is founded on the fact that the bud, which is a branch in embryo, is a distinct individual. It is essential that both the bud and the tree into which it is inserted, should not only be analogous in their character, as in grafting with the scion, but both must be in a state of growth at the time the operation is performed. The union, however, depends much more upon the bud than upon the stock—the bud may be considered a centre of vitality—vegetative action commences in the bud and extends to the stock, connecting them together. The vital energy, however, which commences the process of organization in the bud, is not necessarily confined to the germ, nor distinct from that which maintains the growth of the entire plant; but it is so connected with organization, that, when this has proceeded a certain length, the bud may be removed from the parent and attached to another, where it will become a branch the same as if it had not been removed. The season for budding is usually in midsummer and the early part of autumn, reference being had to the condition of the plants to be worked; these should be in a thrifty, growing state, the woody fibre should be pretty well advanced, but growth by extension must still be active, or the needful conditions will not be found. The cambium must be present between the bark and the wood of the stock, so that the former can be easily separated from the latter; in the language of the art, the bark must "run;" this state of things will soon cease in most stocks, after the formation of terminal buds on the shoots. The success of spring budding, however, would appear to indicate that the cambium layer is formed earlier in the season than is usually supposed; for whenever the young leaves begin to be developed on the stock, "the bark will run," and the buds may be inserted with a good prospect of success. In this case we are obliged to use dormant buds that were formed the previous year, and we should exercise judgment and care in the preservation of the scions, to keep them back by the application of cold, until the time of their insertion. The condition of the bud, says Dr. Warder, in American Pomology, is also important to the success of the operation. The tree from which we cut the scions should be in a growing state, though this is not so essential as in the case of the stock, as has been seen in spring budding—still a degree of activity is desirable. The young shoot should have perfected its growth to such an extent as to have deposited its woody fibre; it should not be too succulent; but the essential condition is, that it should have its buds well developed. These, as every one knows, are formed in the axils of the leaves, and, to insure success, they should be plump and well grown. In those fruits which blossom on wood shoots of the previous year's growth, as the peach and apricot, the blossom buds should be avoided; they are easily recognized by their greater size and plumpness. In cutting scions, or bud-sticks, the most vigorous shoots should be avoided, they are too soft and pithy; the close-jointed, firm shoots, of medium size, are much to be preferred, as they have well developed buds, which appear to have more vitality. Such scions are found at the ends of the lateral branches. These need immediate attention, or they will be lost. The evaporation of their juices through the leaves would soon cause them to wither and wilt, and become useless. These appendages are, therefore, immediately removed by cutting the petiole from a quarter to half an inch from the scion; a portion of the stem is thus left as a convenient handle when inserting the shield, and this also serves afterwards as an index to the condition of the bud. So soon as trimmed of their leaves, the scions are tied up, and enveloped loosely in a damp cloth, or in moss, or fresh grass, to exclude them from the air. If they should become wilted, they must not be put into water, as this injures them; it is better to sprinkle the cloth and tie them up tightly, or they may be restored by burying them in moderately moist earth. The early gardeners were very particular as to the kind of weather upon which to do their budding. They recommended a cloudy or a showery day, or the evening, in order to avoid the effects of the hot sunshine. This might do in a small garden, where the operator could select his opportunity to bud a few dozen stocks; but even there, wet weather should be avoided rather than courted. But, in the large commercial nurseries, where tens of thousands of buds are to be inserted, there can be no choice of weather; indeed, many nurserymen prefer bright sunshine and the hottest weather, as they find no inconvenience arising to the trees from this source. Some even aver that their success is better under such circumstances, and argue that the pulp is richer. Most trees, in their mature state, make all their growth by extension or elongation very early in the season, by one push, as it were; with the first unfolding of the leaves, comes also the elongation of the twig that bears them. In most adult trees in a state of nature, there is no further growth in this way, but the internal changes of the sap continue to be effected among the cells during the whole period of their remaining in leaf, during which, there is a continual flow of crude sap absorbed by the roots, and taken up into the organism of the tree, to aid in the perfection of the various parts, and in the preparation of the proper juice and the several products peculiar to the tree, as well as its wood and fruits. When all this is transpiring within its economy, the tree is said to be in its full flow of sap; at this stage the young tree is in the best condition for budding, but it continues also, if well cultivated, to grow by extension for a greater or shorter portion of the season, and this is essential to the success of the operation as already stated. After the perfecting of the crop of fruit, the main work of the tree seems to have been done for the year, and we often observe, particularly with the summer fruits, that the trees appear to go to rest after this period, and begin to cast their foliage. Now, to a certain extent, this is true of the young trees. The varieties that ripen their fruit early, make their growth in the nursery in the early portion of the summer, they stop growing, and their terminal bud is formed and is conspicuous at the top of the shoots. Very soon the supply of sap appears to be diminished, there is no longer so much activity in the circulation, the bark cleaves to the wood, it will no longer run, and the season of budding for those stocks has reached its terminus; hence, the nurseryman must be upon the look-out for the condition of his trees. Fortunately, those species which have the shortest season, are also the first to be ready, the first to mature their buds, and they must be budded first. We may commence with the cherry, though the Mahaleb stock, when it is used, continues in condition longer than other varieties, and may be worked late. The plum and pear stock also complete their growth at an early period in the season; the apple continues longer in good condition, and may be worked quite late. Grapes, if worked in this way, should be attended to about midseason, while they are still growing; but quinces and peaches may be kept in a growing state much later than most other stocks, and can be budded last of all. The stocks being in a suitable condition, as above described, they should be trimmed of their lateral shoots for a few inches from the ground. This may be done immediately in advance of the budder, or it may have been done a few days before the budding. The stock may be one year old, or two years; after this period they do not work so well. The usual method is to make a T incision through the bark of the stock, as low down as possible, but in a smooth piece of the stem; some prefer to insert the shield just below the natural site of a bud. The knife should be thin and sharp, and if the stock be in good condition, it will pass through the bark with very little resistance; but if the stock is too dry, the experienced budder will detect it by the different feeling communicated through his knife, by the increased resistance to be overcome in making the cut. The custom has been to raise the bark by inserting the haft of the budding-knife gently, so as to start the corners of the incision, preparatory to inserting the bud; but our best budders depend upon the shield separating the bark as it is introduced. The two illustrations will show the difference between budding and grafting, and also the manner of cutting the bud—the slit or nidus—for insertion, and also the manner of tying, with bast or other soft substance, as the inner husk of corn, or woolen yarn, waxed. Some use strips of manilla tissue-paper covered with soft grafting-wax. (See also, article Grafting.) Make a cut from the scion with the the knife used for budding, which is entered half an inch above the bud, and drawn downward about one-third the diameter of the scion, and brought out an equal distance below the bud; this makes the shield, or bud. Some authorities direct that the wood should be removed from the shield before it is inserted; this is a nice operation, requiring some dexterity to avoid injuring the base of the bud, which constitutes its connection with the medulla, or pith, within the stick. Various appliances have been invented to aid in this separation; some use a piece of quill, others a kind of gouge; but if the bark run freely on the scion, there will be little difficulty in separating the wood from the shield with the fingers alone. All this may be avoided by adopting what is called the American method of budding, which consists in leaving the wood in the shield, as shown in the cut, that should be cut thinner, and is then inserted beneath the bark without any difficulty, and may be made to fit closely enough for all practical purposes. In budding, it is found that the upper end of the shield is the last to adhere to the stock; it needs to be closely applied and pressed by the bandage, and if too long, so as to project above the transverse incision, it should be cut off. Tying should be done as soon as convenient after the buds have been inserted; though under very favorable circumstances the bud may adhere and do well without any bandaging; no one thinks of leaving the work without carefully tying in the buds, and most budders lay a great deal of stress upon the necessity for covering the whole shield and cut with a continuous bandaging, that shall exclude the light, and air, and moisture. All ties should be loosened in the course of a couple of weeks, if the stocks be growing freely; otherwise they will injure the tree by strangulation. Sometimes it will be necessary to replace the bandage to prevent the effects of desiccation upon the bud; this is particularly the case with the cherry, and other fruits that are budded early; but the tie is often left on the stock all winter, as a sort of protection to the bud. When loosening the ties, the buds are inspected and their condition ascertained; if they have failed, they may be replaced, the stocks continue in a suitable condition. It is



BUDDING.



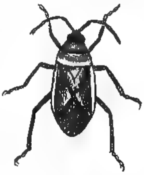
GRAFTING.

very easy to tell the success of the budding; the portion of the petiole left upon the shield is a very good index; if the bud has withered, this will also be brown and will adhere firmly to the shield; but, on the contrary, the bud and its shield having formed a union with the stock, the leaf-stock remains plump, but changes color. Like a leaf-stem in the autumn, it assumes the tint of ripeness, and it will separate with a touch, and soon falls off. The common method of removing the ties is to cut them with a single stroke of a sharp knife, when the bandage is left to fall off. Mr. Knight recommended two distinct ligatures, and left the one above the bud for a longer time uncut. When the buds have not been very fully developed, and when the stocks are very thrifty, it sometimes happens that the excessive growth about the incisions, made for the insertion of the bud, completely cover up this little germ of a future tree, which is then said to be drowned. Judicious pinching and shortening of the stock will prevent this effect, but care is needed not to pursue such treatment too far. The stocks are generally headed back to within an inch or more of the bud, just as vegetation starts the next spring; but early-set buds may be headed back so soon as they have taken, and will often make a nice growth the same season. This, however, is not generally preferred, and a late start in the growing weather of our autumns is particularly avoided, as the young shoot will not become matured before winter, and may be entirely lost. Spring budding is sometimes desirable, either to fill up gaps in the nursery rows, or to secure varieties, the scions of which, may have been received too late for grafting, or when it is desirable to multiply them as much as possible, by making every bud grow. When the operation is to be performed in the spring, the scions must be kept back, by placing them in the ice-house until the stocks are in full leaf, when the bark will peel readily, and the buds may be inserted with a pretty fair prospect of success; of course, the American method must be used in this case, as the wood and bark of the dormant scion will not separate. The stocks should be cut down as early in the spring as the buds begin to swell, with a sharp knife, applied just above the bud, and on the same side; the whole upper portion of the stock must be removed by a clean cut; this is better than to leave a stump of three or four inches, as is often recommended, as a support to which to tie up the buds in their tender growth. All shoots from the stock should be rubbed out while young; this may need repeating a second time. If the stocks were strong the buds will make handsome, sturdy trees the first season, the branched form may be assisted by pinching the points when a few inches high, as recommended with the grafts. Two year old stocks should make pretty trees, at one year old from the bud. In propagation, the proper plan will be found to be as follows: Apple and pear, budding and grafting. Cherry, mostly by budding, but succeeds well by grafting, if done very early. Peach and nectarine, by budding only, at the North; often succeeds by grafting at the South. Plum, by grafting, and also by budding, if the stocks are thrifty. Apricot, mostly by budding, sometimes by grafting. Almond, by budding, and sometimes by grafting. Chestnut, by early grafting. Walnut, by early grafting, and by annual budding. Quince, by cuttings and grafting. Filbert, by suckers and layers. The finer sorts may be grafted on the more common, which reduces the size of the bush and makes them more prolific. Grape, by layers and cuttings; and, in rare instances, grafting is advantageously employed for new or rare sorts on old or wild stocks, producing rapid growth and early bearing. Raspberry and blackberry, by suckers, cuttings of roots, and layers. Gooseberry and currant, by cuttings, and sometimes by layers. In relation to stocks: For standard or orchard-trees, the pear and apple are grafted or budded upon seedlings raised from pips of any thrifty sort of each of these fruits. The Mazzard and Black Heart furnish good stocks for grafting with the cherry. At the West, where the cherry is easily injured, stocks raised from seeds of the Dukes and Morellos are the hardiest for all kinds of cherries. The horse-plum makes a good stock when it will grow freely for this purpose; but, in localities where it will not, the wild or Canada plum, of the largest growing varieties, is a good substitute. The peach and nectarine are usually worked on common peach-stocks; but they make very hardy trees on the hard-shelled almond; and, on the plum, the trees are hardy and of slower or more dwarfed growth. The apricot does well on the peach or plum, or on its own roots. Cultivators differ as to which is the best on all accounts. For dwarfs, the Angers or French quince, is used wholly for the pear. The Doucin and Paradise are employed for dwarfing apples; the former being for the larger or medium-sized dwarfs, and the latter for small ones, the apple-trees worked upon it not growing much larger than currant bushes. The Mahaleb is used for dwarf cherries, reducing their size and vigor of growth but slightly, however. It enables the cherry to grow better on heavy soils. The smaller varieties of the wild plum form, perhaps, the best stocks for the growth of dwarf plums.

BUFFALO. The animal, called buffalo by the people of the United States, is really the bison, *Bos Americanus.* Of the true buffalo there are two species, the *Bos bubalis*, of India, and the *Bos Caffer*, of South Africa. Zoölogically, they are separated as the Indian and Cape buffalo. The Indian buffalo is said to be fully a match for the tiger in his native jungles, but the Cape buffalo, which inhabits the whole of South Africa, is not a match for the lion. Both species, in the wild state, inhabit low and swampy districts, and delight in wallowing in the mud. Both species have been domesticated, but have never been so far modified as to have lost their native ferocity. The true buffalo is short-haired, is destitute of the hump, and in other respects is quite dissimilar to the bison. An East Indian wild bull (*Bos gaurus*), is said to be intermediate between the bison and buffalo. (See article Bison.)

BUFFALO CLOVER. (See Clover.)

BUG. The word is ignorantly used by many for any insect; others again use the word for offensive insects, as blind beetles, and other beetles which sometimes annoy by flying against a person. The true bugs, however, are a small class, and are the true Hemiplera (*H. heteroptera*), in which the wing covers are thick and opaque at the base, more or less transparent at the tips, laid horizontally on the top of the back, and cross each other obliquely at the end. Some of these live on animal and others on vegetable juices. Among plant-bugs the well known squash-bug (*Coreus tristes*) is often very destructive to the whole cucumber family, even eating into squashes in the fall to such a degree as to cause their rotting. The cut we give is another form of plant-bug (*Largus succintus*), rare at the North, but not uncommon at the South. The red bug, or cotton-stainer, of the South, is another vexatious pest in that region. There are numerous plant-bugs, many of them minute, which do little damage, except in particular seasons prolific in insect life. The remedy for all this class, and including also plant lice, is either picking or destroying them with crysalic soap-suds, or, in certain cases, where practicable, dusting with sulphur or a mixture of Paris green, or of London purple. Neither of the two last named must be used on plants where there is danger of the poison becoming lodged in the fruit.


PLANT-BUG.

BUHR-STONE. The mill-stone for flouring; it possesses great hardness with little brittleness, is cellular, of a bluish gray, and feebly translucent. The best kind has a texture nearly half cellular, and is entirely silicious; the pieces or panes are bound together by hoops of iron when set up for use. The great and valuable supply of buhr-stone is from near Paris, in the lacustrine deposit, above the gypsum. It is the latest rock formation known. Buhr-stone of good quality is found now in several sections of the United States, especially in Georgia, above the shell limestone.

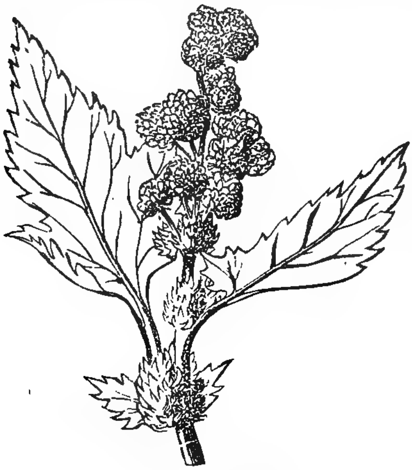
BUILDINGS. (See Farm Buildings.)

BULB. A rounded body, having the properties of a bud, usually growing in the ground, but sometimes produced by the flower stalk. Bulbs are *tunicated*, as the onion, and *squamous* or scaly, like the lily. The adjectives, bulbous, *bulbosus*, are formed from bulb. The fleshy, solid root stocks of some plants are not bulbs but corms.

BULBODIUM. An underground stem resembling the root-stock.

BUPRESTIS. Saw-horned wood beetles. A genera of beetles with hard and metallic coloring, and hard and inflexible bodies. They are principally a tropical family. In the torrid zone they attain great size and dazzling coloring. Dr. LeBaron says of the family that the larvæ present two very distinct forms. The usual form is at once distinguished from all other Coleopterous larvæ by the enormous development of the first segment of the body, into which the head is partly retractile. The other segments are narrow and slightly flattened. This form of the larvæ has caused them to be compared with tadpoles, and the French authors describe them as resembling a pestle. They are wholly destitute of legs. These larvæ usually live under the bark of trees in a state of incipient decay, but some of them penetrate into the solid wood. Some of the smaller species inhabit the stems of small trees or shrubs, causing them to enlarge so as to resemble galls. An example of the former is the flat-headed borer of the apple and soft maple trees (see Flat-Headed Borer); and an example of the latter is the raspberry cane-borer, or larvæ of the *Agrilus ruficollis*. The other form of Buprestide larvæ is that of the Brachyides or short-bodied Buprestidæ. In these the first segment is not enlarged, the body is slender and tapering, and each of the three first segments is furnished with a pair of very small feet, placed wide apart. These species are all very small, and such of them as are known are leaf-miners. In an economical point of view, the Buprestidæ occupy a peculiar position, intermediate between the genuine wood-borers (Cerambycidæ and Scolytidæ), which bore into the solid wood of trees, and those kinds of wood-beetles which (like the Elateridæ and many of the Heteromerous beetles) inhabit wood and bark in an advanced state of decay. In accordance with this position, they are usually the first insects to attack trees which have been injured by sun-scald, or which have otherwise had their vitality weakened. The largest North American species is the *Chalcophora Virginiensis* of Drury, nearly or quite an inch in length, of a dark coppery or blackish color, and a very uneven surface, caused by elevated lines and depressed square-shaped spots. The larvæ inhabit the trunks of different kinds of pine trees, and the perfect insects are to be found, therefore, only in pine growing regions. The *Dicerca divaricata*, Say, is three-quarters of an inch or more in length, copper colored, with a granulated surface. It is distinguished at once by its tapering elytra, separated at the tips. Its larvæ bore into the trunks of cherry and peach trees. We have another smaller and more obscure species, the *D. lurida*, Fab., the larvæ of which inhabit the hickory. The *Chrysobothris femorata*, an obscure bronze-black species, rather less than half an inch in length, is the parent of the well known *flat-headed borer*, so injurious to apple trees, and also to the soft maple. The genus *Acmæodera*, Esch., contains a number of small species of a bronzed-brown color, sometimes with purple and green reflections, and the elytra prettily spotted with yellow. The colors are somewhat obscured by the surface being clothed with stiff, erect hairs. The *A. tubulus*, Fab., and the *A. pulchella*, Herbst, are the most common species. They are often found in abundance on the flowers of the Coreopsis. The genus *Agrilus*, Solier, is easily recognized by the elongate, slender, and cylindrical form of the species The raspberry borer, *Agrilus ruficollis*, Fab., may be taken as the American type of this genus. It is three-tenths of an inch long, black, with a coppery-red thorax. Buprestis, including *Anchylochira*, Esch., is composed of species mostly between a half and three-quarters of an inch in length, of a brassy-green or a brassy-black color, and often ornamented with yellow spots on the elytra; some also have yellow spots on the sides of the venter. The species of *Melanophila*, Esch., are from three to five-tenths of an inch in length, black, sometimes with obscure bronze or purple tints. Some species have four yellow dots on each elytron. The species of *Anthaxia*, Esch., are less than three-tenths of an inch long, brassy-black, and without spots. The head and thorax are sculptured with shallow punctures, with the intervening lines forming a fine net-work. We have two common species of *Brachys*, Sol., the *Ovata*, Weber, and the *Ærosa*, Melsh. (*terminans?* Fab.), and several rarer species, some of which may be only varieties or races of the first. The *B. ovata* is two-tenths of an inch or more in length, of a bronze color, variegated with spots and imperfect transverse waving bands of whitish and copper colored pubescence. The *B. terminans* is smaller and less distinctly variegated, but most readily distinguished by the pale tips of the elytra. *Metonius*, Say, (*Pachyscelus*, Solier), has two species about an eighth of an inch in length; the *lævigatus*, Say, wholly black; and the *purpurea*, Say, black, with dark-blue elytra. The following are the genera of *Buprestidæ: Acmæodera*, twenty-three species; *Agrilus*, forty species; *Anthaxia*, fourteen species; *Brachys*, eighteen species; *Buprestis*, twenty-three species; *Chalcophora*, seven species; *Chrysobothris*, forty-three species; *Dicerca*, twenty-four species; *Melanophila* ten species; and *Metonius*, two species.

BURDOCK. A coarse and homely biennial weed, growing in fields and fence corners under slovenly cultivation, bearing hooked burs which, when ripe, or nearly so, cling obstinately to animals and the clothing of man. The greater burdock (*Lappa major*) is held to possess medicinal properties in its leaves, and is used as an external remedy in fevers, headaches, etc., and its root is sometimes used as a medicinal ingredient in home-made beer. The plant is considerably bitter, but has no excellence that should cause it to be allowed to live. The lesser burdock (Clot-bur) is a species of *Xanthium* (*X. strumarium*), a noxious weed, whose burs, like burdock, are carried in the fleece of sheep, in the manes and tails of horses, and in the tails of cattle. The variety *Echinatum*, has the burs more prickly than *Strumarium*, with the beak incurved. The cut we give shows the flower head and leaves of *X. strumarium*, with heads of staminate flowers above and pistillate ones below. There is another vile weed belonging to this family, Thorny Clot-bur (*X. spinosum*), being three-spined along its branches; an execrable weed, said to be a native of tropical America, but naturalized in many localities West, and particularly South. Like the other species, it is not difficult of extermination and should be eradicated when found.



THORNY CLOT-BUR.

BURSA MUCOSA. Small bags containing a fatty mucus, situated between the joints in all animals. Its enlargement causes wind-galls.

BURST. (See Hernia)

BUSH. Any shrub which naturally throws out branches near, or under ground.

BUSHEL. A measure containing four pecks, eight gallons, or thirty-two quarts. It should contain eighty pounds of water, or 2218.192 cubic inches of capacity, to constitute an imperial bushel. The old Winchester bushel contained only 2150 42 cubic inches.

BUSTARD. *Otis tarda.* A large gallinaceous fowl indigenous to Europe and Asia, often weighing twenty-five pounds. It is now nearly extinct in Europe.

BUTTER. Butter is the solidified oil or fatty matter of the milk of animals. In the United States the milk of the cow only is used for butter, except by that unscrupulous class who counterfeit butter with animal fats. The comparative value of the milk of different individuals and breeds is estimated by the quantity of cream and its yield of butter; the pasture and food given exercising a most important part in the production of butter. In milk, the union of the principal constituent parts—curd and butter—with the water, is mechanical, and so as to be easily separable. Indeed these will settle by mere subsidence, the butter rising to the top and the curd settling to the bottom. After the separation of the whey, which, to be brought about in the best manner requires chemical change, the residue is curd. In the manufacture of butter the strictest nicety is required in all the manipulations, from the time it is drawn from the cow until it is packed. Modern improvement, and the establishment of butter factories, has brought the manufacture of butter almost to scientific accuracy; in the avoidance of odors, and the necessity of strict cleanliness in all the processes, from milking to packing; in the setting of milk, the care of the cream and the churning; economy of space has also been so improved, that the milk of ten to twenty cows may now be cared for in a space not larger than a good sized ice-chest. The component parts of butter, according to chemical analysis of Jersey butter and of factory butter (two samples, the cows of various breeds) and of whey butter, is as follows:

	Water.	Ash.	Fat.	Caseine, etc.
Jersey butter	11.29	3.20	84.76	0.75
Factory butter	12.36	2.98	83.41	1.25

Another sample of factory butter gave water, 8.82; ash, 3.43, and fat and caseine 87 75. A sample of whey butter gave water, 9.77; ash, 1.67, and fat and caseine, 88.56. In relation to the theory that the butter of milk is contained as globules surrounded by a membrane, is denied by some eminent chemists. The conclusions of Soxhlet and Tisserand, in relation to the manufacture of butter, are as follows. The former, in a discussion upon the condition of fat in milk, opposes the generally accepted theory that it exists in globules surrounded by a membrane which it is necessary to break up in the process of churning, or by chemical means, for the production of butter, and believes that it exists in much the same condition as oil in an emulsion with albumen, citing authorities in support of his belief. He considers that in new milk the butter is present in oily drops, as it appears under the microscope;

but his experiments show that if the milk is frozen at a temperature of 28° to 29°, they become solid, and remain in this condition after the milk is thawed. It can then be separated by churning, it is said, in two minutes, a result usually requiring eleven minutes, which is a point of great practical importance. The conclusions of Tisserand, who has made an extended series of experiments upon the influence of low temperatures, varying from 32° to 97° (thermometrical quantities are Fahrenheit, raised from the Centigrade scale as given by Tisserand) upon milk and the production of butter, are similar to those of Soxhlet; for he finds that it renders the separation of the cream more rapid, increases its volume and the yield of butter, and improves the quality of the skimmed milk, butter and cheese. These effects increase with a decline of temperature. Dr. E. Lewis Sturtevant, in a paper on the physiological considerations concerning the feeding for butter and cheese, states that milk derives its whiteness and opacity from the presence of innumerable globules of very minute size, floating in a water-like fluid or serum. These globules are composed of the butter-fats inclosed in a capsule or membranous covering, and vary in size from the 1,500th of an inch to granules of less than the 27,000th of an inch in diameter. The variation in size varies with the breed; it varies with the time from calving, and it varies with the food. After describing the process of the formation of these globules, and indicating their source, he says they are found to be larger in the Jersey cow than in the Ayrshire cow, and the Ayrshire globules are larger than those from the American Holstein. These globules are covered with a membrane of extreme tenuity, which protects their contents, and has to be ruptured through the process of churning before the contents of the different globules can aggregate into butter. This covering is more easily broken in some breeds than in others. The Jersey cream can be churned into butter more quickly than can the Ayrshire cream. These coverings are also differently affected by the acidity developed in the milk. Twenty-four hours' standing will hasten the churning of Jersey milk more than will forty-eight hours affect the churning of Ayrshire milk. The contents of these cells are in varying proportion, and the mixture seems in part physical. Thus, the butter made from the milk of one breed may be more waxy than butter made in a like manner from milk from a cow of a different breed. The butter made from the large globules of a milk appears to be of a superior grain to the butter made from the small globules of the same milk. Globules of a large size are more easily ruptured through the process of churning than those of a small size, and those of extreme minuteness can not be ruptured at all. Thus, the quantity of butter obtained in practice is not dependent entirely on the amount of fat in the milk, by analysis, but rests upon the form in which it occurs By means of a microscopic study of milk, the experienced worker can judge of the butter-value of a milk, and can quickly separate from a herd those cows which produce an unprofitable milk for the butter-manufacturer. He can also separate those milks which are the least valuable for the cheese-maker from those that are the most valuable. He can also tell, to a certain extent, what food will make his milk best for his purpose. Of the effect of food upon the yield of butter, from milk of different breeds, the writer says: The question of the effect of food upon the butter is, therefore, principally a question concerning nutrition, of the digestibility of food, and of the ability to cause certain constituents of the food to be taken up in a quantity sufficient for the wants of the animal as determined by structure. When a cow is producing less butter than her structure fits her for secreting, then must an increase of proper food increase her butter product When her food is unfitted, through its character or condition, to supply the blood with the requisite elements, then must a change of food for the better be beneficially perceived on the butter-yield. We have an individual influence, however, which complicates the action of nutrition, for the superior cow is more a creature of art, the inferior cow more the production of nature, and accordingly the best and poorest cow of a herd being fed with an increased supply of food, in every case the better cow will respond to a greater extent than the poorer. The influence of the fats of the food in accelerating digestion and other chemical re-actions of the food is of importance in a practical view of the effect of the feeding. It is even probable that the nearer the food given approaches the state in which its elements are found in the product (if the food be digestible in this state), the better the result. It is even probable that the presence of certain oils or fats in the food may influence to some extent the proportionate quantity of the separate oils in the butter and the fat. It is but as we regard an animal as a whole, and attempt to know her by the study of the history of how she came to be what she is, as well as what she is, that we can form an understanding of the action or product of any particular part. We recognize the formation of butter as allied to the formation of fat, with this essential difference—the fats are formed and stored subject to the order of the animal economy; the butter is formed and thrown off, and thus disconnected with the animal structure, is nominally subject but to the order of an external being, the calf or the milker. The summary of what would be indicated by the theory of the cow and her food is that each cow has a limit to production, governed by structure, and the greater gain of butter is when her food keeps her to this limit and is not in excess. Second, that the character of the food must influence to a certain extent the character of the butter, but that in the presence of abundant and similar food, heredity exerts a prepotent influence. The third indication is that the proportion of the butter stands in no definite relation with the caseine, but that either may be increased within certain limits without a proportionate increase of the other. I call this an indication only, for we have not as yet presented the formation of caseine, but will here assume that it arises in the milk through an entirely different process from the butter, and although influenced by structure, yet in a different manner from that in which the butter element is influenced, and there is accordingly no necessarily direct co-relation between the quantity of these two products. A summary of facts indicating the same propositions as our theory is, first, that common experience has shown that one cow is always better than some other cow in a herd, and that no matter what may be the food the poorer cow can never, on the same kind of food, and both abundantly supplied, equal in product the better cow. Our second proposition is shown by the experiments of Thomas Horsfall, as given in full in the Journal of the Royal Agricultural Society of England, xvii. 260; xviii. 150. Our third, is the fact that the difference between the butter percentage of various breeds is far greater than is the difference between the case in percentage; that a series of analyses of same milks at different periods from calving indicate no ratio between the two. In relation to the proposition maintaining that superior cows will always respond to increase of food to a larger extent than inferior ones, Dr. Sturtevant states that in just so far as animals have been removed from the natural state through breeding will they be influenced in their product by a more nutritious and concentrated kind of food; for natural food may not be the best attainable under an artificial environment which not only exists, but has been of long continuance, although the same food may be the best in a state of nature. The art of man consists in intensifying natural conditions in the direction toward his own desires. The natural food of animals, although best for the wild condition, cannot be considered as natural food when the whole condition of life of the animal, and her habits and functions, have been modified to a very large extent from those habits and functions of the undomesticated state; for artificial methods of long continuance, and artificial conditions brought about through artificial environment, tend to so completely change the conditions of being of the wild animal, that what in the wild animal might be an artificial food, may be the natural food for the domesticated animal, and *vice versa*. In fact, the establishing of harmony between form and function, food and desired product, is the using of the laws of nature through man's power for man's own good. The practical fact, which is worthy the attention of all those who keep cattle, is that an increase of food, gained by the feeding of meals and other concentrated and artificial foods, may perhaps bring profit to the owner of superior animals, while the same course pursued by the owner of indifferent animals would be surely done at a loss. One farmer can feed grain to his better cows and receive a profit on the extra cost, while his neighbor, perhaps, with inferior stock, can increase his product but very little by the same means, and then this increase will not be sufficient to compensate for the extra expense. Improvement in breed, therefore, should go hand in hand with improvement in feed. The dairy-farmer who believes in artificial feeding, which experience shows to be the true course, must also, for the most profitable results, believe in an artificial breed. As the milk-functions are entirely the creation, in their usefulness, of man, and are hence artificial, the superior cow will pay a larger profit on concentrated food than will another animal, her inferior, while the inferior animals, under the feeding requisite to obtain the best results from a herd as a whole, are kept at a loss. The following is a summary of conclusions from the propositions advanced: First. That the production of butter is largely dependent on breed. Second. That there is a structural limit to the production of butter to each cow. Third. That when the cow is fed to this limit increased food cannot increase the product. Fourth. That the superior cow has this structural limit at a greater distance from ordinary feed, and more ready to respond to stimuli than the inferior cow. Fifth. That consequently the superior cow is seldom fed to her limit, while the inferior cow may be easily fed beyond her limit; and, as a practical conclusion, increased feed with a superior lot of cows will increase the butter product, but if fed to an inferior lot of cows waste can be but the result. Sixth. That the character of the food has some influence on the character of the butter, but even here breed influences more than food. Seventh. That there is no constant relation between the butter product and the cheese product. Eighth. That the caseine retains a constant percentage, and that this percentage does not appear to respond to increase of food. Ninth. That the caseine appears to remain constant, without regard to the season. Tenth. That increase in the quantity of milk is followed by an increase in the total amount of caseine. Eleventh. That insufficient food acts directly to check the proportion of butter, and has a tendency to decrease the caseine of the milk and substitute albumen. Twelfth. That the best practice of feeding is to regulate the character of the food by the character of the animals fed; feeding superior cows nearer to the limit of their production than inferior cows; feeding, if for butter, more concentrated and nutritious foods than for cheese; feeding for cheese product succulent material, which will increase the quantity of the milk-yield. Mr. Curtiss, of Wisconsin, upon the subject of making butter, says: It is said that the small dairy farm cannot make good butter. That the odors of the kitchen from cooking, smoke, etc., uneven temperature, and various contingencies, beyond the control of those manipulating the milk into butter, make it absolutely beyond their power to make a good article. From the usual standpoint I concede this to be a fact, but from an advanced stand point I do not. I much doubt if a better article of butter can be made by any other plan than the common tin pan, provided a pure atmosphere and a temperature of 60° can be controled. While I claim this, I concede the failure, because the small farm dairies cannot control these unalterable requirements. Whatever method is adopted to extract the cream from the milk, a uniform temperature is required; that degree of temperature must be in proportion to the quantity of milk set in one body; therefore, if the common, open tin pan, four inches deep, requires a temperature of 60°, a larger body of milk, set at blood heat, would require a colder temperature, or fermentation would take place before the cream rises. A colder temperature can be secured with ice. We also find a colder temperature in the earth, and that a uniform one of about 49°, at a point not exceeding ten feet from the surface, provided we shut out the uneven atmosphere from above. It has been claimed that the raising of cream required air, but it has been proved that it does not—that it is all the better to exclude all air; hence it appears feasible to put in use this regular temperature of 49° in the earth, provided we set the milk in proper quantities. In doing this we find ourselves required to close the vessels containing the milk air-tight; this confines the animal heat, which must be considered in concluding upon the size of the can to hold the milk. I have tried a great many experiments and finally used, for some three months, cans about eight and one-half inches in diameter by twenty deep. The cover was made like a common tin pail, only the flange going inside was two inches wide, and the top of the cover had a tube hole about one-fourth of an inch in diameter, soldered fast. The cans were filled and the covers pressed down, while the tube hole was open to allow the air to escape as the flange of the cover entered the milk. The tube hole was then closed with a cork, and then cans were lowered into the well about twenty feet, where they remained until the next milking, when they were withdrawn and set in some convenient place until the cream thickened from acidity; it was then easily removed by dipping off with a saucer. I used these cans from the middle of last June to the middle of September, and it will be remembered as a very unfavorable time for making good butter. We found the butter made from the cream raised in this manner to be good; that which was not used or sold (some 300 pounds), was packed for fall and winter use. The unfavorable state of the atmosphere, so loudly complained of by others, did not seem to affect the quantity or quality of the butter. In relation to salting butter, and butter packages, Mr. C. C. Buell, of Illinois, very correctly, holds that it is a question whether salt preserves butter at all by acting directly upon it. It probably does not. Its chief use is to season it. Butter put up for long keeping requires much more salt than that to be used new, for the reason that in new-made butter the fresh flavor is dominant and gives to the butter its chief attraction and value. In the long-kept butter salt plays a more important part, and without plenty of it the butter is likely to taste flat and insipid. Employed in the form of brine, distributed through and around the mass of butter, salt may, and undoubtedly does under favorable circumstances, prevent the incipient development of germ life; but it is only the incipient development that it can control. Butter already tainted it has no power over. The smallest number of these developed spores lurking in churn, or worker, or ladle, or package, may be sufficient to spoil the whole mass, just as a piece of tainted meat, no larger than a walnut, is sure to spoil the whole barrel—and "salt can't save it." So, then, it is only the package for good butter, the well-made butter, the fresh butter, in which is not yet planted the seeds of decay, that we need particularly to discuss here. Perfectly-made butter, if exposed to the air even but a short time, is as sure to go to destruction as if it were bad at the beginning. The air is full of these elements of destructive life, these spores or germs, and they fall upon the surface of whatever is exposed to it, or whatever air is, under non-preventive conditions, admitted to it. There can be only two kinds, the good and the bad—the air-tight and brine-tight package and the open and the leaky package. We hardly need say more under this head. A package made of whatever material, not injurious to the flavor of butter, and of whatever shape, if it preserves the brine—which should be within, around and over the butter—is a good butter-package for preserving good butter. The commercial package, however, is usually quite a different thing. Its top is open, and its sides and bottom are not closed. The thin layer of salt spread over the top of the butter, the cross-grained, porous wood of stave and bottom, are the open ways of air and water. The oak firkin, which is the least used and least acceptable to the trade, is undoubtedly the best of the ordinary packages. The Welsh tub, in which most of the Western butter is sent to market, is a little better than the bail-box, which is only next better than the shoebox and salt-barrel. Qualitative analyses of butter, have been tabulated as follows:

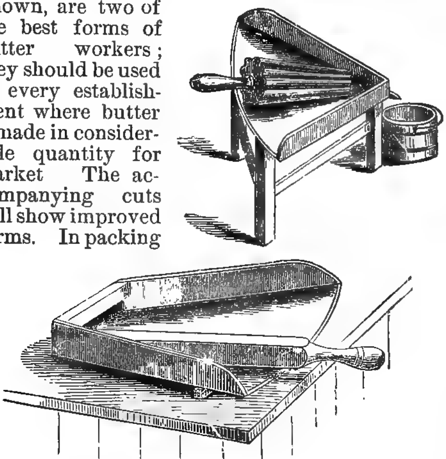
BUTTER-FAT.

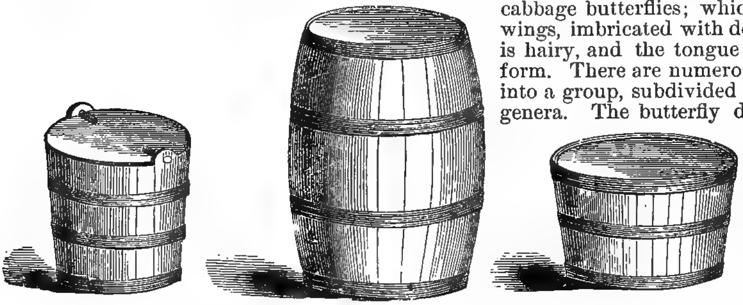
Composition.	Discovered by—
Palmatin.... ..	Heintz (Gmelin's Handbook) xvi. 343.
Olein	Chevreul (Reserches sur les corps gras) p. 205.
Stearine........	Chevreul (Loc. cit.)
Arachin .... Butin..	Gössmasm and Scheven (Ann.) Ch. Pharm. xcvii.
Myristin.......	Heintz (Pogg. Ann.) lxxxvii. 267; xc. 137; xcii. 429.
Butyrin........	Chevreul (Loc. cit.)
Caprin ..... Rutin.	Chevreul (Gm. xiv. 485).
Caproin........	Chevreul (Gm. xi. 414).
Caprylin.......	Lerch (Gm. xvii. 190).

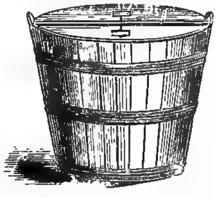
All of these fats are composed of three parts of acid united to one part of glycerine as a base; in such union three atoms of water are liberated. The reaction may be represented as follows:

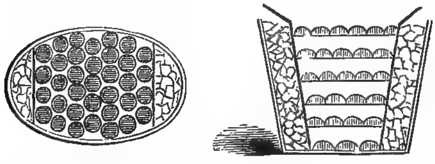
$$\underset{\text{Arachinic acid.}}{\left\{C_{20}H_{40}O_{2}\right\}}\ \underset{\text{Glycerine.}}{\left\{C_{3}H_{8}O_{3}\right\}}-\underset{\text{Water.}}{3H_{2}O}-\underset{\text{Arachin.}}{C_{63}H_{122}O_{6}}$$

The fats, then, should be, more strictly speaking, called respectively, Tri-Olein, Tri-Palmatin, Tri-Stearin, etc. The following may be taken as among the important facts in the setting of cream. 1. The milk globule has a less specific gravity than the water or any other constituent of milk. 2. If the milk is allowed to stand at a high temperature, conditions are immediately produced suitable to the growth of the little fungus plant, *penicillium crustaceum*, and the milk commences to sour before the cream has a chance to form. 3. Water and caseine, etc., grow cool much faster than the milk globules. 4. Since the diameter of the milk globule varies in different breeds, a system which would be practical for the milk containing the largest globules, might totally fail if applied to any other milk. What is needed is a system applicable to mixed milk. 5. While the milk globules expand more by heat, and contract more by cold, than the water of the milk, still they are poorer conductors of heat than the water and caseine of milk, and consequently expand more slowly on the application of heat, and contract more slowly on the application of cold. It would not be difficult from these facts to reason that the proper system to be adopted is to place the milk in a room, the temperature of which is a few degrees below the lowest point which it is desirable for the milk to reach. By adopting this means, the milk from a warm state is cooled gradually down, which sends the milk globules rapidly up, not only for the reason that the fluid in which they are suspended becomes cooled faster than the globules, but because at the same time it becomes heavier. The working of butter, packing and transportation, are of great importance in its manufacture. We once heard the late and lamented Charles Bragdon, a good judge of butter, say, "God bless the woman who works butter too much." This was in the days when butter working and improved machinery were little known. The washing of butter, and taking it from the churn when yet in a granular state, and butter workers, have left no excuse for over-working butter to get out the butter milk. Shown, are two of the best forms of butter workers; they should be used in every establishment where butter is made in considerable quantity for market The accompanying cuts will show improved forms. In packing butter it should be pressed entirely solid, in such forms of packages as will best enable this to be accomplished. Orange county tubs and barrels leave but little to be desired in this direction. They are easily cleaned, compact and quite water-tight; another form is also much used, and is much liked by grocers, since the butter may be easily turned out for cutting up. If butter is to be transported in summer it must never be allowed to become even partially soft. Hence, many devices have been invented for accomplishing this purpose, one of which is shown with a dead air space at the side, the butter so arranged that it is carried in pound pats, perfectly cold. In large cities, so packed, it brings high prices, when branded with the name of well-known respectable makers, who have responsible agents for handling their goods. It is carried in refrigerator cars, and removed to other refrigerators immediately from the cars, served fresh every morning in time for breakfast—some makers getting as high as seventy-five cents per pound, however low the ordinary price may be.


IMPROVED BUTTER WORKERS.


ORANGE COUNTY TUBS AND BARREL.

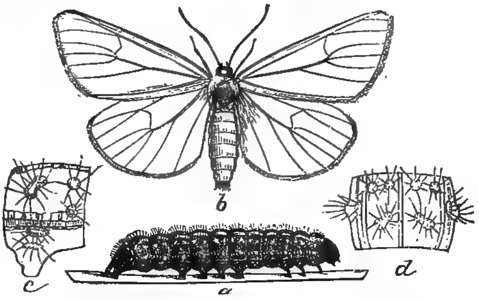




BUTTER, ADULTERATION OF. (See Butter.)

BUTTER FACTORY. (See Creamery.)

BUTTERFLY. Insects of the genus *Papilio* (Linn.) in the imago state. Many of them are produced from caterpillars most injurious to cultivated plants and trees, as the gooseberry and cabbage butterflies; which see. They have four wings, imbricated with downy scales. The body is hairy, and the tongue convoluted in a spiral form. There are numerous species, now formed into a group, subdivided into tribes, families and genera. The butterfly deposits its eggs, which hatch into caterpillars. These change to chrysalides, which again, after undergoing hybernation, come forth as the perfect butterfly. The food of the perfect insect is honey only, but the group, in the caterpillar state, contains some most destructive insects to vegetation. The butterflies are among the most beautiful of the insect tribes. This, however, does not prevent their larvæ from also being, many of them, most destructive to vegetation, probably quite as much so as the larvæ of moths—another beautiful family, in their perfect state. Hence, they should be destroyed wherever found. The cut shows *a*, caterpillar; *b*, butterfly; *c*, *d*, sections of caterpillar enlarged.



BUTTERFLY AND CATERPILLAR.

BUTTERNUT. (See Walnut.)

BUTTON-WOOD. False Sycamore. The Western Plane-tree (*Platanus occidentalis*) is one of the largest and handsomest trees of America, and reaches its full dimensions only in the rich alluvion of the Middle-Western States, and on the banks of the Ohio. The wood is soft, and decays rapidly when exposed, but is serviceable for carpentry if kept dry. The tree in the Northern States has been much injured by early frosts and insects.

BUTTS. The short ridges which are made by the plow in the corners of irregular fields.

BUTYRIC ACID. An oily volatile acid found in rancid butter, and having a rancid smell; it is soluble in water, alcohol and ether; boils at

212°. It is formed by the oxidation of the component of butter called butyrine, and yields, by distillation from lime, butyrone a neutral volatile liquid.

BUXUS, The generic name of the box plants.

BUZZARD. Among the birds injurious to the farmer, as generally understood, may be mentioned some of the buzzards: The Red-tailed Buzzard, or Hen Hawk (*Falco Borealis*); Harlan's Buzzard (*F. Harlani*), and the Broad-winged Buzzard, or Broad-winged Hawk, (*F. Pennsylvanicus*); the Large-footed Hawk (*F. Peregrinus*); the Sharp-shinned Hawk (*F. Fuscus*) of Audubon, also belonging to this family. The Red-tailed Buzzard is found in every part of the United States and Canada, and thence to the Gulf of Mexico. In very severe seasons it migrates, from the Middle States, South. In Louisiana, it builds its nest in February, but in the North not until about corn-planting time. Its flight is long-continued and firm, often very high. It sails to great distances without apparent motion of the wings, and it has the habit, when it discovers its prey, of descending to a convenient distance, from whence, with closed wings, it darts upon it with great accuracy. Squirrels, rabbits, wood-rats and meadow-mice, are its favorite food; but when driven by hunger, it will make bold assaults upon the poultry of the barn-yard, and hence has come to be looked at as a dreaded enemy of the yard. It, however, takes but very few poultry, and the vermin it destroys constitute it a help rather than an enemy to agriculture. The range of the Broad-winged Buzzard is west of the Alleghanies, but is by no means rare east, even in Maryland and Virginia, about its southern limit, except in severe winters at the North, when it sometimes migrates even as far south as the Gulf States. The flight of this bird is easy, graceful and usually in circles. Sometimes when high in the air, it will close its wings for a moment, and glide easily along. Its food is any bird it may overcome, especially young chickens and ducks, also wood frogs, snakes, and such small quadrupeds as it can easily seize In winter its food is insects, and various small animals. Harlan's Buzzard is a Southern species, and comparatively rare. The flight is powerful, protracted and so rapid that it seizes its prey with apparent ease They are destructive to farm-yard poultry, partridges, and the smaller species of ducks. The Large-footed Hawk is rather a rare bird, generally found in the Southern States and, if not identical, is nearly allied to the Wandering, or Passenger Falcon of Europe. Its astonishing rapidity and quick evolutions, when in the pursuit of prey are admirable, and it is strong enough to even cope with the Mallard Duck. Wild and tame pigeons, black birds, other small birds, small ducks and water-hens are its usual prey. When ready to seize its prey, it descends like an arrow, and is recorded to have carried off wounded game within thirty yards of the sportsman. The Sharp-shinned Hawk is found in every State and Territory in the Union, but is more abundant in the Middle and Southern States, than farther North. It has no regular migration, but in severe winters follows the small birds South. In its flight it moves by sudden impetuous dashes; the flight, like the Gos-hawk, is irregular, swift, vigorous, and often protracted. It seizes its prey with great impetuosity, often dashing headlong into a clump of bushes or briers and emerging successfully. For these reasons, Mr. Audubon has called it the miniature of the Gos-hawk. Sometimes two or three will unite in attacking a victim too large for one. Birds from the sparrows to wild pigeons, small reptiles, insects and young chickens are its prey. When it learns to take chickens, it will destroy large quantities of them, even in the presence of man.

BYSSUS. A general name for the thread-like mould of cellars and caverns of vegetable origin. They belong to many genera, and to the family of fungi.

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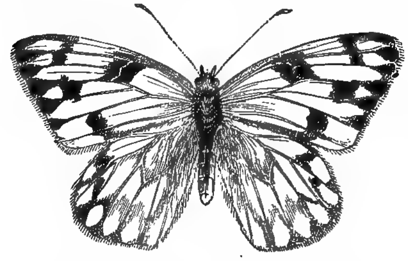
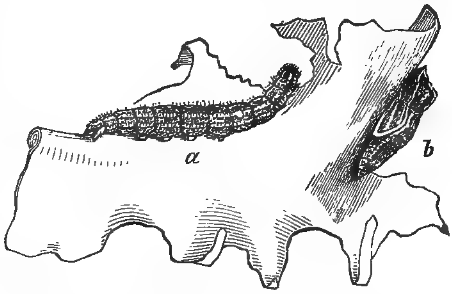
CABBAGE. *Brassica oleracea capitata.* Of the various classes of culinary vegetables the cabbage family (*Brassica*) is most ancient, as well as most extensive, being cultivated in all quarters of the globe from the Torrid Zone to the Arctic Circle. Of the 1,000 species enumerated by Dr Lindley, all are harmless, and many of them are highly useful. It was a favorite vegetable among the ancient Romans, and was introduced wherever their armies penetrated. Cabbage delights in a deep, rich, loamy soil, though it will flourish in any soil, not too dry, if well manured. The cabbage is a gross feeder, and gardeners generally give the land at least forty loads of rich manure per acre. For extra early heads sow the seed in February or early in March, in a hot-bed, and transplant when large enough, four inches apart, in a cold frame. Just before corn-planting time the plants may be set in the open air in rows, nearer or further apart, according to the variety. Under ordinary circumstances, the seed may be sown in a mild hot-bed about the middle of March, or in a cold frame April 1st, and transplanted to the open air when from four to six inches high. The cultivation consists in keeping the spaces between the rows mellow with the cultivator, and the earth about the plants frequently stirred with a hoe or narrow rake. The following is a list of varieties: Early varieties—Early Wakefield. Plant twenty inches apart between rows, and eighteen inches in the row. Early York, one of the earliest and most reliable sorts. Plant twenty inches apart between rows, and fifteen inches apart in the row. Winningstadt. Plant two feet by eighteen inches. Intermediate varieties—Small Ox-heart; an excellent, firm, hardy variety. Plant two feet by sixteen inches. Large Ox-heart; about a week later than the preceding; excellent and firm head. Plant two feet apart each way. Fottler; a very firm variety, a constant header, and in good repute in the Western United States. Plant two feet apart each way. Early Flat Dutch; an excellent cropper, and sure to head. Plant thirty inches by two feet. Pomeranian; a medium sized cabbage, the heads like an elongated cone; the leaves are peculiarly twisted at the top; good for autumn or winter; solid and bearing carriage well. Plant two feet apart each way. Late cabbage—Premium Flat Dutch; the best cabbage for general cultivation, doing well South or North; one of the best late fall or winter cabbages, keeping through the winter, and even to May, perfectly sound. Plant three feet by thirty inches apart. Stone-mason; a good, solid cabbage, tender and sweet. Plant three by three feet. Large, Late Drumhead; a hardy variety, rather loose in the head, but generally heading well. Plant three by three feet apart. Champion of America; this cabbage is of an immense size, sometimes attaining a weight of forty pounds; is a good, tender, well-flavored sort, but objectionable on account of its size. Plant three and a half by three and a half feet apart. There are many ways of saving cabbage through the winter. For use during the season of hard frosts the cabbage may be taken up and set in the ground on their roots, in the cellar. For late winter or spring use, dig a trench on some dry spot, four and a half feet wide, and to a depth of the head of the cabbage, not counting the root. Just before the ground freezes up, or when hard freezing nights occur, place the cabbage heads down, as thickly together as possible, throwing the earth over the whole as you extend the trench, so as to cover the cabbage up to the roots. So proceed until you have the whole buried. When the ground freezes pretty solid—fully down to the heads—cover all over with straw (flax straw is best) to keep the frost in as long as possible. In this way the heads may be preserved intact, and in any quantity, until the first of May. The insects attacking cabbage are numerous. Cut-worms, Flea-beetles, and other insects, attack the young plants in the seed-bud; later, the most destructive are the larvæ of the European and American Cabbage Butterfly. These may be found under their appropriate names.

CABBAGE BUTTERFLY. There are various butterflies infesting the cabbage. Until the European form (*Pieris rapæ*) was introduced, however, but little difficulty was experienced in keeping them in check We give an illustration of the southern species of larva and caterpillar (*P. protodice*). Dr. Riley says, *P. vernalis* is but the spring form of *P. protodice*. The illustration will serve as a key to the various species which infest the cabbage. Of these pests, Dr. Thomas says: The Southern Cabbage-worm (see illustration, *a*, larva, and *b*, pupa on leaf.) is very widely distributed, being found even in the high altitudes of the mountains; but for all that the name is appropriate, being more abundant in the warmer portions of the United States, and there often proving very destructive to the cabbage crop, taking the place in that sense, of the Rape Butterfly, whose latitude is further north. It is quite common in Illinois, but it has been injurious here only to a limited extent, and that chiefly in the vicinity of the large cities. One of the reasons why it is not so abundant further north seems to be that the chrysalides are more susceptible to the influences of our long, cold winters, than some other kinds. This does not destroy the species, but only serves to lessen the number of chrysalides that pass the winter without injury, thereby lessening the number of individuals of the spring brood of butterflies. The larva, or caterpillar, is of a greenish-blue color, with four longitudinal yellow stripes, and covered with black dots. When newly hatched it is of a uniform orange color, with a black head, but it becomes a dull brown before the first moult. The longitudinal stripes and black spots are only visible after the skin has been cast the first time. The chrysalis varies somewhat in color, but is generally a light bluish-gray, more or less speckled with black, the ridges and prominences edged with buff or reddish. The two sexes of the perfect insect differ some in color. In the male the wings are white, with a large trapezoidal spot at the end of the discal cell of the fore wings, and an oblique interrupted black band near the outer border, with a little black on the veins at the outer end. The hind wings are without spots. The female is darker, the black of the fore wings more intense, with the hind wings tinted with grayish. There are at least two broods of the worms in a season. They are to be found on cabbages, in all stages of growth, through the months of July, August and September. The last brood pass the winter in the chrysalis state, and become the first brood of butterflies in the spring of the next year. The European Cabbage Butterfly, since its introduction, has proved fearfully destructive to the cabbage crop both East and West, and is now found even west of the Mississippi river. As yet, no sure means has been found for counteracting its ravages. Its history in America is as follows: It was introduced from Europe to Quebec, Canada, about the year 1857, and from thence it went southwards along the railway lines to New York, Philadelphia and Washington, and thence east and westward over the whole country from the Atlantic Ocean to west of the Mississippi, and north and south from Canada to Virginia. This species is described as a pale green worm, an inch and a half long, finely dotted with black; a yellow stripe down the back, and a row of yellow spots along each side, in a line with the stigmata or breathing pores. The eggs from



SOUTHERN CABBAGE BUTTERFLY.



SOUTHERN CABBAGE-WORM.

which these are produced are laid on the under side of the leaves. There are at least two broods of the worms in a season, the first changing to chrysalides in June and hatching to butterflies in seven or eight days afterwards, while the second brood pass the winter in the pupæ state. The chrysalis is variable in color, being sometimes yellowish-brown or yellow, and passing thence into green, speckled with minute black dots. The perfect insect is about the size of the Turnip Butterfly. In color the body is black in the male, the wings white, with the tip and a dot near the middle of the front wings black, and a black dash in the front edge of the hind wings. On the under side, there are two black dots on the fore wings, while the tip and the whole surface of the hind wings are lemon-yellow. In the female the upper side of the wings are a whitish-ochre, while the lemon-yellow of the under side is more intense than in the male, and there are two dots on the upper side of the fore wings instead of one. These caterpillars differ from the foregoing kinds, and also from the Turnip Butterfly noticed hereafter, in their manner of eating. While the larvæ of the Southern Cabbage and the Turnip Butterflies feed mostly on the outside leaves, going but little, if any, into the head; these are much more destructive, as they have the habit of boring into the interior of the head. When about to change to chrysalides they, like the last, leave the cabbage and attach their chrysalides to the under side of sticks, pieces of board and stones that are above the ground, etc.—anything that can offer a shelter and support. In relation to remedies, Dr. Thomas says. Advantage may be taken of the fact that the full-grown caterpillars leave the cabbages for some sheltered place in which to undergo their transformations, by placing boards, that are raised a little from the ground, among the infested plants. By examining these boards every five or six days and destroying the chrysalides, the future work of the worms may be very materially lessened. Where there are but few infested plants, the caterpillars may be destroyed by hand. As the worms work inside the heads more than either of the other species, chicken picking would be of but little service, as they would not find those that were doing the most damage. Heads that are so badly infested that they are past recovery, should be burned, as by that means all the insects that might be in them in the different stages of development, as well as the eggs, would be destroyed. In addition to the above methods of attacking the insects in the worm and chrysalide state, the butterflies that are seen flying over the cabbages may be caught, thereby preventing the eggs being laid on the plants. For this purpose a net may be used, made of musquito bar or other light material, fastened to a hoop of light wire attached to a stick about three feet long, for a handle. To be convenient to handle, the hoop should be about ten inches in diameter, and the wire not any heavier than is necessary to give it that degree of stiffness to keep its shape. The depth of the net should be twice the diameter of the hoop. As with other insects, man is not obliged to do all the fighting in this case; some species of birds, it is said, devour the larvæ, and also the perfect insect; but the most effective foe to this species is a small Chalcis Fly (*Pteromalus puparum*) that seems to follow close in the wake of its host. It had been supposed that this valuable little parasite was only a native of Europe, and had been introduced into this country at about the same time as the Rape Butterfly, but Packard is of the opinion that it is a native of this country, and preys also upon the other species of *Pieris*. The chrysalides of the butterfly that were infested by this parasite, could easily be told by the livid and otherwise discolored and diseased appearance. In destroying chrysalides, such should not be destroyed, as by allowing them to remain, the parasites, instead of butterflies, will hatch from them and then serve as so much additional help toward the destruction of the Cabbage-worms. The specific character is given as follows: Male—expanse of wings about 1.75 inches. Ground color of both wings above, white. The tip of the fore wings and a round spot near the middle, black. The hind wings have a dash of the same color on the costa a little beyond the middle. Both wings dusky at base. Underside fore wings white, with black spots, the second near the hind angle, and the tip lemon-yellow, the same color reaching a little on the costa toward the body. Hind wings uniform lemon-yellow. Both wings sprinkled somewhat near the base with gray scales. There is a variety of the male that has the same markings but the ground color above is lemon-yellow. Female—differs from the male as follows· The color above is a light ochre-yellow instead of white. The marks are the same, except a second black dot near the hind angle of the fore wings; underside, the lemon-yellow on both wings is more intense, and expands along the costa and outer margin of the fore wings. The body is black above in both sexes, but light beneath. The Turnip butterfly (*Pieris oleracea*) is so nearly related to the foregoing, that we give place to it here. Dr. Harris describes it as follows: About the last of May and the beginning of June it is seen fluttering over cabbage, radish, and turnip beds and patches of mustard for the purpose of depositing its eggs. These are fastened to the undersides of the leaves, and but seldom more than three or four are left upon one leaf. The eggs are yellowish, nearly pear-shaped, longitudinally ribbed, and are one-fifteenth of an inch in length. They are hatched in a week or ten days after they are laid, and the caterpillars produced from them attain their full size when about three weeks old, and then measure about one inch and a half in length. Being of a pale green color, they are not easily distinguished from the ribs of the leaves beneath which they live. They do not devour the leaves at its edge, but begin indiscriminately upon any part of its underside through which they eat irregular holes. When they have completed the feeding stage they quit the plants and retire beneath palings, or the edges of stones, or into the interstices of walls, where they spin a little tuft of silk, entangle the hooks of their hindermost feet in it, and then proceed to form a loop to sustain the fore part of their body in a horizontal or vertical position. On the next day it casts off its caterpillar skin and becomes a chrysalis This is sometimes of a pale green and sometimes of a white color, regularly and finely dotted with black, the sides of the body are angular, the head is sur mounted by a conical tubercle, and over the fore part of the body, corresponding to the thorax of the included butterfly, is a thin projection having in profile some resemblance to a Roman nose.

The chrysalis state of the earlier broods lasts ten or twelve days, but the last brood does not come out till the following spring. Both wings of the butterfly are white, without spots, but dusky next to the body. The underside of the wings are sometimes quite variable, the tips of the fore wings being greenish or lemon-yellow, with the veins of that portion bordered with gray scales, and the hind wings covered all over with these two colors; or, they may be less intense though the gray scales along the veins in the hind wings are usually very distinct. The body is a little lighter than the preceding species, and the antennæ are tipped with light yellow instead of white. The expanse of the wings is about an inch and three-fourths. The ranges of this pest in the West for the last few years, has been so extensive in the market gardens of our large cities as to render the successful raising of marketable cabbages almost impossible. Thus it is important that every means should be used to destroy the insects. Unfortunately, the fact that the head of the cabbage, the edible part, is directly preyed on, renders it dangerous to employ poisonous compounds. In fact, scarcely any of the many remedies proposed have proved effectual. Chloride of lime in solution, has been reported to the editor of this work, by a successful German gardener, as the best known means in his country. Solutions of salt and various other compounds seem to have very little effect. Mr. P. T. Quin, of New Jersey, was successful in saving 75,000 cabbages with a loss of only five per cent. by using the following: Twenty parts of superphosphate, one part carbolic powder, and three parts air-slacked lime, all well mixed together and dusted freely over the plants and into the heads, at intervals of four days. The present season, 1880, we have noticed less than formerly of any of the species near Chicago, not enough to render anything but hand picking necessary. The probability is that persistent work heretofore, and the increase of parasitic insects, have caused the decline, a fact worthy the attention of all cabbage raisers. Assistance to the natural enemies always pays, where the destruction of any noxious insect is concerned, a fact not generally known outside of those circles where science goes hand in hand with practice.

CABBAGE TREE. *Chamœrops palmetto.* (See Palmetto)

CACTUS. A tribe of fleshy plants, some of which are cultivated for their splendid flowers, and pleasant acid fruits, the whole family being curious in their habit of growth. There are several species of cactus, the principal in cultivation being *Cereus*, *Echinocactus*, *Mammillaria*, and *Opuntia*. The well known Night-blooming Cereus, belongs to the first. The Hedge-hog cactuses to the second. The Prickly Pear belongs to the *Opuntias*. *Epiphyllum*, known as Crab cactus, is also a species containing many fine varieties. These are usually grafted on pereskia stocks, especially *E. truncatum* one of the finest of early winter bloomers and magnificent in every respect. The writer prefers *Cereus Hexagonus*, or *Speciosissimus*, one grafted at a height of two feet, then allowing buds of the Cereus to start, and again grafting when it has grown six or eight inches, makes a very pretty combination, different varieties being used. Take a shoot of epiphyllum two inches long, pare off the outer skin or bark half an inch or less, at the base, and then cut that which is to be inserted in a wedge-shape. Make an incision in the angles of the stock, or in the top, with a pointed stick of the shape of the graft, insert it, fasten it with a thin sliver of wood, cover with moss, place them in a rather warm, shady place, syringe over the top occasionally, and they should unite in two or three weeks. All the cactus tribe should be kept quite dry during the season of rest. They should only be kept moderately moist at any time. They all root freely from cuttings, or sections of the plants, taken when they are in a growing condition, and it is better that they be allowed to dry for some days, after being cut off, especially if pretty succulent. The illustration, Fig. 1, page 169, shows the fruit of the Giant cactus, (*Cereus giganteus*); Fig. 2, fruit of Prickly Pear, (*Opuntia*); Fig 3 shows one of the Hedge-hog cactus *Echinocactus Wislizeni*. There are many of the cactus tribe well adapted to window gardening, from their well known power of withstanding heat and drouth. At blooming-time, however, they require heat and moisture, not continual watering, but a soaking at intervals to keep the soil moist, and if an occasional watering be given with liquid manure, so much the better.

CÆSAREAN OPERATION. The removal of a fœtus from its mother by cutting into the womb.

CAFFEIN. A slightly bitter, white, silky principle obtained from coffee, tea, guarana, paullinia and some other plants. Liebig and others have shown that it may act as an assistant to other food in increasing the amount of bile formed, by furnishing nitrogen thereto. *Asparagine* and *theobromine*, analogous principles, act in like manner.

CALAMINE. An absorbent for ulcerous sores and extensive burns. It is an impure carbonate of zinc, prepared by roasting. An ointment made with calamine and lard is sometimes used to promote the healing of sores.

CALANDRA. The genus of wheat weevils. (See Weevil.)

CALCARATE. Flowers having a spur like the larkspur are so called. The spur is also called a *nectarium*.

CALCAREOUS. Containing carbonate of lime, as calcareous marl, soils, sand, etc. (See Soils and Manures.)

CALCINATION. The burning of substances to ashes.

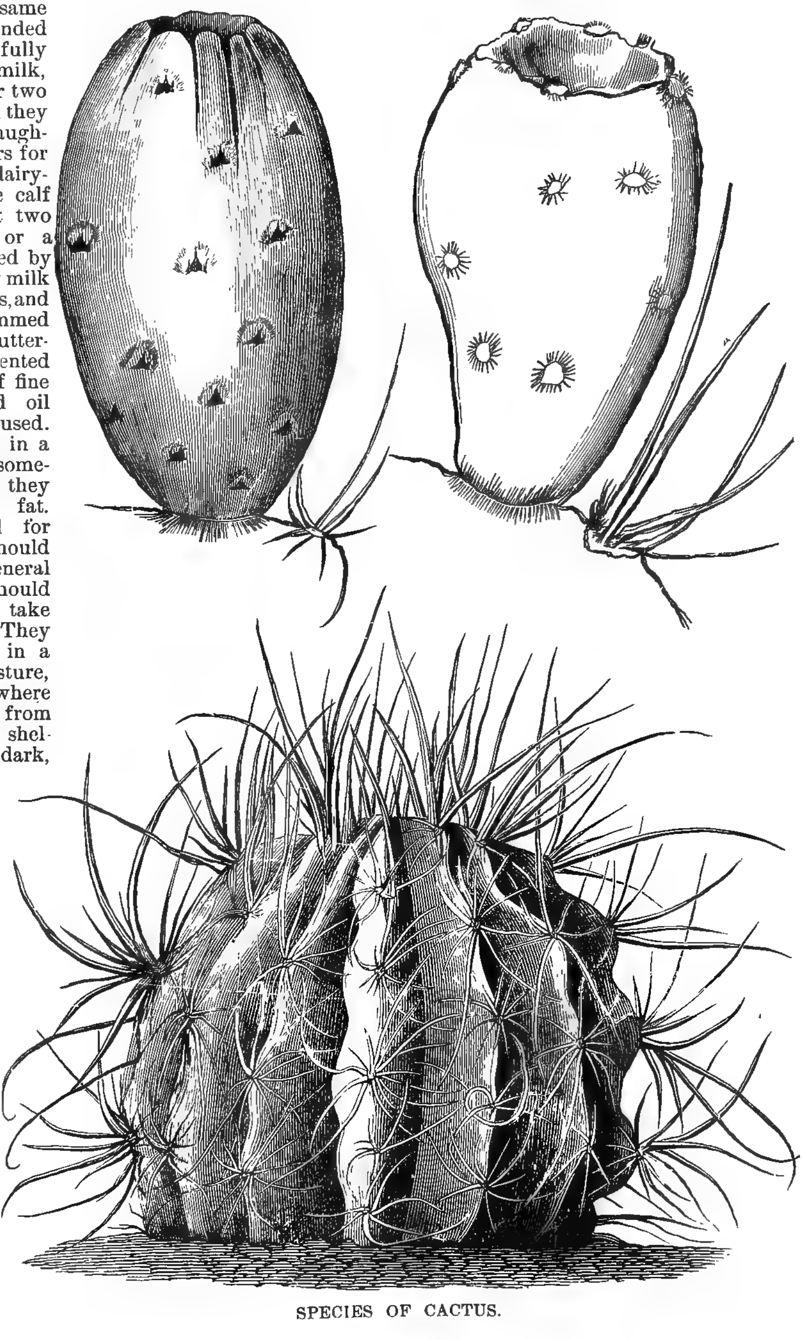
CALCIUM. The metallic base of lime, which is an oxide of calcium. A few electro-negative bodies, as sulphur, chlorine, fluorine, form salts directly with the metal, and are called sulphuret, chloride, fluoride of calcium, etc.

CALC SPAR. Crystallized carbonate of lime.

CALCULUS. Any solid, stony concretion formed in the bladder, gall-duct, etc.

CALEFACIENT. Medicines that produce the sensation of warmth, as alcohol, are so called.

CALF. The word signifies to throw out or vomit, thus the groove made in sawing, is called the saw-calf or carf. It also signifies a protuberance, as the calf of the leg—the swell of the muscles between the ankle and knee. It is among animals applied to the young of the bovine species, and among fishes to the young of the whale, and other warm-blooded species. In the rearing of calves, the farmer must have in view the purpose for which they are intended. If for beef, the young animals should be pushed forward, from the time of birth, as fast as possible, and as they begin to eat solid food, should early be learned to eat grain. The bulls should be castrated at from four to six weeks old, and the females spayed when they arrive at an age to bring them in heat. When the young are intended for working oxen, the dairy, or for breeding, it is not well that they be pushed so strongly, as when intended for beef. When they are intended for veal they should have the same care as when intended for beef, being fully fed with new milk, until six weeks or two months old, when they are ready for slaughter. Some feeders for veal, especially dairymen, remove the calf from the cow at two or three days, or a week old, and feed by hand, giving new milk for about ten days, and afterwards skimmed milk; and later buttermilk, supplemented with the mush of fine corn meal, and oil meal may be used. Thus, if placed in a clean, airy, but somewhat dark, pen they become very fat. When intended for breeders, calves should have the same general treatment, but should be allowed to take full exercise. They should be kept in a well shaded pasture, with shelter where they may escape from the flies. This shelter should be dark, which will exclude insects. Another shelter should be supplied, to which they can retire at will — simply a structure covered with boughs but admitting the air freely — the object sought being shade, and a cool retreat. Thus they will soon learn to seek the dark quarter secure from flies, or the other lighter, cooler shade for rest. In rearing calves for breeders or milk, or when the steers are intended for working oxen, there is no objection to their running with their dams and taking the milk. In this case there will be no necessity to give grain the first summer. When weaned, which should be at the age of four to six months, they should be learned to eat grain—oats preferably—and during the first winter should have sufficient grain to keep them growing, but not fat; simply in good muscular



SPECIES OF CACTUS.

condition. The same rule will apply to breeders and animals destined to become dairy cows. They should not be kept fat, but in good growing, muscular condition. See articles ~~on Cattle, Dairy, Live Stock~~, Working Cattle, etc. Upon the subject of thorough-breds Mr. Charles Lowder, of Indiana, at a convention of Short-Horn Breeders, in relation to the management of calves, held the following: Upon the care bestowed upon them during the first year of their lives depends their size and value as neat cattle. Abuse and ill-treatment during the early life of the calf can never be overcome in subsequent years. The calf, when dropped, should be allowed to remain from twenty-four to forty-eight hours with the dam, unless some very extraordinary circumstances make it necessary to remove it. Calves will, in a majority of cases, get upon their feet and take the teats in due time; but if one should be too weak from any cause to be up within one or two hours after birth, some of the first milk or biestings should be drawn from the cow and given to it. If the cow should, from after pain or mere indifference, fail to give it proper attention, the herdsman should have it well rubbed with a woolen cloth until dry, and its hair nicely laid by means of a camel-hair brush. After one or two days the calf should be removed from the cow and taken to the stall, where it should be tied fast by means of a leather strap around the neck, or with a head-halter made to fit, which is preferable. It should be allowed to suck the teat three times a day until about two weeks old, and should be led to and from the cow by the halter. If it has been well handled it will by this time be quite gentle and well broken. It may now be turned out so as to have fresh air, sunlight, and plenty of exercise. If a steer, and intended to be fed for the shambles, this exercise is not necessary. In that case the more quiet and comfortable he can be kept, and the more highly fed, the greater will be the net profits. If the calf, whether male or female, is to be grown to maturity for breeding purposes, the treatment should be quite different. In the first place the object is to develop the greatest possible amount of soft flesh and fat without any regard to the healthy development of the vital organs, as the heart, lungs, liver, etc. In the latter case due regard must be had for the uniform development and perfect health of every organ and part of the system. Without exercise the muscular part of the system of young and growing animals is not fully developed, and in the mature animal becomes enfeebled. The heart, being no exception to the law, becomes to some extent diseased, while the liver and kidneys share the same fate. With all the vital organs enfeebled, the animal is not prepared to withstand the sudden change of temperature to which it is sometimes exposed. As like tends to produce like, animals with diseased and enfeebled vital organs should not be selected to breed from. Those engaged in rearing calves have several things to take into consideration If the cow is an inferior beef-breed, the milk from her may be worth more to make into butter or cheese than to be given to the calf. In that case the calf should be sent to the butcher as soon as old enough to kill But if the calf is of good beef-stock, and is to be raised to maturity for that purpose, or to breed from, it should be allowed to suck twice a day until four, five, or six months old. If an early-spring calf, it will learn to eat grass during the summer, and can be weaned in the fall without much, if any, loss of flesh. If a fall calf, it will soon learn to eat oats, hay, bran, or sheltered corn, and as the grass starts in the spring it can be weaned without any check to its growth, the grass answering the place of milk to some extent. When calves are allowed to suck twice a day, care should be taken that they do not get too much milk, as they may become sick, and fail to make as great gains as they would on a less quantity. In case of scours, a little chalk well powdered and placed in a trough, or in some place where it will attract their attention, will frequently be of good service to them. Calves intended for steers should be castrated when about two weeks old. The male calves that are to be reared and kept for breeding purposes, should be removed from the females at one or two months old, and placed in a lot inclosed by a permanent fence, and should not be allowed to run with other cattle afterwards. The heifers at one year old should be removed from all other cattle, and placed in a lot by themselves. At this age, if they have been well fed, they will express their desire for male company, by a great deal of restlessness. If allowed to run with steers or older females they will be worried a great deal to no purpose. Heifers fifteen or eighteen months old are much more likely to get in calf than when they are kept from breeding until two or two and a half years old, especially if they are fed highly on grain, and are inclined to take on fat. The milking qualities of heifers depend much upon the kind and amount of food they receive while carrying their first calf. They should be in perfect health and in a thriving condition, and kept in full flesh until after calving. If they have been properly handled while calves, and up to the time when they are milked the first time, there will be no trouble in breaking them. In relation to the artificial feeding of calves, the following will be interesting: Prof. E. W. Stewart, New York, fed a miscellaneous lot of ten calves wholly upon skim-milk. The milk was all weighed daily and the calves each week. It required of milk for one pound gain—first week, 11.02 pounds; second week, 12.18 pounds; third week, 13 17 pounds; fourth week, 13.40 pounds; fifth week, 14 60 pounds; sixth week, 15.05 pounds; seventh week, 16.71 pounds; eighth week, 16.80 pounds; ninth week, 17.01 pounds; tenth week, 16.08 pounds; eleventh week, 16 pounds; twelfth week, 15.90 pounds. The decrease of milk to make one pound live weight, beginning the tenth week, was caused by the calves learning to eat grass. These calves were each weighed separately, as was the milk fed to each, and the gain was very unequal in different calves, as they were not a uniform lot; but the result stated is the average of the ten. In further illustrating this subject, Mr. A. L. Bradbury, of New York State, in reply to the question, How soon can we begin to substitute other food than milk for our calves? answered: Not the first week, for the calf should have the milk of its dam for one week at least. Now, if we wish to commence to substitute something instead of milk, he must be taken from the cow and taught to drink and feed the same elements of nutrition the milk contains. One quart of milk contains about one and a half ounces of butter, one ounce of sugar, one and a half ounces of caseine, and seventy grains of bone matter. Experiments have shown that one pound of oil or fat is equal to two and a half pounds of starch or sugar; thus one quart of milk contains of flesh-forming material one and a half ounces, of fat or heat-giving material four and one-eighth ounces, or a total of five and five-eighth ounces of nutritive elements. Now, if we take out one ounce of butter to a quart of milk, we shall have removed one-half of its value for the calf, which we must make up in quantity by doubling up, or substituting starch in the form of buckwheat flour, at the rate of two and a half ounces for every ounce of butter taken away. The better plan is to gradually substitute skimmed milk for the new by adding new milk with warm skimmed milk for its morning and evening meals, and giving it skimmed milk at noon, for it should be fed three times per day at least. When the calf is four weeks old it will do well enough on skimmed milk alone, provided it can have enough, with always keeping good sweet hay by it. Reared in this way, we have our milk for use in the dairy and get much better calves than in the ordinary way of letting them draw the milk themselves until they are ten or twelve weeks old, then taking them away at once. A calf should not be weaned until it is four or five months old. In a cheese-dairy whey and oatmeal can be substituted for skimmed milk, after the calf is two months old, with good success. Another method of raising calves is as follows: For the first week I let them have half of the milk; then I take them off and teach them to drink. I let the milk stand from twenty-four to thirty-six hours, skim it, warm it milk-warm, and give it to them, six quarts to a feed, twice a day for the first week or fortnight; then I increase the quantity so as to give them all that the cow will give. When they are about four weeks old, I put a little shorts, oatmeal, or oats, cooked potatoes or crusts of bread, in a trough where they can get at it. After they get so as to eat too much, I allowance them to about a pint and a half of oats a day, or something equivalent; and so right on until they are six or eight months old, increasing the feed. I give them milk until they are four months old. If you want to carry the calves up to great growth early, keep them up for eight months; but I usually turn them out to grass when four months old. The first winter I feed some roots with good dry grass, not hay. I have by this system of feeding matured my Jersey calves at seventeen months old. Mr. L. C. Fisher, of Vermont, raises calves as follows: At the age of two days old he takes the calf from the cow, and teaches it to drink its own dam's milk mixed with skimmed milk twelve hours old. At the age of ten days he feeds it exclusively with skimmed milk twelve hours old; at fifteen days, twenty-four hours; at two months, thirty-six; at three months, thick milk, with what dry shorts it will take. As often as once in six weeks he dissolves a piece of saltpeter, as large as a robin's egg, in the milk. He says: With plenty of milk, shorts, early-cut hay, water, and exercise, a calf can be grown from two to three pounds a day for a year. It will be seen from the extracts given, that the testimony of experts is in one direction to feed well, having consideration to the use intended. Yet not one farmer in one hundred does this, and hence the great bulk of calves are allowed to shift for themselves to a great extent, the owners depending upon extra feed at some time in the future, or else upon selling the immature animals to other feeders. The loss, however, always comes upon the individual who has failed in his duty while the animal was young; the loss of flesh during the winter having to be regained during the summer, so that the animal must be kept one or two years extra to make up this loss. A loss in fact never fully recovered.

CALKS, or CALKINS. The parts of a horse-shoe turned downward to prevent slipping on pavements and other smooth surfaces. Calking is the cutting, by the calk of the shoe, by stepping on the coronet of the opposite foot, often making a bad wound difficult to heal. The cut should be covered with hot pitch, filling the cavity, and then bound up to prevent the animal getting dirt in it. In any case it should be kept clean and free of dirt.

CALLA. There are four species, chiefly green-house, herbaceous perennials. The genus belongs to the *Arum* family. *C Palustris*, is a native of Northern Europe, and is found in bays and marshes in the United States. The well-known Calla Lily(*C. Æthiopica*) is common in many windows in winter, and much admired. It is strictly an aquatic plant, but will give a profusion of bloom if potted in a six or eight inch pot, according to the size of the tubers, in rather strong, rich loam, and freely watered with warm (tepid) water. It is all the better if the pot be placed in a saucer, constantly kept full of water. The cool purity of its great spathes of pure white flowers, and the length of time it remains in bloom, make it a general favorite. When bloomed in winter, the pots should be plunged into the open ground about the first of June, and allowed to gradually dry off. The tubers may then be repotted in September or October, breaking off all small off-sets, and will thus furnish yearly bloom, the plants increasing in size from year to year.

CALLUS. When the bone of an animal is broken by accident, nature restores the union by depositing bony matter around the loose extremities, and thus fixing them. This deposit is sometimes called a callus; it should be absorbed after the limb is reëstablished. In a general sense, a callus is any induration, as the palms of a working man, a tumor becoming indurated; in fact any induration of the skin or its tissues.

CALOMEL. The sub-chloride of mercury. A medicine formerly much used to produce an increased secretion of bile and purgation, and a component of many live-stock medicines. It is now far less used for man or beast than formerly.

CALORIC. Heat, or pertaining to the matter of heat. Really the source of the phenomena in nature producing force. (See Heat.)

CALYX. The outer green case of flowers. It protects the internal parts. It is colored in many plants, as in tulips, hyacinths, etc.

CAMBIUM. The viscid secretion separating the alburnum from the liber in the spring. It affords the materials out of which the new wood and bark are partly made, and disappears in a short time, or when the season's growth is finished. During the deposit of the cambium the bark easily peels.

CAMEL. A genus of ruminant animals without horns, and probably among the first, if not the first of animals domesticated by man. So long has the camel (called the ship of the desert) been domesticated that its original country can not be definitely fixed; though Diodorus and Strabo mention it as existing wild in the deserts of Arabia, and Desmoulins asserts that it so existed there in the time of the Emperor Hadrian. The probability is, that even these animals escaped from domestication, as have those, probably, still said to exist in the wilds of Central Africa and Asia. In desert regions it is the most valuable of servants. Attempts have been made to domesticate the camel in the United States. (See Article on Acclimation.)

CAMELLIA JAPONICA. A beautiful evergreen, green-house shrub, much sought after for its elegant flowers, in various tints of red to pure white. There are numberless varieties, but it is not adapted to house culture, since the plants are apt to drop their buds.

CAMPANULA. Canterbury-bell. This is a hardy perennial, blooming profusely, in long spikes, the flowers being borne in succession along the stem. It is of the easiest cultivation, only requiring a well-drained soil, but is better, as all flowers are, for a covering in winter. Sow the seeds in the spring, and transplant to the border. If sown in a hot-bed and transplanted once before being finally put into the border, they will blossom the first season, but require the second or third year to come into their full vigor of blossoming. It is also called Bell-flower, a name common to other flowers of the bell shape. The cut shows the flower, natural size, and also plant reduced at the left. Of late years many of our old-fashioned flowers have been discarded for newer and more fashionable ones of less beauty. The old-fashioned Canterbury-bell should not be one to be cast aside.

CANTERBURY-BELL.

CAMPANULATE. Bell-shaped; applied to flowers of that figure, as the Canterbury-bell.

CAMPHOR. A solid essential oil consisting of carbon and hydrogen. It is a nervous sedative, soothing pain. It is obtained in the crude state by distilling the twigs, roots, etc., of several plants, chiefly the *Laurus camphora* and *Dryobalanops camphora*, trees of tropical Asia. Camphor is peculiarly disagreeable to insects which infest cloth and woolen goods. The solution in alcohol is the commonest form of the medicine. A solution in oil is an admirable embrocation to painful sprains, rheumatism, etc. Camphor is found in numerous herbs, especially peppermint, rosemary, thyme, lavender, etc. The quantity is minute.

CANADA THISTLE. (See Thistle.)

CANADIAN PONY. The Canadian pony is distinct in many characteristics and was, undoubtedly, originally derived from the French horses brought over to Canada in its earliest settlement. Dwarfed by generations of exposure and semi-wildness, and subsequently crossed upon various stocks of horses introduced into Canada, these nervous animals are valuable in proportion to the characteristic points of the supposed original progenitors, the Norman, or Percheron Horses. Their characteristics are: Head rather large, but lean and well-formed; forehead broad; ears wide apart, but upright; the eye small, clear, bright, and indicating spirit and courage; the shoulders strong, rather straight, with somewhat low, heavy withers, but with a broad, full chest; the body compact, inclining to flatness, but with firm, muscular loins; the croup round and fleshy, with muscular thighs; the legs heavy-looking, with large joints, but with sound, flat bones; the feet are hard, tough, and of the very best, so that the limbs and feet are the perfection of form for beauty and endurance; the average height is about fourteen hands; the mane and tail are very heavy, and with a peculiar wavy form, and the back sinews and fetlocks are also covered with long, and often shaggy hair. The principal colors are black and brown, but chestnuts are not infrequent. Occasionally a dark iron-gray is found, with black legs, mane and tail. These are especially prized. Sorrels and dun-colored animals are not uncommon. These have lighter manes and tails than the darker colored ponies, and are probably the result of crosses with the English blood horse. The Canadian pony, though not speedy, is capable of pulling the trotting load of a horse at the rate of six to seven miles an hour, and this, day in and day out, up and down hill, and on a level. They are easily kept, docile, spirited, of undaunted courage and perseverance, and sure-footed on the worst possible ground. Crosses of thoroughbred, on Canadian mares of good form and action have produced some wonderful trotting and pacing, as witness the get of St. Lawrence. We have one in mind, now, owned by a prominent butcher of Chicago; a little black mare, now fourteen years old, that has pulled her owner to and from the city daily for six years, a distance of seven miles, never requiring more than forty minutes, and capable at any time of showing a three-minute gait, whether trotting or pacing. As a rule they are somewhat headstrong; but if properly trained, they make nice pony teams that an invalid lady may fearlessly drive.

CANCELLATE. Full of cells, as the ends of long bones. Cellular, as the porous structure of bones. In botany, consisting of a network of veins without intermediate parenchyma, as in the leaves of certain plants.

CANCER. A malignant tumor, at first hard and painful, afterward ulcerous, attacking glands.

chiefly. The only remedy is extirpation, which should be done as soon as its nature is discovered. Cancer of the eye is not uncommon in cattle and horses, produced probably by blows and ill-usage.

CANE SUGAR. (See Sugar)

CANIS. The generic name of the dog species.

CANKER IN THE HORSE. The separation of the hoof from the fleshy parts of the leg, attended with a diseased growth. Pressure and caustics are necessary, with rest, for a cure. Cast the horse, and cut away all diseased growths, touch the diseased parts with nitrate of silver, pack with dry tow and put on a leather boot, and apply pressure, moderately tight to the fetlock Soak away the dressing in two days, and if fungous growths have not disappeared, dress the surface with nitrate of silver, or, if deep-seated difficulty is suspected, use a wash of forty grains of chloride of zinc and one ounce of water This is excellent for all foul wounds and ulcers that can not be reached by the pencil of nitrate of silver. The part may be freely syringed with the solution as given above. Canker should really be treated under advice of a veterinary surgeon. Canker in trees, is a gangrene attacking both fruit and trees, shown by enlargement of the vessels of the bark of a branch, or the stem itself. Cutting out the gangrene, painting the exposed surface with collodion, and the application of liquid manure to stimulate growth are appropriate remedies.

CANKER-WORM. The moth from which this destructive worm is produced belongs to the genus *Anisopteryx*, so named from the fact that in some species the sexes are very unequal in size, and in others the females are wingless. This is the case with the Canker-worm. The cuts represent the insect in its various stages of development. The following description of the Canker-worm is from Dr. Harris' Insects Injurious to Vegetation: Their general time of rising is in the spring, beginning about the middle of March, but sometimes before and sometimes after this time; and they continue to come forth for the space of about three weeks. It has been observed that there are more females than males among those that appear in the autumn and winter, and that the males are most abundant in the spring. The sluggish females instinctively make their way towards the nearest trees, and creep slowly up their trunks. In a few days afterwards they are followed by the winged and active males, which flutter about and accompany them in their ascent, during which the insects pair. Soon after this, the females lay their eggs upon the branches of the trees, placing them on their ends, close together in rows, forming clusters of from sixty to one hundred eggs or more, which is the number usually laid by each female. The eggs are glued to each other, and to the bark, by a grayish varnish, which is impervious to water; and the clusters are thus securely fastened in the forks of the small branches, or close to the young twigs and buds. Immediately after the insects have thus provided for a succession of their kind, they begin to languish, and soon die The eggs are usually hatched between the first and the middle of May, or about the time that the red currant is in blossom, and the young leaves of the apple-tree begin to start from the bud and grow. The little Canker-worms, upon making their escape from the eggs, gather upon the tender leaves, and, on the occurrence of cold and wet weather, creep for shelter into the bosom of the bud, or into the flowers when the latter appears. A very great difference of color is observable among Canker-worms of different ages, and even among those of the same age and size. It is possible that some of these variations may arise from a difference of species; but it is also true that the same species vary much in color. When very young they have two minute warts on the top of the last ring, and they are then generally of a blackish or dusky-brown color, with a yellowish stripe on each side of the body; there are two whitish bands across the head, and the belly is also whitish. When fully grown these individuals become ash-colored on the back, and black on the sides, below which the pale yellowish line remains. Some are found of a dull greenish-yellow and others of a clay color, with slender interrupted blackish lines on the sides, and small spots of the same color on the back. Some are green, with two white stripes on the back. The head and the feet partake of the general color of the body; the belly is paler. When not eating, they remain stretched out at full length, and resting on their fore and hind legs, beneath the leaves. When fully grown and well fed, they measure nearly or quite one inch in length. They leave off eating when about four weeks old, and begin to quit the trees; some creep down by the trunk, but great numbers let themselves down by their threads from the branches, their instinct prompting them to get to the ground by the most direct and easiest course. When thus descending, and suspended in great numbers under the limbs of trees overhanging the road, they are often swept off by passing carriages, and are thus conveyed to other places. After reaching the ground, they immediately burrow in the earth to the depth of from two to six inches, unless prevented by weakness or the nature of the soil. In the latter case, they die, or undergo their transformations on the surface. We give cuts of the Fall Canker-worm, male and female, larva and chrysalis. Fig. 1 represents *a*, *b*, egg, side and top views; *c*, *d*, joints of larva, side and top views, magnified; *e*, batch of eggs; *f*, full grown larva; *g*, female chrysalis, natural size; *h*, top view of, and tubercle of, chrysalis enlarged. Fig. 2 shows: *a*, male moth; *b*, female, natural size; *c*, joints

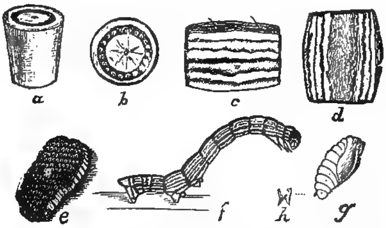


FIG. 1.

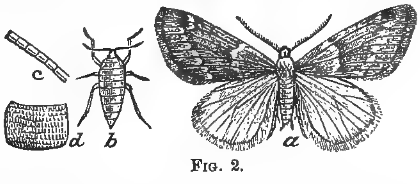
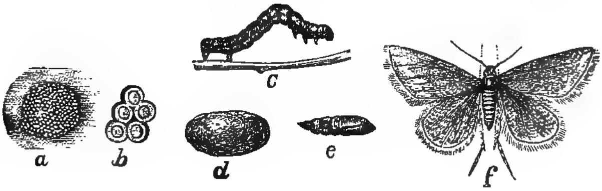


FIG. 2.

of female antennæ; *d*, joints of female abdomen, magnified, to bring out their pecular markings. The Spring Canker-worm (*A. vernata*) is represented by the cut as shown below, male and female, and also the larva or caterpillar; *a*, shows the eggs natural size; *b*, eggs magnified; *c*, caterpillar; *d*, cocoon of the worm while passing to the chrysalis state; *e*, chrysalis of male; *f*, male moth (winged); *g*, female (wingless). In relation to means of extermination, the Spring Canker-worm (*A. vernata*), with its chrysalis in a simple earthen cell, is severely injured and often killed, by late fall plowing. The Fall Canker-worm will not be injured severely by plowing, since the cocoon is thick, yielding, and interwoven with particles of earth. Many plans for preventing the ravages of the larvæ on orchard trees are adopted, among which, casing the trees with bands and circles of tin, tightly attached to the trees, and flaring from it. This is smeared with petroleum or castor-oil, or a mixture of both, which causes the worms to drop to the ground as soon as they touch it. It is evident that any means that will prevent the wingless females from climbing the trees will protect; yet, except in the case of fern trees, the expense has caused this means to be abandoned. In relation to remedies, Dr. Thomas says: Like most other caterpillar foes, birds and predaceous ground-beetles help man in keeping them in check. Of the artificial means that have been from time to time recommended, the following seems to be the most desirable, as embracing simplicity with lightness of expense. First. To prevent the females from ascending the trees to deposit their eggs, a band of coarse cloth, six inches or more wide, may be put around the tree, and then smeared with tar or a mixture of tar and molasses. Second. A hay rope may be put around the tree, and over this a ring of tin, wide enough, so that there will be free tin below the rope, and the whole securely fastened, being careful that there are no crevices between the tin and the tree through which the insects may pass. The tin should be smeared on the inside with a mixture of castor-oil and kerosene. In both these cases, the moths will lay their eggs below the bands if prevented from going above them. To insure success, these should be sought and killed, as if allowed to hatch, it will be much more difficult to keep them from ascending the trees than it was the moths. Third. When the worms are already in the trees, and if the trees are not too large, a sudden jarring will cause them to be detached from the leaves or twigs, and hang suspended, when they may be swept down by passing a switch between them and their support, and they may be destroyed. Fourth. Washes of Paris green and other substances may be resorted to when they are in the tree, but it is probable that where the tree is small enough to make the application of washes practicable, a few times jarring will answer the same purpose. Fifth. If the worms have entered the ground and changed to chrysalides, fall plowing will, if the ground be mellow, break up their slender cocoons, and expose them to the action of the weather, which, with the birds, will destroy most of them. In extensive orchards, jarring and catching the worms with a hay wisp fastened to a pole, and passed between the branches and ground as they drop and hang by their fine spur filaments, is effective, more so is showering the trees with a mixture of Paris green, or London purple, and water; the latter in about the proportion as used for the Colorado Potatoe-beetle.



CANKER-WORM.

CANNABIS SATIVA. (See Hemp.)

CANTER. An artificial pace to which horses are broken. It is much less fatiguing than the trot to the rider, but is distressing to the horse, if persisted in for some time, since to induce the gait the horse must be so far on his haunches as to destroy his equilibrium or natural balance.

CANTHARIDES. The genus meloe is mentioned by Kirby as apparently forming a connecting link between the coleoptera and orthoptera, as having the head vertical, and the elytra lapping at the base. Dr. Le Baron says, the resemblance is very remote. The genus *Lytta*, Fabricius, or *Cantharis*, of Geoffroy, contains the blistering beetles of the shops, and also the well-known ash-colored, black, and striped blistering beetles. Some entomologists divide them into two groups or sub-genera: *Lytta* proper, in which the antennæ are almost monniform, and a little thicker towards the tip, and *Epicuata*, in which the antennæ are filiform, or a little tapering, with the joints elongated. The latter group contains all our common species. Of the species usually found infesting our plants, principally potatoes, and beets, although they are in a sense omnivorous vegetable feeders, they do not attack plants indiscriminately. Of these enumerated, and which comprise the most noxious species with us, the Striped Blister-beetle, the Ash-gray Blister-beetle, and the Black Blister-beetle will suffice to give an idea of the whole tribe. Of these varieties Dr Riley says: The Striped Blister-beetle is almost exclusively a southern species, occurring in particular years very abundantly on the potato vine in Central and Southern Illinois, and in our own State, though according to Dr. Harris, it is also occasionally found even in New England. In some specimens, the broad outer black stripe on the wing-cases is divided lengthways by a slender yellow line, so that instead of *two* there are *three* black stripes on each wing-case; and in the same field all the intermediate grades between the two varieties may be met with; thus proving that the four-striped individuals do not form a distinct species, as was formerly supposed by the European entomologist, Fabricius, but are mere varieties of the same species to which the six-striped individuals ap-pertain. The Ash-gray Blister-beetle (*Lytta cinerea*, Fabr) is the one commonly found in the more northerly parts of the Northern States, where it usually takes the place of the Striped Blister-beetle figured above. It is of uniform ash-gray color; but this color is given it by the presence upon its body of minute ash-gray scales or short hairs, and whenever these are rubbed off, which happens almost as readily as on the wings of a butterfly, the original black color of its hide appears. It attacks not only potato vines, but also honey-locusts, and especially the English or Windsor bean, and the Early Snap bean. It also attacks the foliage of the apple-tree, and likewise gnaws into the young fruit. The Black-rat Blister-beetle (*Lytta murina*, Le Conte,) is sometimes found upon the potato in the month of July, and early in August. The Black Blister-beetle (*Lytta atrata*, Fabr.) is very similar in appearance to the Black-rat Blister-beetle; the latter being distinguishable from it only by having four raised lines placed lengthwise upon each wing-case and by the two first joints of the antennæ being greatly dilated and lengthened in the males The Black Blister-beetle appears in August and September, and is very common on the flowers of the Golden-rod. The Margined Blister-beetle (*Lytta marginata*, Fabr) may be at once recognized by its general black color, and the narrow ash-gray edging to its wing-cases. It usually feeds on certain wild plants, but also on potatoes. The same means of destruction will apply equally to all of the Blister-beetles. Let it be remembered that during the heat of the day, these beetles are ready with their wings and may be driven from the vines. Thus the most practical and efficient mode of destroying them, is to drive them into a windrow of hay or straw, and kill them by setting fire to it. They may also be driven entirely from a field, when the weather is warm, by continued noise. If they can find feeding grounds outside they will not return. Occasional seasons, however, produce them so abundantly, and they swarm so suddenly, that all ordinary means of prevention from damage fail entirely.

CAPERS. The caper is a small prickly shrub, cultivated in Spain, Italy and the southern provinces of France. The large rose-formed flowers are pretty, but the flower buds alone are used in culinary art. They are plucked before they open and thrown into strong vinegar, slightly salted, where they are pickled. The crop of each day is added to the same vinegar tub, so that, in the course of the six months during which the caper shrub flowers, the vessel gets filled, and is sold to persons who sort the capers by means of sieves. The smallest are the most valued. The capers of commerce in the French market are distinguished into five sorts, the nonpareille, the capucine, the capote, the second and the third; this being the decreasing order of their quality, which depends upon the strength of the vinegar used in pickling them, as also the size and color of the buds, the smaller buds being superior. The shrub grows in the dryest situations, even upon walls, and does not disdain any soil; but it loves a hot and sheltered exposure. It is multiplied by grafts made in autumn, as also by slips of the roots taken off in spring.

CAPILLARY ATTRACTION. Some fluids rise in fine glass tubes much higher than their level. This elevation is said to be owing to capillary attraction. It occurs to greater extents as the tubes are finer, and is an affinity exerted by the sides of the glass upon the fluid. The cause has been shown to be electrical, and to depend upon the electrical conditions of the tube and fluid. If there be no affinity the fluid sinks. The minute tubes of plants assist in drawing up the sap by this attraction. So also if threads of wool are placed inside a vessel of liquid, and extends over the edge, the liquid will rise, and, passing along the medium, drip from the ends. The moisture of the earth rises in the same manner, being communicated from one particle to another. If the soil is very coarse this is not easily accomplished. Hence the necessity that a soil be rather compact, to induce the attraction of moisture from beneath and enable it to withstand drouth.

CAPILLARY VESSELS. The minute vessels which exist over every part of the bodies of animals and plants.

CAPITULUM. That species of inflorescence in which the flowers are grouped together into a head, as in clovers.

CAPON. A male bird that has been castrated. The removal of the organs of generation not only improves the flavor of the flesh, but the weight also, often to double that of ordinary birds. Caponizing is performed on Barnyard (Gallinaceous) fowls.

CAPPED ELBOW. This is a callus or tumor formed by a bruise of the shoe in the horse in lying down. It is found on the point of the elbow, near the chest, and behind the shoulder. Capped hock is a soft swelling on the point of the hock. Capped knee is a soft tumor in front of the knee. In whatever place the difficulty lie, if there is matter forming, it must be brought to a head, by the application of poultices, and allowed to heal with simple dressings. If it has assumed a hard, indurated form blistering must be resorted to. In the case of capped elbow, the callus is sometimes dissected out. Except in the case of a valuable horse, it will hardly pay to use any but simple means to remove the affliction.

CAPROIC ACID. One of the rancid acids of butter. Capric acid is very similar.

CAPSICUM. The generic name of the red pepper.

CAPSULE. In botany, a dry, membranous seed-vessel, generally splitting spontaneously into several parts, or valves. In chemistry, a thin porcelain or other ware standing heat, or a metallic basin for evaporating fluids.

CARAWAY. The seed of *Carum carui*, used in confections and medicine, grateful to the stomach, and slightly stimulant. The seeds are sown in drills six inches apart, early in spring. The plants must be weeded and hoed, or the land otherwise kept clear. They flower in June, and the seeds ripen in autumn. The roots are perennial, and yield well for three years. As much as a ton of seed is taken from an acre in good tilth, but it is an exhausting crop, and in the United States is not much cultivated.

CARBON. Carbon is one of the most common, as it is one of the most important substances in nature, occurring in a great variety of forms, in the animal, vegetable and mineral kingdoms. In both the vegetable and animal kingdoms it is the most considerable element. Charcoal may be considered the type of carbon, since, prepared from animal and vegetable substances, it is pure, or nearly so. Lampblack is also nearly pure carbon. The carbon of anthracite coal is pure. The diamond is crystallized carbon, and when colorless, is pure and uncontaminated. Carbon resists the influence of many re-agents which powerfully affect other bodies, and to the farmer it is one of the most important of the elements. In vegetation it is taken up by plants as carbonic acid. If one atom of carbon is combined with two atoms of oxygen, it forms carbonic acid, and these elements compose the organic part of all plants. This is contained in the air alone in sufficient quantity for the growth of plants. Although the air contains only 1-10,000th parts of carbonic acid, yet so enormous is the supply that the atmosphere of the earth contains 3,400,000,000,000 tons of carbonic acid or about twenty-eight tons for each acre of the earth's surface. The supply is maintained by the oxydation of carbon in the decay of all organic matter, in the respiration of animals, and in the combustion of fuel. In the animal economy carbon is one of the most essential elements. Starch, sugar and the gum of plants, furnish carbon. The fat of animals is largely composed of carbon, and large amounts are exhaled in the form of carbonic acid by animals in the act of breathing. Carbon constitutes about 42.47 per cent. in sugar, 41.906 per cent. in gum, 43.55 per cent. in wheat starch, 52.58 per cent. in the wood of the oak, and 51.45 in that of the beech; 46.83 in pure acetic acid or vinegar, 36.167 in tartaric acid, and 41.369 in citric.

CARBONATES. Minerals or salts containing carbonic acid. These are all readily known by the effervescence they produce when thrown into strong acids. The principal native carbonates are marble, limestone, and chalk, which are carbonates of lime.

CARBONIC ACID. The gas formed by burning charcoal in the open air. It is also given out from fermenting and putrefying bodies. It is colorless, heavy, incapable of sustaining combustion, suffocating, and soluble in water. It is formed of one atom of carbon (6) and two of oxygen (16) and unites with oxides in the proportion of 22. Fertile soils containing vegetable matter give it off during their decay. It is one of the principle articles of vegetable nutriment since from carbonic acid is obtained the carbon of their wood, sugar, and other principles. Light decomposes it in plants, and a part of its oxygen is thrown out by the leaves. The dissolved carbonic acid in rain and spring water is invaluable in the soil, serving to disintegrate hard rocks and dissolve minerals necessary for plants. It is this gas that gives sprightliness to beer, soda water, champagne and other effervescing fluids.

CARBONIC OXIDE. An inflammable gas consisting of one atom carbon and one oxygen.

CARBONIFEROUS. Relating to coal. Coal bearing. The carboniferous age is that geological age in which limestone and other carboniferous rocks and minerals were formed. So also the coal fields of the earth were formed during the carboniferous age.

CARBURETS. Compounds in which carbon is united with a metal or other body. Plumbago (black lead) is a carburet of iron and one of the purest forms of carbon.

CARBURETTED HYDROGEN. Marsh gas, and the gas used for lighting cities.

CARCINOMA. A cancerous tumor.

CARDAMOMS. The seeds of the *Alpinia cardamomum* of the East Indies. They are used as an aromatic.

CARDIAC. Relating to the heart.

CARDOON. The *Cynara cardunculus.* The stalks of the blanched inner leaves are used as salad, in soups, etc., the seed is sown in April, in rich earth; it requires nearly a month to start; the plants must be thinned to five inches apart. Transplant in June, and allow four feet each; dress each plant like celery. As they grow tie up the leaves and earth up several times; they may thus be obtained two feet high. They are to be taken up during winter, like celery. They are in perfection from autumn through the winter. An ounce of seed produces 600 young plants. For seeds protect the plant without blanching, through the winter, and it will flower in the following July. The cardoon is scarcely cultivated in the United States.

CARDUUS. The generic name of numerous thistles. (See Thistles.)

CAREX. The genus of sedges and rushes.

CARIES. Mortification or ulceration of any bone. It gradually produces the destruction of the part, and can only be arrested by scraping out every diseased portion. Rotten bone, Necrosis, is a decay of the bone, from founder, poll-evil, or inflammations attacking the bone. The treatment consists in cutting down to the bone, scraping it, and removing all decayed parts; then wash the wound with diluted carbolic acid. This should be performed by a veterinary surgeon, or one who understands the anatomy of the horse. Caries of the face is called Big Head. This form is scarcely ever worthy an attempt at cure, even in the case of a valuable breeding animal, since it is no doubt hereditary, in some cases at least.

CARMINATIVE. Any medicine that dispels flatulency and relieves the uneasiness of the stomach. The best are caraways, ginger, aniseseed, cardamoms, especially as tinctures or dissolved in alcohol. Caraways powdered in doses of half a teaspoonful given in warm water, repeated if necessary, is one of the best remedies known for simple colic or flatulency. For torpidity of the digestive organs, a dose in the food may be given a horse once or twice a week with benefit.

CARNIVORA. The race of animals that live on animal food. Carnivorous: eating animal food.

CAROTID ARTERY. The large arteries that carry blood to the head. There is one on each side of the neck, known by their strong pulsation.

CARPEL. Each division or cell of a fruit is a carpel. The number of carpels, or carpellary leaves, is as the number of divisions in the pistil. which is the uppermost part of the carpel.

CARROT. This esculent root, (*Dancus carota*) is a half hardy biennial in the North, and is said to be indigenous to some parts of Great Britain. Wild, it is of no value; as a cultivated plant, it is used in various ways for the table, and is one of the most valuable roots cultivated for stock. The carrot should have a good light, rich loam. If manured, it should have been done the previous year, since green manure causes all esculent roots to grow forked and otherwise ill-shaped. The soil should be carefully and deeply plowed, brought into a state of fine tilth, and leveled smooth. In the kitchen garden, the drills may be as near as twelve inches, the plants thinned to three inches, and subsequently to six inches if large roots are desired In field culture the rows are made two feet apart, for ease in horse cultivation, and the seed should be sown pretty thickly and at a depth of three quarters of an inch to one inch. All weeds must be kept down, and the plants ultimately thinned to a distance of three or four inches apart Sow in the spring, as soon as the ground is in good working condition. On loams it is better that the ground be fall-plowed rough, and the soil brought into tilth before sowing. All farm stock are fond of the roots. They are especially valuable for horses and milch cows, fed at the rate of a peck a day for horses, and half a bushel per day for cows. For garden culture, the Early Horn is the most desirable for summer, and Early Half Long Scarlet for winter. The latter is also a good field variety. For field crops, the Yellow Intermediate, Long Orange, and Altringham are generally sown, the Belgian and other European field carrots not being in repute in the United States. An ounce contains 24,000 seeds, and will sow from 150 to 200 feet of garden drill. Three or four pounds per acre are usually sown in field culture, and the plants thinned first with a narrow tool, and subsequently by hand in weeding.

CART-HORSE. (See English Cart-horse.)

CARTILAGE. The same as gristle. It is almost identical in composition with skin, and yields, when perfectly dry, eighteen per cent. of nitrogen. It is one of the proteine compounds

CARYA. The generic name of the hickory, which see.

CARYOPHILLOUS. Flowers like the pink and clove are so called.

CASCARILLA BARK. The bark of a tree, *Croton eleutheria*. A drug having powerful tonic and aromatic qualities.

CASEINE. A substance identical in its composition and properties with legumin, hence called Vegetable Caseine, and found in certain leguminous plants. Caseine is the curd or coagulable portion of milk from which cheese is made. It is one of the proteine bodies, or albuminoids, divided into three sub-groups, the type of the first being albumen, nearly pure in the white of eggs; of the second fibrin, or animal muscle; of the third, caseine, or the curd of milk. Caseine, therefore, may be either animal or vegetable. Caseine contains in addition to carbon, oxygen and hydrogen, from fifteen to eighteen per cent. of nitrogen, with a small quantity of sulphur, and sometimes phosphates. Its chemical composition is as follows:

PARTS.	Animal.	Vegetable.
Carbon	53.5	53.5
Hydrogen	7.0	7.1
Oxygen	23.7	23.4
Nitrogen	15.8	16 0
	100.0	100.0

Caseine constitutes the most nourishing portion of milk, and, as a rule, those foods are most nourishing which contain the greatest portion of caseine.

CASEOUS and CASEUM. (See Caseine.)

CASHMERE GOAT. (See Goat.)

CASSAVA. The starch obtained from the roots of the *Jatropha manihot* of the West Indies.

CASTANEA. The generic name of the chestnut-tree.

CASTOR-OIL BEAN. *Ricinus communis*, sometimes called *Palma Christi*, from the shape of its leaves. In the tropics this plant attains an immense size and lives for years. In Texas it strongly shows this perennial tendency. It is cultivated for its seeds, from which is expressed the well-known Castor Oil of commerce, once used solely as a medicine, but now used as a lubricator and for other purposes in the industries. It is cultivated as far north as 40 degrees, and constitutes an important agricultural industry. As showing its perennial tendency, and also yield at the South, we find that B. C. Franklin, of Galveston, had a plant in his garden the stem of which was seven inches in diameter, and that it had yielded seed for eight years. Captain Slaight, of Chapel Hill, relates a similar experience. Mr. McIntire, of Washington, reports having raised seventy bushels per acre, and E. Bell, of Gonzales, raised an hundred bushels on one acre. The plant is quite obnoxious to insects, and its freedom from their ravages is a strong point in favor of its culture in sections ravaged by locusts. The principal losses attending its cultivation in the extreme South arise from planting the small, light-colored bean of Missouri and Illinois, instead of the large seed appropriate to the climate of Texas and Florida; from planting too thickly; and from mismanagement at harvesting. In the North the yield is from ten to thirty bushels per acre, according to soil and cultivation. It is not much cultivated north of 40° of latitude. The soil best suited to the plant is a light, rich, sandy loam, although any dry, fertile soil will produce good crops. In the South the seed is planted in rows six feet apart. In the North it is planted at almost the same distance as Indian corn, leaving rows at suitable intervals wide enough so a horse and light sled may pass along in gathering the seeds. Three or four seeds are usually planted, since the cut worms sometimes ravage the young plants. When the plants are six inches high they are thinned to one plant, the cultivation being precisely similar to that of Indian Corn. The seeds begin to ripen from the first to the 20th of August, according to latitude, and will continue to ripen until the plants are killed by frost. Before the ripening of the seeds, a yard for spreading the pods must be prepared. This is generally selected on some knoll, or other hard, dry spot. The ground is cleared and beaten perfectly hard and smooth, and if declining slightly to the sun so much the better. The first ripenings should stand until the pods on the spikes begin to crack. Later the spikes may be cut as soon as two or three beans begin to open. They are carried to the drying yard and spread thinly. The heat causes the beans to pop out of the pods. In warm weather two or three days will suffice. When all are cut, the heads are raked off, and the seed cleaned through a fanning mill, with a suitable screen, and then spread on a floor, or other suitable place, safe from rain, being turned occasionally until quite dry. When the plantation is sufficiently extensive it is better that drying houses be prepared for the pods, and also moderate kilns for drying the beans; for thus much loss is obviated, in drying, from wet weather, and also from mold in the packages in which the beans are packed. But in dry countries, as California this is not necessary. The analysis of Castor Oil Beans, French and American, is stated to be as follows:

PARTS.	I.	II.	III.
Moisture	4.40	4.35	4.10
Oil	46.95	47.78	45.55
Matter extracted by alcohal and water	6.35	4.20	4.40
Starch	8.875	9.81	12.50
Albuminoids	3.788	3.10	2.40
Cellulose	25.50	27.22	27.70
Inorganic matter	2.90	2.90	2.94
	98.763	99.36	99.59

No. I represents the composition of a sample of *Ricinus sanguinarius* grown in Texas; No. II, the same variety grown in France; while No. III represents that of a sample of *Ricinus minor* grown in France. It thus appears that, so far as the oil-contents of the seeds are concerned, the American sample is about as valuable as the European. The following are the results of an analysis of the mineral matters contained in the beans of the *Ricinus sanguinarius:*

Lime	11.31	Chlorine	0.89
Magnesia	7.33	Potassa	29.52
Peroxide of iron	0.89	Soda	8.75
Phosphoric acid	38.65		
Sulphuric acid	2.21		99.56

In the West, Southern Illinois, Central Missouri and Kansas, large quantities of Castor Beans are grown for the oil, and this industry is on the increase in Central and Southern Kansas.

CATALPA. Of this most valuable timber and ornamental tree there are two varieties, *Catalpa bignonioides* and *C. speciosa*, both North American species of excellence, although the variety *speciosa* was discovered and named many years ago by Dr. Warder. The two species, until within the last few years, have, even by able botanists, not been considered distinct. The variety *bignonioides* is decidedly tender north of 40 degrees. It is a more spreading tree in its habits than *C. speciosa*, which variety is the tree native to the West and indigenous to the forests of Central Indiana and Illinois, and the South, and hardy up to the latitude of 43 degrees. It is a tree worthy of extensive planting everywhere south of 42°, being a fast growing tree, erect and reaching a height of eighty to ninety feet, with a diameter of two feet in its native forests. It is among the most valuable of western trees for posts, or any use where extreme durability is required. It is superior to white cedar in respect to lasting qualities, and the timber takes a fine polish. Its leaves and flowers are handsome. The leaves put forth late and are cast after the first frost. The seeds are contained in a long, slender cylindrical pod, often eighteen inches long. The seeds are arranged in a long, narrow, membranous wing, peculiarly feathered. The committee on Forestry of the Iowa Horticultural society, 1877, says of it: A variety now grown quite extensively in central Iowa seems as hardy as any of our native trees. The writer (presumably Mr. J. L. Budd) has trees now five years set, large enough for small posts for wire fences, which have had open exposure north of 42d parallel, during the past severe winters. Dr. Warder, Mr. C. C. Barney of Ohio, Mr. E. Y. Teas, of Indiana, Robert Douglas and Jonathan Periam, of Illinois, and others, have done much to bring this valuable tree to notice, and this under the continual antagonism of some eastern scientific men, who have persisted in stating that there is but one variety The discussion on the catalpa is now substantially closed. It is demonstrated beyond doubt that the hardy variety, *C. speciosa*, is not only distinct, but is a tree native to our western forests, superior in habit and hardiness to *C. bignonioides*, and its equal in every other respect. Planters, however, should know the source from whence they get their seed. It is not safe even that they be gotten from western trees, since occasionally the tender variety, widely distributed from eastern nurseries, may be found growing in the west, and bearing seed. The seed of *speciosa* is somewhat larger than *bignonioides*, but the differences, either in the pod or seed, would not be noticed, except by a botanist It is easily raised from seed, grows fast, and is in every way a valuable tree anywhere south of 42°, and even north, in protected situations. Among the ornamental varieties not entirely hardy, *C. Bungei* is quite dwarf, and *C. Kæmpferi*, the Japan catalpa, is one of the most handsome.

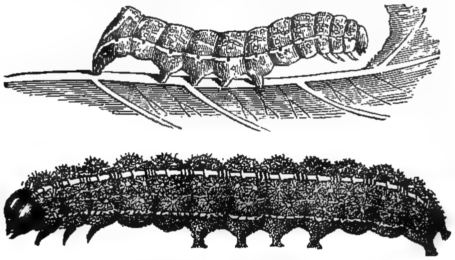
CATARACT. An affection of the eye causing blindness. Albugo, eye spot or white spot, causes defect in the eyesight. Moon blindness is periodic ophthalmia, or recurring at specific intervals until at length the animal becomes blind. In buying a horse examine the eyes particularly to see if they are exactly alike. If cataract is suspected, turn the horse's head from the strong light, dilate the eye by rubbing a little belladonna on the lid, shade the eye and examine carefully. Cataract is operated on by extracting or couching. By the first operation, an incision is made into the eye, and the opaque lens taken out; by the second, it is depressed by the point of a couching needle thrust into the eye, and, being carried to the lower part of the chamber of the eye or vitreous humour, it is left there to be absorbed. The first operation is the more effective, but the more hazardous of the two, owing to the inflammation which succeeds. The second is tedious and sometimes fails, but it is free from the risk of inflammation.

CATARRH. A cold. The irritation of the mucous membrane of the nostrils, a disease to which horses and especially hogs are subject in some of its forms. It may degenerate into nasal gleet, bronchitis, or chronic cough, influenza, etc. For cold in the head use no purgatives, or other harsh medicines. Do not bleed, or use irritants as drenches. This will apply also to all diseases of the breathing organs. Keep the animal warm, steam the nostrils with the steam of hot water in which a red hot iron is placed. Dissolve two or three ounces of nitre in a bucket of water for drink occasionally and, if necessary, one drachm each of belladonna and powdered camphor, made into a ball. If there is much fever, give two drachms each of ammonia and ether in half a pint of linseed oil or gruel. Good food and nursing, however, are all important

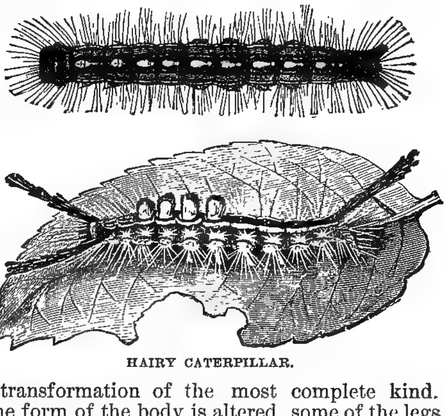
CATCH-DRAINS. The lower ditches of irrigated lands which receive the water, that has flowed over their surface, and return it to the stream.

CATECHU. A drug of a very astringent or binding nature. It is also used in dyeing browns and in tanning.

CATERPILLAR. Caterpillars are the young or larvæ of butterflies and moths, and being all vegetable eaters and extremely voracious, inferior only to locusts and grasshoppers, may be classed as among the most destructive of insects to vegetation. They are found everywhere, in every climate where vegetation exists, and are exceedingly fecund. The females lay from 200 to 500 eggs each, so that of the nearly 4,000 species enumerated, as belonging to the United States, their numbers in prolific seasons are almost beyond calculation. Caterpillars exist in a great variety of forms, from almost microscopic ones up to the immense tobacco and tomato worm. We give cuts of two smooth and two hairy species, which will serve for illustration. Dr. Harris, in Insects Injurious to Vegetation, defines caterpillars as follows: Caterpillars vary greatly in form and appearance, but in general, their bodies are more or less cylindrical, and are composed of twelve rings or segments, with a shelly head, and from ten to sixteen legs. The first three pairs of legs are covered with a shelly skin, are jointed and tapering, and are armed at the end with a little claw; the other legs are thick and fleshy, without joints, but elastic or contractile, and are generally surrounded at the extremity by numerous minute hooks. There are six very small eyes on each side of the head, two short antennæ, and strong jaws or nippers, placed at the sides of the mouth, so as to open and shut sidewise. In the middle of the lower lip is a little conical tube, from which the insects spin the silken threads that are used by them in making their nests and their cocoons, and in various other purposes of their economy. Two long and slender bags, in the interior of their bodies, and ending in the spinning tube, contain the matter of the silk. This is a sticky fluid, and it flows from the spinner in a fine stream, which hardens into a thread so soon as it comes to the air. Some caterpillars make but very little silk; others, such as the silk-worm and the apple-tree caterpillar, produce it in great abundance. Some caterpillars herd together in great numbers, and pass the entire period of their existence in society; and of these there are species which unite in their labors, and construct tents serving as a common habitation in which they live, or to which they retire occasionally for shelter. Others pass their lives in solitude, either exposed to the light and air, or sheltered in leaves folded over their bodies, or form for themselves silken sheaths, which are either fixed or portable. Some make their abodes in the stems of plants, or mine in the pulpy substance of leaves; and others conceal themselves in the ground, from which they issue only when in search of food.


SMOOTH CATERPILLAR.

Caterpillars usually change their skins about four times before they come to their growth At length they leave off eating entirely, and prepare for their first transformation. Most of them, at this period, spin around their bodies a sort of shroud or cocoon, into which some interweave the hairs of their own bodies, and some employ, in the same way, leaves, bits of wood, or even grains of earth. Still other species of our caterpillars suspend themselves, in various ways, by silken threads, without enclosing their bodies in cocoons; and, again, there are species which merely enter the earth to undergo their transformations. When the caterpillar has thus prepared itself for the approaching change, by repeated exertions and struggles, it bursts open the skin on the top of its back, withdraws the fore part of its body, and works the skin backwards until the hinder extremity is extricated. It then no longer appears in the caterpillar form, but has become a pupa or chrysalis, shorter than the caterpillar, and at first sight apparently without a head or limbs. On close examination, however, there may be found traces of a head, tongue, antennæ, wings and legs, closely pressed to the body, to which these parts are cemented by a kind of varnish. Some chrysalides are angular, or furnished with little protuberances; but most of them are smooth, rounded at one end, and tapering at the other extremity. While in the pupa state these insects take no food, and remain perfectly at rest, or only move the hinder extremity of the body when touched. After a while, however, the chrysalis begins to swell and contract, till the skin is rent over the back, and from the fissure there issues the head, antennæ, and body of a butterfly or moth. When it first emerges from its pupa-skin the insect is soft, moist and weak, and its wings are small and shriveled; soon, however, the wings stretch out to their full dimensions, the superfluous moisture of the body passes off, and the limbs acquire their proper firmness and elasticity. The conversion of a caterpillar to a moth or butterfly is a transformation of the most complete kind. The form of the body is altered, some of the legs disappear, the others and the antennæ become much longer than before, and four wings are acquired. Moreover, the mouth and digestive organs undergo a total change; for the insect, after its final transformation, is no longer fitted to subsist upon the same gross aliment as it did in the caterpillar state; its powerful jaws have disappeared, and instead thereof we find a slen-

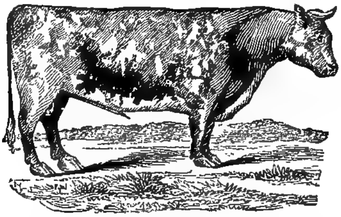

HAIRY CATERPILLAR.

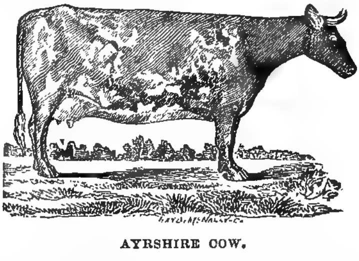
der tongue, by means of which liquid nourishment is conveyed to the mouth of the insect, and its stomach becomes capable of digesting only water and the honeyed juice of flowers. Ceasing to increase in size, and destined to live but a short time after their final transformation, butterflies and moths spend this brief period of their existence in flitting from flower to flower and regaling themselves with their sweets, or in slaking their thirst with dew, or with the water left standing in puddles after showers, in pairing with their mates, and in laying their eggs; after which they die a natural death, or fall a prey to their numerous enemies. These insects belong to an order called *Lepidoptera*, which means scaly wings; for the mealy powder with which their wings are covered, when seen under a powerful microscope, is found to consist of little scales, lapping over each other like the scales of fishes, and implanted into the skin of the wings by short stems. The body of these insects is also more or less covered with the same kind of scales, together with hair or down in some species. The tongue consists of two tubular threads placed side by side, and thus forming an instrument for suction, which, when not in use, is rolled up spirally beneath the head, and is more or less covered and concealed on each side by a little scaly or hairy-jointed feeler. The shoulders, or wing-joints, of the fore wings are covered, on each side, by a small triangular piece, forming a kind of epaulette, or shoulder-cover; and between the head and the thorax is a narrow piece, clothed with scales or hairs, sloping backwards, which may be called the collar. The wings have a few branching veins, generally forming one or two large meshes on the middle. The legs are six in number, though only four are used in walking by some butterflies, in which the first pair are very short, and are folded like a tippet on the breast; and the feet are five-jointed, and are terminated, each, by a pair of claws. It would be difficult and, indeed, impossible to arrange the lepidopterous insects according to their forms, appearance and habits, in the caterpillar state, because the caterpillars of many of them are as yet unknown; and therefore it is found expedient to classify them mostly according to the characters furnished by them in the winged state. We may first divide the *Lepidoptera* into three great sections, called butterflies, hawk-moths, and moths, corresponding to the general *Papilio*, *Sphinx*, and *Phalænæ* of Linnæus. The butterflies (*Papiliones*) have thread-like antennæ, which are knobbed at the end; the fore wings in some, and all the wings in the greater number, are elevated perpendicularly, and turned back to back, when at rest; they have generally two little spurs on the hind legs, and they fly by day only. The hawk-moths (*Sphinges*) generally have the antennæ thickened in the middle and tapering at each end, and most often hooked at the tip; the wings are narrow in proportion to their length, and are confined together by a bristle or bunch of stiff hairs on the shoulder of each hind wing, which is retained by a corresponding hook on the under side of each fore wing; all the wings, when at rest, are more or less inclined like a roof, the upper ones covering the lower wings; and there are two pairs of spurs on the hind legs. A few fly by day, but the greater number in the morning and evening twilight. In the moths (*Phalænæ*) the antennæ are neither knobbed at the end nor thickened in the middle, but taper from the base to the extremity, and are either naked, like a bristle, or are feathered on each side; the wings are confined together by bristles and hooks, the first pair covering the hind wings, and are more or less sloping when at rest; and there are two pairs of spurs to the hind legs. These insects fly mostly by night.

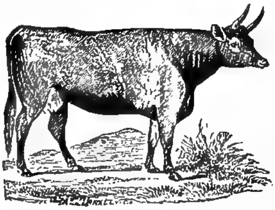
CATHARTICS. Medicines producing increased defecation. Aloes, castor oil, senna, jalap, Glauber salts, Epsom salts and calomel are the principal cathartics. They should be used sparingly in man or beast, as they produce habitual costiveness after a time. In fact, strong cathartics are but little known in veterinary practice, as they are also by the modern school of physicians. Hence if they are considered necessary, it is better to consult professional advice.

CATKIN. A pendulous spike of flowers, which falls after a season, as in the willow. *Amentum* has the same meaning.

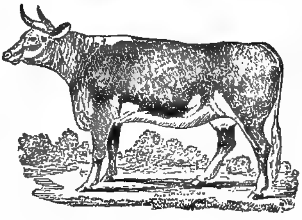
CATTLE. In the United States the term cattle is usually applied to the ox species, though sometimes to all horned animals. In England they are termed neat cattle. In a primary sense however, the term cattle included not only horned animals, but horses and asses and, it has been supposed, swine. We should use it in its distinctive acceptation to mean the genus *bos*, or the ox tribe. The distinctive features of domestic cattle are smooth, round, more or less curved horns, forehead flat, longer than it is broad, the horns placed at the two extremities of a projecting line at the top of the forehead. In all domestic cattle, except in certain well fixed breeds, the colors vary exceedingly, no two animals being alike, varying from pure white to jet black, running through all the shades of brown, red, dun, gray, and blue, including brindled, mottled, piebald, spotted and flecked. The Devons are the purest and most uniform in color, being light and mahogany bay. The Short-Horns, originally mottled and flecked, or spotted are, of late years, being bred more to self colors. The Ayrshires run to roan and piebald; the Holstein to black and white definitely marked;


AYRSHIRE BULL.

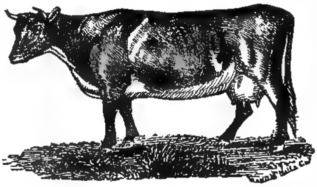

AYRSHIRE COW.



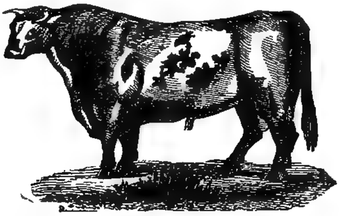
DEVON COW.



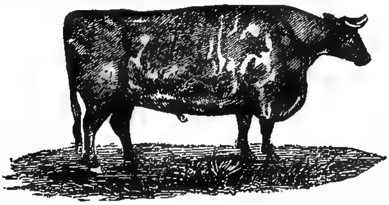
HEREFORD COW.



DURHAM COW.



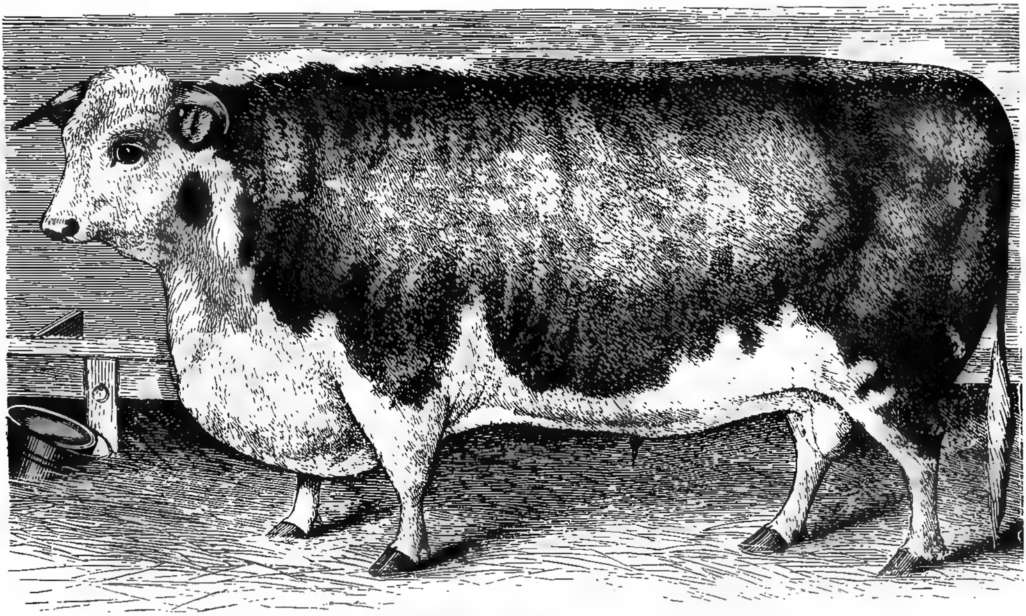
DURHAM BULL.



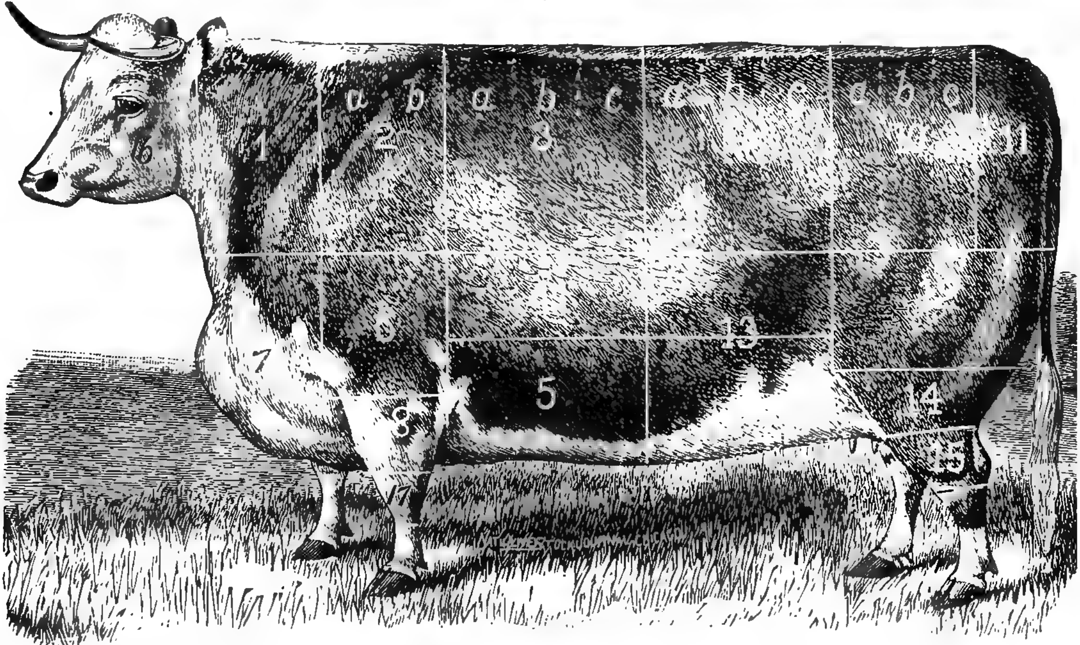
NEW LEICESTER.

the Kyloes, to black, black red, and brindle, and the Herefords to red with white faces and flanks, and the Alderneys to yellow red and black, or fawn color, with black points. In the Campagna there is a breed of large gray and mouse-colored cattle. In Calabria there is a breed of snow-white cattle. The so-called wild cattle of Chillingham are white or dingy white, with black noses, horns and hoofs, the ears tipped either black or red. In Hungary there is a curious breed of gray, or dark blue cattle, with immense, widespread horns. The Hindoo or Brahmin cattle have short reflected horns, large pendulous ears, an enormous hump, and a dewlap of solid, fatty matter. Their hair is exceedingly sleek and smooth, and they never seem to be affected by the most intense heat of that oven-like climate. As showing something of the cattle of the last century in England, and by comparison with improved stock of the present day, as illustrated in other portions of this work, we give cuts, reproduced from a work of the last century, illustrating Ayrshire, Devons and Hereford cattle, three of the most celebrated of the old breeds of England, as they were known years ago. The Durhams, now called Short-Horn, were among the most noted of the beef breeds of England in the latter part of the last century. The New Leicester, during its short-lived celebrity, it having soon degenerated after the death of Bakewell, must have been a magnificent beef animal if we may credit the illustrations that have come down to us. The cuts illustrating the New Leicester and Durham of the last century, will show what they were like. These and the ones preceding them in this article were reproduced by photo-engravings,from the originals of the last century. Where cattle first originated, or when first domesticated, is lost in obscurity nor can you now find the animal in a wild state, except when escaped from domesticity. It is indeed recorded that Jubal, the son of Lamech, was the father of such as have cattle, but the term might mean other domestic animals, as the sheep or goat. That horned cattle were early domesticated is evident from the fact that the ancient Egyptians worshiped the bull, and the traditions of every Celtic nation, acknowledge the cow as among the earliest servants of man, and represent her as having divine attributes. L. F. Allen, in American Cattle, gives their history and introduction into America in the following words: The genus *Bos*, as a domesticated animal, has been the useful and cherished companion of man from the earliest date of history, either sacred or profane. That they were highly valued in days most ancient, we may know, from their being objects of labor, sacrifice, and worship, by different nations and people. They were esteemed articles of wealth and sources of prosperity, and were probably cared for and cultivated with equal solicitude as any other domestic animal attached to husbandry, or of use as food. What was their normal condition as to race or breed, as we understand races and breeds, little or nothing is known, nor is it necessary that we do know. That they were then, in their chief essentials, as now, we have no reason to doubt; and that they may have been improved, or that they deteriorated in condition as civilization progressed, or waned, with the people who held them in subjection, we have no reason to question. The hieroglyphics of Egypt, most ancient in date, rude as were their representations of man, things, and animals, give us no accurate likeness of what they might have been among that ingenious and wonderful people, and they were probably as highly cultivated among them as anywhere else in contemporary times. The earliest representations or pictures we have, give them rugged forms, enormous length of upright, or spreading horns, and a gaunt appearance. The climates of the East permitted them to live throughout the year in the open air, and we may well suppose that nature supplied them with the rough, long hair necessary for their protection, so usually represented in their portraits by the artists of more civilized nations. In the modern world, among the more highly cultivated classes of society, in polite literature it has been considered vulgar to speak of cattle, or illustrate them other than as appendages to scenery, landscape, and rural representations among a rude and uncultivated people. So, too, with artists. The latter have composed cattle scenes, and introduced them as accessory to landscapes in their paintings, and so grossly have they misrepresented their forms for artistic effect, as to caricature and give the ugliest appearance to them. Claude

Lorraine, Salvator Rosa, Poussin, and others of the most celebrated schools of landscape painting of olden time, as well as Paul Potter, Van Ostade, and others of more modern date, made their cows, bulls, and oxen vulgar and uncouth in shape, and wretched in condition. Even landscape painters of the present day, with a silly affectation of art, will put nothing resembling the noble contour of our improved cattle into a picture, but select some unhappy brute, depleted with poverty, and unkempt as a wild buffalo in appearance, to give piquancy and effect to their drawings. For such slanderers of these noble animals, we have no respect whatever, nor for the taste of artists in the way of cattle, while yielding an unqualified admiration to their fidelity and skill in other subjects. Our modern animal painters have done better. Landseer and Herring, among the English artists, have accorded somewhat of justice to their objects, while some of the Continental and American artists in that line, have drawn our improved domestic animals—cattle as well as others—with admirable truth and fairness. The ancients had a high respect and admiration for their cattle. We cannot admire the Egyptian worship of their ox, apis—a magnificent tomb of which has been recently exhumed—nor do we look with complacency on the present worship of the Brahma bull, which has been from time immemorial, an object of Pagan idolatry in India; but it is evident that these subjects of adoration originated in a most devout appreciation of the admirable and useful qualities of the genus to which they belonged. The author of the book of Job, which the eminent sacred chronologist, Dr. Hales, dates back to the year 2,337 before the Christian Era—whether the author was Job himself, or one of his cotemporaries—had a most poetic appreciation of the value of domestic animals. He makes Job, in the days of his revived prosperity, the owner of one thousand yoke of oxen, in the enumeration of his great wealth of goods and chattels. Jeremiah—B.C. 628 years—in one of his prophesies, speaks of a fair heifer. Among the Pagan writers, Homer, 1800 years before the Christian Era, celebrates the noble bullocks with golden knobs, or balls, on the tips of their horns, and describes the manner of the artisan in putting them on. Among the heathen deities, Juno is named as ox-eyed, in those clear and liquid features of her countenance. Virgil, who wrote his Georgiacs just before the birth of Christ, celebrates the beautiful cattle of the Roman Campagnas, and their value in the agriculture of the people. Oxen were used for labor in husbandry, and more or less in commerce, in all countries where neat cattle were kept, and could endure the climate well, as being the most convenient beast of burden. It is probable that they were bred in their best estate by those who used them, and the cows were cultivated for dairy and household uses in the family. As they spread West and North into the higher latitudes and elevations of Europe, they somewhat changed their characters, and became, as now known there, acclimated and fitted to their new conditions, and inured to the habits of the people who kept them. We may suppose, too, that in the severer climates they were afforded somewhat of shelter, and more pains-taking in food and treatment, than in the milder latitudes where they had long ranged, and with such increased care, improved in quality and appearance. They took, possibly, somewhat different shapes, and conformed, more or less, to the uses to which they were subjected. The Moors of Spain reared great herds of neat cattle, and from them descended the dominant races of Spanish herds. They were there the progenitors of the savage and headstrong bulls still sacrificed in the arena of bull-fights and picadores. The Gauls of France, bred the gentler and more economical forms of cattle, adapted to a better husbandry. By what gradual, peculiar, or natural progresses these European cattle acquired their present distinctive characteristics, we have no definite information. History is either altogether silent or obscure on these subjects, and we have no better guide than conjecture to inform us. Throughout Western Europe numerous different breeds exist, of diverse qualities, all more or less useful for the purposes to which they are applied, and profitable to the people who breed and rear them Italy, France, Spain, Germany, Switzerland, Holland, and other northern countries, each have their peculiar national breeds, while England, Scotland and Ireland have many varieties widely divergent in character and appearance. Indeed, it is not necessary, unless for speculation or curiosity, that we know the particulars of their history or progress, inasmuch as we, in America, are already in possession of the best breeds of Western Europe, fully answering our own immediate purposes, and which have been successfully naturalized on our soil. It has been said, or conjectured, by some speculative antiquarians, that neat cattle were introduced to the Continent of America by the Northmen, who are supposed to have made a descent on to the coast from North-western Europe some centuries before the discovery of the Continent by Columbus. This, however, is simply a conjecture, as no cattle were known of here before they were brought out by the Spanish and Portuguese emigrants, a few years after the voyages of Columbus. In the year 1519, the Spaniard, Cortez, discovered Mexico. He first made a landing at Vera Cruz, and not long afterwards penetrated to the City of Mexico, then ruled by Montezuma. The object of Cortez and his party was conquest. They were accompanied by a troop of horses, on which his cavalry was mounted for military purposes; but we have no account of any cattle in his expedition. Mexico soon became a colony of Spain, and was rapidly settled by emigrants from that country. Their first object was gold, and trade with the natives, and to their acquisitions followed agriculture, which brought in cattle from Spain. We may suppose that cattle were introduced there as early as the year 1525, and in the mild climate and abundant pasturage which the country afforded, they rapidly increased. As Mexico became peopled and spread her population along the coast, and into the interior, in the course of time Texas was reached, and there were spread the foundations for the immense herd of Mexican, or, as we now call them, Texan cattle. California was afterwards settled by the Spanish Mexicans, who drove their cattle thither and, in time, scattered over it numerous herds. In what is now the United States, the first English settlement was made in Virginia, on the James river, in the year 1607, by a colony of an hundred men, which, by suffering, disease, and want of food, was reduced within a year, to thirty-eight. In 1609, by new emigrants, the colony was increased to five hundred persons; but in a few months they were reduced by death to sixty. Many cows were carried from the West India Islands to Virginia in 1610, and 1611. In succeeding years more adventurers came out, but in 1622, three hundred and forty-seven men, women and children were massacred by Indians, and the colony, in effect, broken up. Whether their cattle were also destroyed, we have no account; but the settlement was soon after renewed under better auspices and protection, and neat cattle were further introduced and propagated. New York was first settled in the year 1614, by the Dutch. That colony, after some vicissitudes, prospered. The first importation of neat cattle there, is said to have been in the year 1625, from the mother country, Holland, and they rapidly increased in numbers, both in breeding and further importation. In 1620, the English Plymouth colony landed in Massachusetts. In 1623, further English colonies came out and settled at Boston, and in New Hampshire. In 1624, the first arrival of cattle entered Massachusetts Bay. These were soon followed by other arrivals. New Jersey was settled by the Dutch in 1624, and Delaware by the Swedes in 1627, who brought cattle with them. The early records of New Hampshire state that in the years 1631, '32 and '33, Captain John Mason made several importations of cattle into that State from Denmark, to supply the Danish emigrants who had settled on the Piscataqua river These Danish cattle were coarse, large beasts, and yellowish in color Settlements were made in Maryland in 1633; in North and South Carolina in 1660 and 1670; and in Pennsylvania in 1682, all by the English, who either with the first settlers, or soon after, brought cattle over, chiefly from the countries nearest the ports from which they sailed. In all probability, numerous importations of cattle were annually made into the several colonies, during successive years, as the emigrants came in rapidly, and the few early importations, with their increase, were insufficient to supply their wants. That cattle multiplied, both by natural increase and importation, is evident. We see it recorded, that in the year 1636, a party of emigrants went out to settle the town of Northboro, Massachusetts, thirty miles west of Boston, and in a company of one hundred men, women and children, they drove with them one hundred and sixty cattle—and that was but twelve years after the first importation into the colony. From these diverse and miscellaneous beginnings, our native cattle originated. Of what distinctive breeds they were selected, if selected with reference to breed at all, we have no information, nor, at this distance of time, can we be at all certain. Distinct breeds did then exist, well defined in their characteristics, both in England and Scotland, and we are to presume, that needy and necessitous as the emigrants mostly were—going out for conscience sake, as many of them did, and in a hope to better their fortunes withal—they paid little regard to breed or race in their cattle, so that they gave milk, performed labor, and propagated their kind. As the colonists grew in numbers, and prospered in gear, their cattle, now become a leading branch of husbandry, aided much in their subsistence. Families of considerable wealth from home, began to add their numbers to the earlier emigrants, and brought with them domestic stock of various kinds, provided them forage, and gave them shelter, and in some instances, probably, selected choice specimens from favorite breeds in the localities from whence they came, with which to improve those previously imported, or their descendants, the then native


IMPROVED HEREFORD BULL.

herds. But in a new country, harassed by hostile savages, difficult of locomotion and intercourse with each other in distant settlements, their cattle were localized and confined to their own immediate neighborhoods. Pushing out into new districts only with the adventurous parties forming settlements, where they could, of necessity, pay little attention to selection or improvement in their herds, they took such as they had, or such as they could get, at the least possible cost, as browse for the first few years was their principal forage in winter, leeks in spring, and coarse grass in summer and autumn for pasturage. The best they could do was to provide food for their families, and let their cattle shift for themselves. We presume however, that the earlier colonists, having become well settled and thrifty in circumstances, cared well for their herds and measurably improved their quality. Thus, undoubtedly, stood the condition of the neat cattle of the colonies down into the years 1700, and after. We have accounts that, as the merchants of the sea-coast towns grew rich, some enterprising ones made importations of choice breeds from England, which were driven into the country neighborhoods, and very considerably benefited their common stock. In the year 1608, Quebec, in Lower Canada, was founded by the French, and soon afterwards, colonists came in considerable numbers from the western coast of France, and brought with them the little Normandy, or Brittany cattle, closely allied in blood, appearance and quality, to the Alderney cows of the Channel Islands. Their descendants are now propagated in all Lower Canada, and throughout the many French seignories in large numbers, forming their principal stock of neat cattle. They proved excellent milkers, hardy, easy of keep, and profitable for the dairy. They are also tolerable for the yoke, and for beef. In their remote distance, and limited intercourse with the people of the English colonies, it is not probable that their herds became intermixed. We have no accounts of the peculiar characteristics of the cattle then there. After nearly two hundred years of acclimation and breeding they show no relations with the New England stock of our Northern States. As showing the gradual improvement in the weight of cattle from the year 1700, and the rapid advance therein within the last fifty years, the following will be interesting: In the year 1710 the average weight of beef cattle of Smithfield was 370 pounds each. In a report of a select committee of the House of Commons in 1795 it is stated that since 1732 their cattle have increased in size or weight on an average one-quarter or twenty-five per cent. making the weight at that time (1794) 462 pounds. Few animals then were fatted, even to this light weight, under five years old, while thirty years later they were considered ripe at four years. At this last period we find a very striking improvement in the weight of cattle at Smithfield, 656 pounds being the average—an increase of nearly forty per cent. in thirty-five years; showing that the efforts for the improvement of the breeds of cattle were attended with far greater success than at first. Steadily within the last fifty years has maturity been attained earlier and earlier, so that now we have yearlings that will dress heavier than the four year olds of fifty years ago. Indeed, now, some of the improved breeds may be fattened ripe at the age of two years. According to the census of 1870 the number of cattle in the United States and territories, not including Texas and New Mexico, was 24,000,000. Those of Texas and New Mexico, were computed at 4,000,000. Of the improved breeds introduced into the United States the Herefords and Short-Horns are deservedly the most popular for beef and early maturity. The Devons as working cattle and in the quality of their flesh are acknowledged to be superior to any other. Of dairy cattle the Ayrshire originally brought from Scotland, the Jersey from the Channel Islands, and the Dutch and Holsteins from Holland, and Holstein, have merits of exceeding excellence. The Ayrshire and the Dutch and Holsteins are noted for large messes of milk, rich in caseine, and the Jersey and Guernsey as cows giving milk exceedingly rich in cream and consequently in butter. A writer in the report of the Commissioner of Agriculture for 1877, gives a statement of the early importation of the beef breeds of cattle into the United States in which we find that the imported breeds more especially valued on account of beef-producing qualities are the Hereford, the Devon, and the Short-Horn. The first Herefords were brought to Kentucky by Henry Clay, who was a great admirer and patron of fine stock, in 1816. But, notwithstanding their well-defined excellences and great superiority over the cattle common to this country, for some reason, not wholly explained, this breed has not been as widely distributed nor attracted the public attention that its undoubted merits deserve The race is highly prized in England, where, in some grazing districts, it is held in equal esteem with the Short-Horn, which it nearly equals in size and weight. It is a distinct race, however, purely bred, it is claimed, from a time long anterior to the development of the Short-Horn. The Hereford, as generally seen, is red in color, with white face, and frequently with white along the back and underneath the body. In England there are other varieties, presenting a mottled face and a gray or roan body, which is deemed to be the original type. In that country, according to an English writer, the truest standard of form is still considered by many to be that of the mottled-faced breed, although, in other respects, the white-faced is undoubtedly superior; and as regards the form of the shoulders the breed stands pre-eminent, and produces comparatively little coarse meat in those parts; the hips, loin, and rump are equally good. The ribs do not spring out so wide as some breeds, but the sides can scarcely be found fault with; the twist is unusually full and the chest well expanded. As a milker the Hereford cow is not highly valued. The first importation of Devons from England was made in 1817 into Maryland, and another in the succeeding year by Hon. Rufus King, of New York. Others have followed at intervals, finding a permanent place principally in the Eastern States. As in the case of the Herefords, they have not occupied as great a place in the public mind as their merits would fully warrant. But there are nevertheless a number of fine herds in the country, the purity of which has been maintained. It is claimed for this race that, as a distinctive breed, it is the most ancient in the United Kingdom. Mr. George Turner, an agricultural authority in Great Britain, said of the Devon tribe some years ago: There is scarcely any breed of cattle so rich and mellow in its touch, so silky and fine in its hair, and altogether so handsome in appearance as the North Devon; added to which they have a greater proportion or weight in the most valuable joints, and less in the coarse, than any other breed, and also consume less food in its production. These animals seem wanting in nothing except the size and weight which distinguish some other breeds, and which are therefore more sought after on account of larger gross profits. But, the suggestion is made, large animals eat more than small ones, and it is still a vexed question, both with regard to sheep and cattle, whether small first-quality animals are not more profitable to fatten than those with more bulky frames that produce coarser meat and a larger proportion on the worst joints. The Devon is red in color; in size, medium. For centuries bred, for the most part, in the hill regions of England, with little care as to shelter or prepared fodder, the race inherits stamina and hardy constitutions, and possesses milking traits in good degree, and easy of improvement through cultivation for that object. Prof. Lowe, in his work on The Domesticated Animals of the British Isles, throws some light on the origin of the now admirable race of Short-Horns. He says: While Ireland and the western parts of England have been possessed for an unknown period of a race of cattle having long horns, and furnished with thick skins and abundant hair, fitted to protect the animals from long and continued rains, the eastern and drier districts toward the German Ocean have been inhabited by varieties of cattle having thinner skins, shorter hair, and horns comparatively short. In the fens of Lincolnshire and the other tracts of alluvial country toward the Wash, the cattle were of great bulk and coarse figure, and had, usually, a dingy color of the skin, and short, blunt horns. More inland, and following the course northward of the vale of Trent, and thence across the Ouse, and through the central plains of Yorshire and the River Tees, and beyond it, the cattle assumed a less gross and unwieldy form, but were still a very tall race, of varied colors, with horns of medium length, but which might be termed short with relation to the same parts in the Long-Horn breed. The race now distinctively known as Short-Horns is derived through the cattle of the Tees Valley, upon which the brothers Charles and Robert Colling instituted breeding experiments about the year 1777. Their bull Hubback was the progenitor of this now celebrated breed. The first importation to this country was made as early as 1785, and others have followed in more rapid succession that of Col. Saunders into Kentucky in 1817. They now very largely outnumber all other improved breeds in the United States, the Herds-Book showing a record of more than 60,000 well-bred animals. In England it is asserted that nearly two-thirds of the animals sent to London are Short-Horns or their crosses. Returning to the improvement in cattle, the illustrations given in this article, show some British breeds as they were delineated in the early part of the century. It will be seen that the Ayrshires, Devons and the Herefords, are the only breeds that would be at all recognized in the improved breeds of to-day, and the Herefords only in their general symmetry and color. The cuts will be interesting as a means of comparison with the best animals as seen in our show rings at the agricultural fairs of to-day, and in the illustrations showing the various improved breeds, to be found in their appropriate places in this work It is important that every farmer, and especially every breeder, know the points of animals, especially those pertaining to prime flesh points for, other things being equal, the animal that carries the most flesh on the prime parts, is the most valuable. On this page we give an illustration of a modern Hereford cow, fat, figured to represent these. The inferior parts are

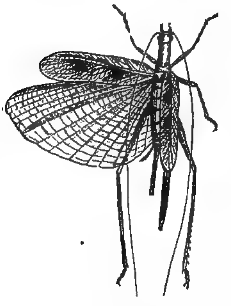


HEREFORD COW, SHOWING BEEF POINTS.

contained before the girth place lying just behind the fore-shoulder, but again all the superior parts lie above the middle line drawn from front to rear. All the best roasting pieces lie in *a, b, c,* 3; and in *a b, c,* 9; the best steak also lies in *a, b, c,* 9; next in *a, b, c,* 10 and in 11, and the inferior in 12; but 12 is good for drying; 14, 15, 16 and 17, are used for soups and stews; 4, 5 and 13 are the plate pieces best for corning. The brisket 7, comes next; the neck 1, is also used for soups, for corning and also for inferior steak, *a, b,* 2, may be used either for roasting or for corning. So 12 may be used thus if necessary. Note 10 and 11 also for drying. In fact, there is plenty of room for calculation in cutting up any animal for home use. The illustration shows the parts from a butcher's stand point. On page 183 there is a cut of a model Hereford bull of to-day, which will still further illustrate the difference in breeds as between the last and the present century.

CATTLE PLAGUE. Various malignant diseases, as catarrhal fever, foot and mouth disease, violent inflammations, murrain, pleuro-pneumonia, etc., are sometimes called plague. In fact, any disease, when it becomes epidemic, and contagious diseases of a malignant nature are apt to be so termed. When suspected a Veterinarian should be consulted and, if one be not near, a humane physician should not disdain to give advice as to proper means to be used in the case. Isolation is one of the first things to be attended to, as a preventive of infection by others. (See diseases herein mentioned under their respective heads elsewhere.)

CATYDID. The Catydids belong to the locust family, usually, but incorrectly, called grasshoppers. So there is a large wingless cricket, (*Anabrus simplex*) and the slender meadow-grasshopper," (*Orchelimum vulgare.*) The Catydid and the slender grasshopper, Fig. *c*, will enable these insects to be readily recognized. In relation to the habits of the Catydid it is well known that they live in trees, and their peculiar shrilling noise caty did, caty did'nt, is familiar to every child. It is however, not so well known that the male only produces the note. As a rule they are not found in such numbers as to be particularly injurious, and bearing so striking a resemblance, as many of them do, to the limbs, twigs and leaves of trees, in color and neuration of wings, it is quite difficult to distinguish their form. The eggs are deposited along the limbs and twigs in double rows, like partly flattened hemp seed, and by others it is laid singly in leaves, etc. The slender meadow-grasshoppers, Fig. *c*, are often numerous, and may be destroyed by catching in nets or by driving as recommended in the article locust. (See Katydid.)



c

CAUDATE. (from *cauda,* a tail.) Furnished with a tail-like appendage.

CAUDEX. The body of a root.

CAULIFLOWER. (*Brassica Oleracea var.*) Unlike the cabbage, cauliflower and broccoli are strictly annual plants, flowering and perfecting their seeds the first season. In fact broccoli in some of its varieties, is so like cauliflower that, as to the cultivation, no separate article will be required. So, the general care and cultivation necessary to the cabbage will apply to the cauliflower, except when the curds, the edible portion, are beginning to be fairly formed, the leaves must be drawn up and tied together, or broken over the end, to protect it from the sun. Both cauliflower and broccoli, in the climate of the West, must be brought into head either before the heat of summer commences, or else late in the autumn. In late plantings, those that are not well headed at the time the ground begins to freeze, may be taken up and transplanted in a light cellar, where they will go on and form fair curds, and often so continue until late in December or January. For early use sow the seed in a hot-bed early in March, in the North, or in any latitude as soon as winter is broken. Transplant when large enough, four inches apart, and about the time apples blossom, transplant into a soil made very rich with rotten manure, the rows 30 inches apart, the plants from 15 to 20 inches in the row, according to the variety. If the weather is dry liberal applications of water must be given, since the plant is impatient of heat and drouth. For the late crop, sow the seed in a sheltered prepared border as early as the soil can be worked, and transplant when large enough. Among the special applications to all the brassica tribe, salt has been found most valuable. It should be sown at the rate of about five bushels per acre, or two pounds per square rod. This may be applied at the time of setting, or, at the first hoeing. So soon as the curds are well formed, and while yet compact and hard, cut for use. The varieties of cauliflower are comparatively few. The Extra Early Paris is the sort usually grown by market gardeners. The Erfurt is decidedly fine. The Large Late Asiatic stands drouth well, and the Walcheren, really a broccoli, is also well adapted to drouths. Mitchell's Early cauliflower is compact, remains long without running to seed, and is valuable, if true to name, for the kitchen garden. Broccoli is so nearly like cauliflower that the same description will answer for both. (For cultivation see Cabbage.)

CAULIS. A stem. From this word comes cauliferous.

CAUSTIC. In farriery, a substance which, by its powerful operation, destroys the texture of the part to which it is applied. Corrosive sublimate is the best caustic; but that requires skilful hands, for it is a dangerous remedy except in the hands of the veterinarian. Mix one drachm of powdered verdigris with one ounce of basilicon ointment and apply this upon a piece of tow; or a drachm of blue stone (sulphate of copper) dissolved in one ounce of water may be used, or lunar cauatic in a quill may be rubbed on to the diseased part.

CAUSTIC LUNAR. Nitrate of silver, sold in sticks, ready for use as a caustic; when used in solution, ten grains are mixed with an ounce of water.

CAUTERY. 1. The application of the hot iron to diseased growths, as fungus, etc. It is cruel and barbarous, unless used with discretion, and with a full knowledge of the necessity that should call for its application. This is called the actual cautery. 2. Potential cautery is the application of any caustic, as nitrate of silver.

To cauterize a wound or affected part, is to kill the integuments, after which they slough off. (See Blistering.)

CAVIARE. The salted roe of the sturgeon, prepared and dried. It is an unwholesome food used in Russia.

CEDAR. The cedars (*cedrus*) proper are mostly natives of Africa, India, and the mountains of Lebanon. The so-called white cedar, *Arbor vitæ*, is a *Thuya* (see Arbor vitæ); and the so-called red cedar is a juniper (see Juniper). Among the more noted of the varieties used for ornamental planting, where they may be protected from the summer sun, and in locations where they will stand the winter's cold, are the Deodar (*C. deodara*) and cedar of Lebanon (*C. Libani*). There are many sub-varieties, some pendulous and some quite upright and conical.

CEDAR BIRD. (*Ampelis Cedrorum*). The cedar bird, or wax-wing, is properly understood as being a bird of but little practical use in agriculture. They do, indeed, eat some insects, but not to any considerable extent. In the nesting season they feed their young principally upon insects. They are destructive to the buds of some trees, and also to the small fruits, especially the cherry, strawberry, raspberry and blackberry. They have even been accused of boring into apples to get at the seeds. The bird is common all over the North, and sometimes in mild winters remains. Generally they make their appearance early in the spring, but incubate late. The evidence for and against this bird would seem to render it proper that they be killed wherever found; for while it is true that they live on insects at some seasons, and the seeds of weeds at others, and also that they feed their young on insects, the destruction to fruit, and to fruit buds, undoubtedly more than counterbalances this.

CEDAR, RED. *Juniperus Virginiana* is found on the sea-coast from Maine to the gulf of Mexico; attaining in the South forty feet, but is small inland. It is evergreen and ornamental. The heart wood is very durable, light, and odorous, red in color, but scarce in quantity. It is essentially a southern tree, but is hardy well up to the Canada line. (See Juniper.)

CELERY. (*Apium graveolens*). This much cultivated plant is a half hardy biennial, being killed at about 20° below freezing. It is found wild and growing near the sea, and on the sides of ditches in England. It is esteemed when cultivated for its solid blanched leaf stalks. For the early crop in the North, the seed is sown in a hot bed in March, covered about an eighth of an inch deep, and kept moist until germination takes place. When the plants have made their third or fourth leaf, prick them out, transplant into a sheltered border, or in a cold frame, three inches apart each way, where they will make fine plants for transferring into trenches, from the twentieth of June to the first of July. Prepare the trenches by plowing two furrows apart, and as deep as possible, making the bottom loose and mellow, and from five to six feet apart between rows. In this throw fully four inches of rich, compost manure, working the manure and soil well together. Set the plants in this trench, six or eight inches apart, just at evening; water, and if the sun be hot, shade for a day or two. The subsequent cultivation consists in keeping the stalks growing perfectly upright, by earthing from time to time, being careful not to allow earth to fall into the crown of the plant, or between the stalks. So continue from week to week, earthing as the plants grow. About the middle of September, or from this time to the middle of October, the plants will be blanched ready for use. The rows should be five to six feet apart. For the late crop, to be blanched in winter, sow the seed in a warm border, rather thin, and early in the spring; press the earth firm, and sift over a very little light earth, cover with brush just so as not to impede the sun's rays, and water lightly to keep the surface moist; or sow in a cold frame about the middle of April. The plants will be large enough to plant out about the middle of July, in soil made quite rich with compost manure, in rows three feet apart, by ten inches in the row, no trenches being required. All the cultivation needed will be to keep the ground free of weeds, and the stalks growing upright, by earthing up from time to time. In the fall, before the ground freezes hard, the plants must be lifted and placed in trenches for use. To do this, select a dry spot, throw out the soil about twelve inches deep, and three feet wide; in this place the celery on their roots, with what earth will adhere in digging. In earthing them up, hold the stalks so no earth can enter between or in the crown. Pack earth firmly about the stalks, nearly to the tops of the leaves, and so one stalk may not come in contact with another. So proceed, packing row by row, until you have the plants all in. A covering to shed rain is to be placed over the trench, and sufficient litter thrown over all to protect from frost. Market gardeners form this covering of brushy poles and hay. In this way the late celery will be ready for use about the first of January, and continue in use often until the middle of May. Boston Market and White Solid are the dwarf white sorts most used; of the dwarf red varieties Cole's Superb Red, is solid and delicate in color, when blanched. Of the large red varieties, the Large Purple Tours, or Red Solid is good; and of the large white sorts, Seymour's Champion is compact and excellent.

CELERIAC. This is a variety of celery having an enlarged root or tuber, and under favorable circumstances, attaining a weight of two or three pounds. The seed is sown precisely as is celery and, when large enough, it is transplanted into rows two feet apart, by two inches in the rows, and in very rich, rather moist soil. Keep the soil clear of weeds. When the bulbs are three-quarters grown, earth them over, up to the crown, to make them grow crisp. Their use is in soups, and also for boiling. They may be kept through the winter, by packing in damp sand in the cellars.

CELL. In physiology, the minute cavities in plants and membranes; the size differs from hundredths to thousandths of an inch in diameter. Cells may contain air, or fluids and solids. The cell is the first structure of all membranes, but subsequently it may be converted into a tube. They are originally spherical, but become changed by pressure into cubes, dodecahedrons, and other figures.

CELLARS. In all farm-houses the cellar is of special importance. There are so many things to be kept from freezing in winter, and, cool in summer, that no expense should be spared in making this part of the farm-house as complete as possible. When sufficient depth can not be had so the cellar may be entirely under ground, freezing may be prevented by having that portion of the wall extending from two feet below the surface double, with a hollow space for dead air extending up to the first floor Thus, with double windows, the cellar will be frost-proof in winter, and measurably cool in summer. The following general rules will suffice to indicate the means to be used in building cellar walls: A simple, hollow space in which the air may be confined between the inner and outer surfaces of a wall is the most effectual and readiest mode of rendering it impervious to heat, and it makes little difference how wide or how narrow the space is, if the air within is entirely cut off from escape or change. Whether the material is wood or masonry, every good wall, where the retention or exclusion of heat is an object, should be built in this way. It is as essential for summer as for winter. at the South as at the North. Care, however, must be taken that the inner portion of the wall is not massive enough to absorb so much heat as sensibly to affect the temperature of contiguous rooms. A warm wall will almost always be a dry one. It is frequently, perhaps generally, thought that the moisture which stands on basement, and sometimes other exterior walls, is caused by water passing through them from the outside. A glance at a pitcher of iced water in a summer day, with its outside covered with dew, ought to correct such an opinion. If a wall is poorly built, it may become saturated with water, which shall escape by evaporation from the inside, and affect the air; or, in a severe rainstorm, it might, in rare instances, be driven through, so as to trickle down the inner surface; but in neither case would it show in the manner spoken of. If, as is sometimes said, the dampness is absorbed from the ground, the very capillary attraction which drew it into the masonry would hold it there. Moisture collected in this way is vapor from the air of the room, condensed by contact with a cold surface, and indicates both a bad atmosphere and a conducting wall. Thick and solid masonry, of course, only aggravates the evil. The most damp and unwholesome rooms are found in buildings of the heaviest construction, where the substance of the structure acts as a great reservoir of caloric, receiving or giving out its supplies as the contiguous air, at different points or hours, may be warmer or colder than its own average temperature. This average does not differ greatly from the mean temperature, day and night, of the different seasons, and is considerably lower than that by day in the summer months. In building cellar walls, stone will generally be used where quarries are found. They should, if practicable, be laid with a flat surface down, and made so solid as to keep out water and rats. Where it can be obtained readily, it will always pay to lay cellar walls with hydraulic cement, on account of solidity and durability. As coolness is desirable in a cellar, there is no occasion to make cellar walls otherwise than solid at the bottom. They will then always be just as warm as the earth around them. So far down, however, as they are exposed to the air, or in contact with earth liable to freeze, they may be so cold as to endanger the contents of the cellar, and should be protected by a coat of lathing and coarse plastering, formed on wooden strips, a little way from the stone work. Brick walls for cellar purposes ought, whenever practicable, to be laid in hydraulic mortar, and, in most soils, covered with a perfect coating of cement on the outside, as they are otherwise liable to absorb so much water as to affect the atmosphere inside and to impair their durability. The foundation should be level, and care must be taken that the surface of the trench on which it stands shall not have been broken or disturbed. If basement rooms are to be used for other than cellar purposes, it becomes necessary to make the walls double. When stone is used, this is to be done by furring, with small wooden strips secured to the masonry and covered by lathing and plastering. Brick walls may either be furred in the same way, or laid as two separate walls, two or more inches apart, occasionally bound together by cross bricks, or, better, by small, flat iron bars; and then, if desired, the inner wall may be plastered directly on its surface. If openings are left in the air space, it greatly hastens the drying of the wall, but they should all be tightly closed when the work is done. Such spaces are sometimes used as ventilating flues, with a total ignorance or disregard of their real value. Any ventilating or hot air pipes which may be needed may very well be inserted in such spaces, but should be entirely shut off from the air cells. Another common mistake in building hollow walls, is making occasional vacancies, while the main part of the wall is solid, as though there were some virtue in the air, which would be diffused over the whole mass. The solid portions must be just as small as may be consistent with strength, for even a single bond-brick will often betray its position by a damp spot on the plastering. Wherever hollow walls are used, whether above or below ground, the builder must remember that their purpose is not to save materials or cost, but to increase efficiency. He must not, as some do, make the entire thickness the same as if it were solid, filching the material from the middle, but must, for safety, add all the thickness of the air space, and spare no cost in the bonding, for safety is of prime importance. If properly built, a hollow wall is stronger than the same material laid solidly. There, nevertheless, are some things in the way of its universal adoption, and, except for the greater danger in case of fire, the preferable mode of securing the required air space is that by furring. While we are below ground, let us examine the cellar bottom. If the ground is wet and springy, it will be necessary to cover it with a coat of concrete, made of coarse gravel and hydraulic cement an inch or two thick. Where the soil is dry, hard gravel, or even sand, will do, if the occupants are careful people; otherwise, it would be better concreted, so that it may be the more readily cleansed. Foundations, other than cellar walls, ought always to be laid on hard ground, and below the deepest frost, according to soil and and climate. The choice of material for the walls of the superstructure is to be governed mainly by location. Good sense and good taste, never inconsistent, both say it should be the most substantial which can be procured with economy. Stone is undoubtedly the most suitable for any permanent building, when it, and the requisite lime, can be obtained of proper quality and wrought without too great labor and cost in comparison with other substances. Next to this is brick. One great obstacle to the use of stone has been the supposition that it must appear smooth, or it would look badly; and another, the difficulty of forming the heads and jambs of doors and windows. Both of these objections are obviated by using bricks in combination with the stone, where much accuracy of finish is required, or where openings are to be covered. A natural and simple surface of broken stone, suggests an unassuming control of the resources of the neighborhood, which no far-fetched material can show Stone walls ought always to be furred or built hollow. It is best never to build any wooden blocks into the masonry, but for nailing to, a thin strip may be occasionally laid in the mortar-joint, not more than two inches wide and less than half an inch thick. This will hold nails and will not weaken the walls. The ends of floor timbers are commonly built into the masonry, just as so many stones would be, but it is better, for the durability of the timber and the solidity of the wall, that, except on the bottom where they rest, they should touch nothing, a little space being left above them, and around their sides and ends. Bricks, if used, ought to be hard-burned, so that they may be left in their natural state, as much of the advantage of either brick or stone is lost if an external covering, demanding frequent renewal, is required for protection. It is useless to give any attention to outside cements, mastics, and plasterings of any name, since, while they are most objectionable for other than structural reasons, they form neither a permanent nor a cheap surface for exposed walls. The drainage from the cellar is of the first importance There should, in any case, however dry the bottom, be a line of tile leading away from the cellar to lower ground, whatever the distance required. If dry, this forms one of the best known means of introducing cool and pure air. If the bottom needs drainage the tile will serve the double purpose of drainage and ventilation. To serve this double purpose the tile should not be less than three-inch caliber, four is better, and should be protected at both ends to prevent the entrance of vermin, as rats, mice, etc. Ventilation is another matter of importance. One of the house chimneys should go entirely to the bottom of the cellar, with a fire place provided. This, in summer, will pass off foul air, while the sub-earth ventilation will furnish pure air. In winter, close the fireplace, and insert a pipe into the chimney near the floor. This will provide all necessary ventilation, except when the weather is so mild as to allow the door or windows to be opened. The cellar should be divided into suitable rooms, by brick walls, and if the bottom be not perfectly hard and dry, it should have a solid floor of broken stone and cement. Thus built, with solid walls and properly floored, it will be proof against rats, moisture and frost.

CELLULAR TISSUE. The membrane or tissue in plants and animals which consists of cells. It exists between all muscles, and under the skin in animals. (See Cells)

CELLULOSE. Cellulose is one of the most important of the organic substances of animals and plants. The group, or the amyloids comprise cellulose, starch, inulin, dextrine, gum, cane-sugar, fruit-sugar, and grape-sugar. This group, in some form, comprises the larger part, estimated at seven-eighths of all the dry matter of vegetation, and as a rule they are distributed throughout all portions of plants. Samuel W. Johnson, M A., gives an account of cellulose, its composition and its amount in various plants, from which we make copious extracts· Every agricultural plant is an aggregate of microscopic cells, i. e., is made up of minute sacks or closed tubes, adhering to each other. The outer coating, or wall, of the cell is cellulose. This substance is accordingly the skeleton or framework of the plant, and the material that gives toughness and solidity to its parts. Next to water it is the most abundant body in the vegetable world. All plants and all parts of all plants contain cellulose, but it is relatively most abundant in their stems and leaves. In seeds it forms a large portion of the husk, shell, or other outer coating, but in the interior of the seed it exists in small quantity. The fibres of cotton, hemp, flax, white cloth and unsized paper made from these materials are nearly pure cellulose. Wood, or woody fibre, consists of long and slender cells of various forms and dimensions, which are delicate when young (in the sap wood), but as they become older fill up interiorly by the deposition of repeated layers of cellulose, which is intergrown with a substance (or substances) called *lignin.* The hard shells of nuts and stone fruits contain a basis of cellulose, which is impregnated with ligneous matter. When quite pure, cellulose is a white, often silky or spongy, and translucent body, its appearance varying somewhat according to the source whence it is obtained. In the air-dry state, it usually contains about ten per cent. of hygroscopic water. It has, in common with animal membranes, the character of swelling up when immersed in water from imbibing this liquid; on drying again, it shrinks in bulk. It is tough and elastic. Cellulose differs remarkably from the other bodies of this group, in the fact of its slight solubility in dilute acids and alkalies. It is likewise insoluble in water, alcohol, ether, the oils, and in most ordinary solvents. It is hence prepared in a state of purity, by acting upon vegetable matters containing it with successive solvents, until all other matters are removed. Though cellulose is insoluble in, or but slightly affected by dilute acids and alkalies, it is dissolved or altered by these agents, when they are concentrated or hot. The result of the action of strong acids and alkalies is quite various, according to their kind and the degree of strength in which they are employed. Prolonged contact with strong sulphuric acid converts cellulose into dextrine, and finally into sugar. Other intermediate products are, however, formed, whose nature is little understood, but the properties of one of them is employed as a sort of test for cellulose. Boiling for some hours with dilute sulphuric acid also transforms cellulose into sugar and, under certain circumstances, chlorhydric acid and alkalies have the same effect upon it. The denser and more impure forms of cellulose, as they occur in wood and straw, are slowly acted upon by chemical agents, and are not easily digestible by most animals; but the cellulose of young and succulent stems, leaves, and fruits, is digestible to a large extent, especially in the stomachs of animals which naturally feed on herbage, and therefore cellulose ranks among the nutritive substances Cellulose is a compound of the three elements, carbon, oxygen, and hydrogen. Analysis of it, as prepared from a multitude of sources, demonstrates that in 100 parts it contains carbon. 44.44; hydrogen, 6.17; oxygen, 49.39, 100.00. The larger proportion of the cellulose structure of the nutritious fruits, foliage, and grasses is easily converted into starch, and ultimately into sugar, by chemical means, and by animals when used as food, and known as carbohydrates. The mycelium of microscopic fungi consists, for the most part, of cellulose; and, although the fungi are very low forms of plant-life, they are not only the principal formers of some of the organic acids, as the acetic, but they grow to maturity in them; while the woody cellulose of the higher plants dissolves in the acetic ferments and becomes food for the cryptogams. Some varieties of mycelium take the blue stain by iodine and sulphuric acid, while other kinds are turned of an amber-color by the same tests. The amount of cellulose in plants is shown in the following table:

	Per cent.
Potato tuber	1.1
Wheat kernel	3.0
Wheat meal	0.7
Maize kernel	5.5
Barley do	8.0
Oat do	10.3
Buckwheat kernel	15.0
Red clover plant in flower	10
Red clover hay	34
Timothy hay	23
Maize cobs	38
Oat straw	40
Wheat straw	48
Rye straw	54

Fig. I.

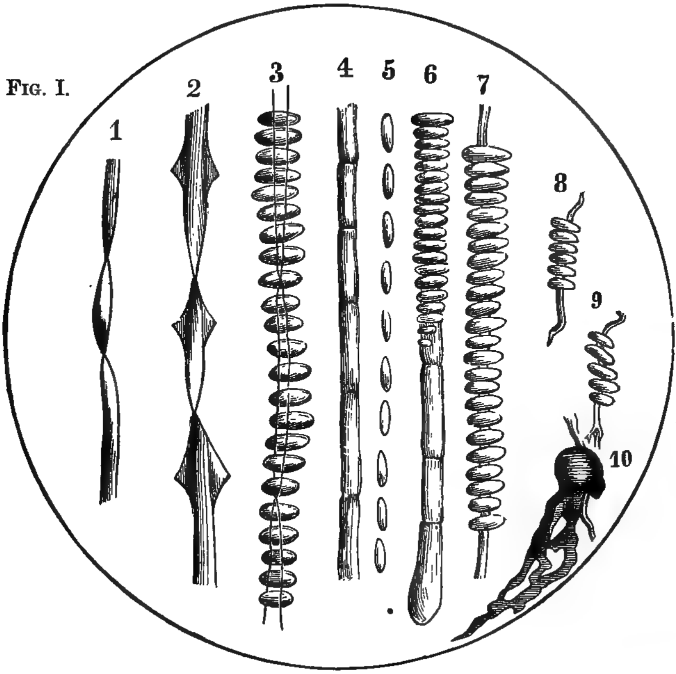
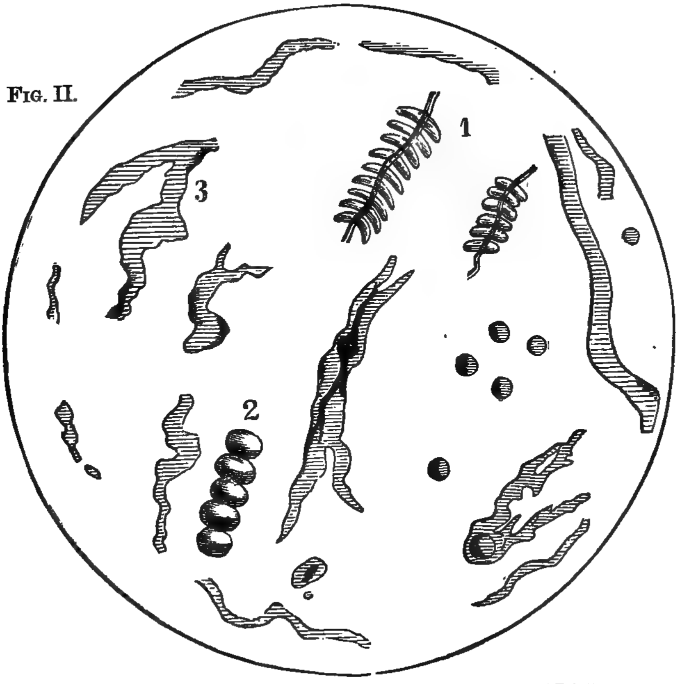


Fig. II.



ANIMAL AND VEGETABLE CELLULOSE AND STARCH.

The cuts showing vegetable cellulose and starch, are explained as follows: In the illustration, Fig. I, the numeral 1 shows the fibre of cotton in its natural state highly magnified; 2 shows the same, subjected to the action of strong sulphuric acid; 3 shows how the cellulose is changed by being subjected, first to tincture of iodine, followed by commercial sulphuric acid, and, immediately after, to concentrated sulphuric acid. The fibres are thus reduced to a starchy condition, and appear in the form of discs or beads. 4 shows a fibre of flax, magnified, in its natural state; 5 shows the same treated with concentrated sulphuric acid; 6 and 7, the same when acted on by the tincture of iodine and acids as described in cotton fibres. 8, 9 and 10 show some of the forms of heart, liver, muscle, etc.; that is, structural cellulose found in them. In Fig. II, the numeral 1 is similar; 2 and 3, and the other forms not numbered, are produced from 1 by using extra acid, and sometimes friction. The illustration is given simply to show the forms assumed by cellulose and starch under a high magnifying power. When gun-cotton, a nitro-cellulose body, is treated very frequently with iodine and acid tests, it becomes yellow or amber-colored; and when the fine sawdust of box-wood is similarly treated, it appears, when viewed under the microscope, of three colors, amber, green, and blue; but the latter color appears in very small quantities. Chitine, the cellulose of insects, is stained yellow, and is supposed by some chemists to be combined with nitrogen. Color can not be relied on wholly as a test for cellulose, since it assumes so many colors under treatment with iodine and acid. The following colors are frequently observed when treating cellulose and starch with iodine and sulphuric acid; purple, bluish-purple, green, yellow-amber, reddish-amber, pale-blue, deep-blue, and a translucent amylaceous white. When starch is acted on by sulphuric acid alone, it dissolves, and is partially carbonized.

CEMENT. (See Cisterns.)

CENTIGRADE. A division into one hundredths, as the centigrade thermometer.

CENTRE OF GRAVITY. An imaginary point in the centre of any mass which has the same weight of matter arranged on at least two sides. When any substance is balanced on a point, as the finger, the centre of gravity lies immediately above that point. In falling to the earth, all substances take such a path that the centre of gravity descends in a straight line.

CEREAL GRAINS. This is a general term applied to wheat, rye, barley, oats, Indian corn, millet and other grain plants, the seeds of which are used either as human food or for the fattening of animals, but applied generally to the edible grains. The technical term used to designate this group is *cerealia*.

CHARBON. Black Quarter, Bloody Murrain, Contagious Anthrax, Spotted Fever. A malignant epidemic fever, from blood poisoning, of a typhus character, often following pneumonia, catarrhal fever, influenza, etc. Bad ventilation and want of proper care are the predisposing causes. The treatment should be under the care of a veterinary surgeon. If there is constipation relieve the bowels by injections or by a moderate dose of oil. Give also, if a horse, half an ounce of chlorate of potash, twice in twenty-four hours, or give one ounce each of tincture of chloride of iron and oil of turpentine, and two ounces of solution of acetate of ammonia in a pint of gruel, and repeat three or four times a day. (See Blain and Murrain.)

CHALYBEATE. Medicines or mineral waters containing iron: they are tonic.

CHARCOAL. Any vegetable matter burned in a pit, or other place without free access to air, is converted into charcoal. It is usually burned as follows: Logs or billets of wood are piled either horizontally or vertically into a dome-shaped mass, a chimney being left in the centre about four or five inches square, and the rest covered close with sods and earth a foot deep, so that no smoke can escape through it; a small flue or channel for air may also be left along the ground, under the wood, on the windward side, and passing to the central chimney; this is the simplest construction. Sometimes a pit or walled space is used, in which the wood is laid, flues being sunk to convey air to the bottom, and a central chimney left, the top being covered with earth, ashes, or cinders. The kiln is fired by placing in the central chimney leaves, straw, or twigs well lighted, and allowing the draught to remain open until the upper logs of wood are well fired, afterward closing the under flue. As soon as the flame dies away, the wood being red-hot above, close the top of the chimney and let the fire smoulder. It requires some six to ten days to burn a kiln, and constant attention must be paid. The average yield is sixteen per cent, by weight, of coal, but hard woods, well burned, sometimes furnish twenty-five per cent., the hard woods yielding the most. In this process, nearly all the *carbon* of the wood is left, the *oxygen* and *hydrogen* uniting in combustion to form water, and the object in view is to keep out atmospheric air, which would cause the combustion of the carbon also. Charcoal possesses many remarkable properties. It has the power of removing fetid smells from water, meats and manures; hence it is used in disinfecting privies and manures. It removes the color of many fluids, and is used in clarifying juices and solutions, especially in refining sugar. It is remarkably porous, and absorbs from the air, and other media, gases: one cubic inch of fresh coal from box-wood was found by Saussure to absorb and condense ninety of ammoniacal gas, thirty-five of carbonic acid, nine and a quarter of oxygen, and seven and a half of nitrogen; this property gives it great value in putrescent composts, and as a manure. Charcoal is nearly unchangeable in common air at the ordinary temperature, but burns when heated to redness, into carbonic acid, if abundance of air be present.

CHARRING. Burning so as to produce a crust of charcoal. It is a good way of preserving the ends of posts inserted in the ground of wet places, but the charring should extend some little distance higher than the point where the post appears above the surface of the earth.

CHEAT. (See Chess.)

CHEESE. A product of the dairy, obtained from the curd of milk. (See Caseine.) The analysis of cheese shows it to be one of the most nourishing of foods. Its manufacture from milk has of late years been reduced to a science, many of the best minds in the country having contributed to improvements in the manipulation of the milk, the chemistry of the various transformations and in improved implements and machinery for manufacturing and curing. In cheese-making, the utmost nicety must be used from the time the milk has been drawn from the cow until the product is boxed for sale, to produce a uniform article from day to day. The introduction of cheese-factories has rendered this possible. These exact conditions cannot be carried out in ordinary dairies, when the proper temperature and facilities are wanting, when any thing in the make up, as salt, rennet, scalding, etc., are guessed at. Hence cheese-factories have greatly stimulated production, until the manufacture of cheese in New York, Pennsylvania, Ohio, and particularly in the western States, constitute one of the most important of the agricultural industries. The report of the chemist of the Department of Agriculture, in relation to the various analyses made from cheeses on exhibition at the centennial exhibit at Philadelphia, and, concerning the common mode of manufacture, that which yields whole-milk cheese, made from the whole of the milk, without skimming, is most elaborate in its details, the main points of which are familiar to all who are interested in the subject. Therefore we simply give below the results of the chemical analyses of several samples obtained from different parts of the country, and represented in the collection; one unusually large, and contributed from those known as the best manufacturers. They are as follows:

Designation.		Water.	Ash.	Fat.	Caseine, sugar, etc.
New York factory-cheese	No 1	31.41	3.53	37.88	27.18
	No. 2	35.68	3.60	35.15	25.57
	No. 3	35.24	3.23	35.68	25.85
	No. 4	33.73	4.05	35.57	26.65
Massachusetts factory-cheese	No. 1	34.18	3.02	33.92	28.88
	No. 2	38.5	3.73	31.19	26.58
Maine factory-cheese, Jersey milk		28.11	2.71	41.03	28.15
Wisconsin factory-cheese		35.49	3.34	34.05	26.12

Of the second method of manufacture, that by which the ordinary skim-cheese is produced, the usual proportion of cream being taken from the milk for the manufacture of butter, two varieties are presented By the one method, and that which is in most common practice, the skimmed milk alone is used for manufacture into cheese; by the other method, the buttermilk is added to the skim-milk; the fresh milk is heated to 130° Fahrenheit, cooled to 65°, allowed to stand from twenty-four to forty-eight hours for the cream to rise, and the cream is churned sweet. The results of the analyses of the two kinds of cheese are given below:

Designation.	Water.	Ash.	Fat.	Caseine etc.
Common skim-cheese	42.38	3.63	20.55	33.44
Scalded milk and buttermilk cheese	44.48	4.50	15.22	45.80

While these analyses indicate a larger proportion of fat in the ordinary skim-cheese, there was nevertheless a marked difference in quality in favor of the other; the latter was softer and more salvy, and probably more digestible. It may be said, further, that the proportion of fat in skim-cheeses is not so constant as in whole-milk cheese. Another sample of scalded skim-milk and buttermilk cheese analyzed in the laboratory was found to contain twenty per cent. of fat. In the third important method of cheese making, as in the manufacture of skim-cheese, the butter fat is mostly removed from the milk by skimming; but while the milk is coagulating after the addition of the rennet, as much of a clean animal fat, manufactured from the beef's caul, is most intimately mixed with the forming curd as it will take up; the excess of oil floats on the surface after the coagulation is completed, and is skimmed off; a cheese is thus obtained which, as the analysis below shows, is sometimes richer in fat that the ordinary skim-cheese:

Designation.	Water.	Ash.	Fat.	Caseine etc.
Oleomargarine-cheese	40.56	3.98	20.43	36.97

For some unexplained reason the curd will not always take up the same amount of fat, so that its proportion in the cheese is variable; in the case of other analyses of the same kind of cheese made in the laboratory, the proportion of fat has ranged from eighteen to 25.9 per cent. This fat that is added to the curd is sometimes called oleomargarine, and the cheese is hence conveniently distinguished from other kinds by the name given to it above; in respect to quality, it is superior to the ordinary skim-cheese, although, as in the case of the comparison between the two varieties of skim-cheese already mentioned, the better cheese is not always found to contain the larger proportion of fat. The chemist found but one veritable imitation of the styles of cheese so common on the continent of Europe. Limburger cheese is made in one place in the State of New York, somewhat in the same manner as it is made in Europe The analysis shows that it contains a large proportion of water—43.67 per cent.; and somewhat less than the usual proportion of fat that is found in whole-milk cheese, or about thirty per cent. In the manufacture of whole-milk cheese, a considerable portion of the fat remains in the whey. In a few cases this fat is collected and made into whey-butter, that brings a fair price in the market; and the removal of this fat does not, it is asserted, lessen the feeding value of the whey. A sample and an analysis of this butter are presented; but if a chemical analysis is no true test of the quality of a sample of cheese, still less is it so in the case of butter Two samples of factory-butter and one of butter made from the milk of Jersey cows are also contained in the collection, of which the last mentioned was by far superior to the others in quality; but no such difference is indicated in the results of the analysis given below.

Designation.		Water.	Ash.	Fat.	Caseine etc.
Jersey butter		11.29	3.20	84.76	0.75
Factory-butter		12.36	2.98	83.41	1.25
		8.82	3.43	87.75	
Whey-butter		9.77	1.37	83.56	

Mr L B. Arnold, of New York, one of the best American authorities on cheese-making, in relation to the manner of making cheese and butter from the same milk, states the case as follows: There are different modes of managing milk in creameries. In some, the milk is set in the cheese-vats at night, and stirred and cooled as if the whole contents of the vats were to be made into cheese in the usual way. It is then left standing at 60°, as near as may be, through the night, for the cream to rise. In the morning the cream is taken off and made into butter, and the skim-milk is mixed with new milk that is brought to the factory in the morning, and made into cheese. In this class of creameries, there are two modes of working the cream into butter: One is to churn the cream as soon as it is taken from the vats, while it is sweet, and then put the buttermilk back into the vats with the milk, and work it into cheese In this way the valuable properties of the milk are worked up very closely, leaving nothing but a very poor whey. The other mode is to set the cream aside till it becomes sour, before churning. In this case the buttermilk cannot be worked into the cheese, and of course is cast out with the whey. In the former case the cheese always receives a peculiar flavor from the buttermilk, which some people fancy, but which most people dislike, and hence it does not find favor in the general market. In the latter case, if the curd is cured rapidly and without any cessation in the curing process, by exposing it to a temperature too low, the cheese can scarcely be distinguished from whole-milk cheese; and where unprejudiced selections are made, it is often preferred for its better keeping qualities and the purity of its flavor. The butter in the two cases differs as much as the cheese. When milk is set for the cream to rise, the odor peculiar to new milk escapes slowly, and as the cream soon coats over the surface of the milk, the odor, in attempting to rise, becomes entangled in the cream, and is hence carried with it into the churn. In the process of churning, much of the so-called animal odor escapes, but enough is always left in it to modify the fine flavor of the butter, and to serve as a ferment to work its early destruction. In the other case, where the cream is kept till it is sour, the acidity developed neutralizes the objectionable odor, and destroys it, and leaves the butter with a better flavor and in a better condition for long keeping, As the best of the cream rises first, the butter made from this partial skimming is of the finest quality, and usually sells at an advance above dairy butter, when equal skill is used in its production. The amount of butter taken from milk in this way is, perhaps, one pound from 100 pounds of milk, in the middle of the season, increasing to a larger percentage as the milk grows richer in the fall. By this practice, the pounds of butter and cheese counted together generally exceed the number of pounds of cheese that could be made from an equal quantity of unskimmed milk. This difference may be accounted for from the waste that always occurs in making whole-milk cheese. by particles of cream escaping with the whey, and from the fact that more water is retained in a curd from skim-milk than in a curd from whole milk, when all other circumstances are the same. The purpose in this class of creameries is to make only so much butter as will allow of making a fine quality of cheese. In another class of creameries the purpose is quite different. It is to make all, or nearly all, the butter that can be made from the milk, and then to make a profit by converting the skim-milk into cheese instead of feeding it to swine. To accomplish this it is necessary to keep the milk sweet while it is standing for the cream to rise. Cold water is the agent employed. At a temperature of about 60° the lactic ferment hardly makes any perceptible advancement. Hence, if milk is kept at 60° or a little below, the cream rises readily, and the milk is preserved for a long time in a good condition for cheese-making. To effect this, a reservoir is made in the creamery, with mason work laid up with water-lime or cement, and kept constantly full, and of even temperature by a steady stream of water from a cool spring. The milk, as it comes to the creamery, is strained into a small vat, and thence drawn into tin pails, eighteen or twenty inches deep, and eight inches in diameter, and the pails then set into the reservoir, which is just deep enough for the water to rise around the pails as high or a little higher than the surface of the milk. This is found to be a better way of keeping milk than to spread it out in shallow vessels. The cream rises as quick, and some contend, quicker, in the deep as in the shallow dishes, and much less surface is exposed to be injured by drying. The exposure is so little that the cream always remains soft and thin, requiring to be dipped off instead of skimmed. The time of letting it stand in these pails varies in different creameries. In some, the milk of one day is made into cheese the next, thus allowing the morning's milk to stand twenty-four hours and the evening's milk twelve hours. In others it stands forty-eight and thirty-six hours. When the cream is taken off it is set away to sour, and at the proper time is churned by an application of steam, horse, or water power. It is a singular fact, that after all the trials made with the great variety of churns that are being continually introduced, the creameries and the best butter-makers all fall back upon the old dash-churn, as the best, both for quality of product and convenience. Patent churns are in bad repute with the creameries. When the butter is taken from the churns, it is thoroughly washed in cool water before salting. However much washing butter may be condemned by others, the practice works well in the creameries. The idea that water washes out the fine aroma of the butter seems to be more fanciful than real, and certainly much less injury is done to the texture by washing out the buttermilk than by working it out. The working is usually done on an inclined slab, with a lever rounded on one side and held in its place by a universal joint at the lower end of the slab. (See article on Butter.) The salting is generally lighter than in farm dairies, being usually only one pound of salt for twenty pounds of butter, and the inclined slab is used in working it in. The butter made at the creameries is generallyof superior quality, and commands a high price, and is beginning to exert an influence in the market. Creameries are educating the public taste to a higher standard. Though much may be said of the excellence of creamery butter, little can be said of the excellence of cheese made in this class of factories. Though rich in valuable nutriment—that might under more favorable circumstances, be at least palatable food—the shape in which it now usually goes to market, rates it very properly with the poorest class of human food. It is so dry, and hard, and insipid, and indigestible as hardly to be reckoned as a wholesome means of sustaining life. It is little else than dried curd. It cures so slowly and dries out so quickly that the cheesing process is arrested before it is hardly begun. There is a wide field open for improvement in the manufacture of skim-milk cheese. The valuable flesh-forming material with which it abounds ought to be, and will ere long be, presented in more attractive forms. I have no expectation that a fancy article will be made from thoroughly skimmed milk, but am confident that a cheese much more palatable and wholesome than those now made in creameries, can be made from milk in the condition in which it is there manufactured. The most that is needed is to make the cheesing process as complete as in curing other cheese. When dairymen shall have become familiar with the fact that the cheesing process is but the result of the continued action of the rennet upon the coagulum it has formed from the milk, they will find some efficient way of keeping up that action, however much it may be retarded by depriving the curd of the stimulating influence afforded by the fatty matter in the milk. When the manufacture and curing of skim-milk cheese shall be adapted to the altered condition of the milk, its value will be greatly enhanced. But even now the dried-curd, if I may so call it, makes a better return than can be made by feeding the milk to pigs and calves. It requires just about four times as much milk to make a pound of pork or veal, as it does to make a pound of skim-cheese, while there is but little difference in their market value. The quality of milk varies so much, that no precise results can be stated when it is worked up in the different ways of manufacturing it, but they will not vary much from the following: 10,000 pounds of milk, of average quality, will make 1,025 pounds whole-milk cheese. The same quantity, if partially skimmed, will make 100 pounds butter and 975 pounds cheese, that will scarcely differ from whole-milk cheese. If deeper skimmed, it will make 250 to 300 pounds butter and 700 to 775 pounds skim-cheese; or, if thoroughly skimmed, it would make 350 to 370 pounds butter and 600 to 650 pounds skim-cheese. The cheese will vary considerably with the varying amount of milk taken off with the cream. If the whole-milk cheese be worth fifteen cents per pound, the partially skimmed will be fourteen to fourteen and a half cents, the deeper skimming nine cents, and the full skimming seven cents per pound. The butter in each case will keep with the top of the market as it fluctuates. The cost of making the cheese and getting it ready for market is two cents per pound, and the butter five cents. From the foregoing facts, the reader may gather at least a general idea of the *modus operandi* in creameries, and of the results produced. They give a little greater return than making cheese only from the milk, but, considering the greater outlay in building and apparatus, the results financially do not differ very widely. Their general effect upon the markets is to raise the standard of American cheese. In relation to the manufacture of cheese in various countries, and the means used, Mr. F. B Thurber, of New York city, presented much valuable and condensed information to the New York State Dairymen's Association at the Session of 1878. This was collected during a visit to the late French International Exposition. It is as follows: The French *Roquefort* cheese has a reputation which extends as far back into dim antiquity as the time of Pliny, who mentions it in one of his works. It is made from the milk of sheep and goats, principally from that of the former. In 1866, 250, 000 out of a flock of 400,000 supplied the milk for 7,150,000 pounds of cheese. The very fertile pasturage of these animals is an immense plain, eight or ten leagues across. In the evening, after the return of the sheep from the pastures, they are allowed to rest for an hour before being milked, after which they will yield the milk more readily, and are milked as rapidly as possible. From May first to the middle of July the yield of milk is the largest, and each animal gives nearly one pint. After the shearing the flow of milk diminishes. The Larzac breed of sheep, from the milk of which the Roquefort cheese is made, have unusually large udders; this is attributed to the practice of beating them with the hand as soon as the milk ceases to flow, in imitation of the manner in which the young lamb seeks to get more milk. The evening's milk is heated almost to boiling, and set aside. In the morning it is skimmed, heated to 98°, and mixed with the morning's milk for coagulation. After the curd has been divided, by stirring with a paddle, and the whey drawn off, it is well kneaded with the hands, and pressed, in layers, into moulds with perforated bottoms, and usually a thin layer of mouldy bread is put in between each layer of curd, the object being to hasten the ripening of the cheese by supplying the germs of the green mould peculiar to cheese, the technical name of which is *Penicillium crustaceum.* The bread for this purpose is usually made before Christmas, of equal parts of summer and winter barley, with considerable sour dough, and a little vinegar. The mouldiness is not sufficiently developed in it until three months, unless hastened by warmth. When mouldy enough it is ground, sifted, moistened with water, and kept from contact with the air until wanted. The curd remains in the moulds under pressure three or four days, after which the cheeses are wrapped in dry linen and put to dry. They remain in the drying-room three or four days, after which they are taken to the village of Roquefort, where the ripening is completed in a very peculiar manner. This village is situated in a deep, narrow gorge, with high precipitous walls of limestone rock that overhang the houses, and often immense boulders may be seen between the houses, which have sometime fallen from the rock above. This wall of rock is filled with caves and fissures, from which currents of cold air issue without cessation, and it is in vaults constructed in these fissures that the ripening of the Roquefort cheese is carried on; and it would appear that the peculiar characteristics and excellent quality of this singular kind of cheese can only be obtained by ripening in these vaults. The currents of air are quite cold, so that even in the hottest weather their temperature is kept at from 41° to 44° Those vaults which are so situated that the currents of air flow from south to north, are believed to yield the best cheese, and they are consequently held in the highest estimation. The cheeses are brought in at all seasons by the shepherds, and are bought by the proprietors of the vaults; sometimes these purchases are made several years in advance, so sure is the demand for the cheese when ripened. They are carefully examined when brought in, and classified according to merit. Salt is then sprinkled over them, and they are piled up one on another for two or three days; then the piles are taken down, the salt and brine rubbed in, piled up again, and left for a week. They are then scraped and pared, pricked through and through with needles driven by machinery in order to accelerate the moulding, and after this they are left in piles again for fifteen days, till they become dry and firm in texture, and begin to be covered with mould; this mould by its brilliant whiteness, its length—the filaments being sometimes five or six inches long—its succulency, and the thickness of its coating, indicates the quality of the cheese on which it grows, and the suitability of the vaults in which the ripening is perfected. Another of the celebrated cheeses made on the Continent of Europe, and which is exported to a considerable extent, is the Swiss Gruyère; but it is now extensively manufactured in France and Germany, and also to some extent in other countries. This is made mostly in huts, called châlets, high up among the Alps, in the time during which the pastures on the mountain sides are accessible and the huts habitable, say from the melting of the snow in May to the end of September, when men and animals descend for the winter into the sheltered valleys thousands of feet below. The châlets are located in the midst of the mountain pastures, on a spot safe from avalanches, and generally near to a small spring or pond of water when such are available. Provisions from the valleys are carried up weekly to the châlets, and it is under such difficult and romantic circumstances that a cheese is made which for hundreds of years has been considered almost, if not quite, the best on the Continent. The milk, partly skimmed, or not, according to the quality of cheese desired to be made, is put in a great kettle and swung on a crane over a gentle fire, where it is allowed to attain a temperature of 77° F., when the kettle is swung off the fire and rennet is added to the milk. When coagulation has advanced far enough, the curd is cut into as fine pieces as is practicable with the large wooden knife which is used for the purpose. The kettle is then swung over the fire again, and the curd is taken up in small quantities in a porringer and poured back through the fingers, whereby it is still more finely divided. Great importance is attached to this manipulation in the division of the curd, in order that each particle may be fully exposed to the action of the heat in the cooking process which ensues up to a point when a temperature of 90° has been attained. The kettle then is immediately swung off the fire, and the waste of curd and whey stirred for some fifteen minutes longer; and if the cooking has been properly performed the particles of curd have the appearance of bursted grains of rice, swimming in the whey. The curd is then collected in a cloth, and great care is taken to expel all the whey. The salting of the cheese is also considered a delicate and important process. The salt is rubbed from time to time on the outside of the cheese, care being taken to discern when enough shall have been absorbed. One authority states that, in the manufacture of the best cheese, the salting process is sometimes continued for one or two years, at intervals of a week. The Gruyère cheeses are commonly three feet in diameter and weigh over one hundred pounds. A successful cheese of this kind is like a soft, yellow paste, which melts in the mouth, and it is filled with cavities about the size of a pea, one or two, say, in each square inch of cheese. The small, round Dutch cheeses, known to the trade as Edam, are called after the place of that name, a small but flourishing town near Amsterdam, in Holland; in size and shape resembling cannon balls, and when dry nearly as hard. They have perhaps been made more widely known by the story which has passed into the literature of the age, that during the siege of one of the cities of Holland, the supply of cannon balls gave out, and Edam cheeses were used as a substitute. Perhaps more important to American dairymen will be the methods pursued by English dairymen in making the principal varieties of cheese consumed in that great cheese-consuming country. The more important varieties are Cheddar, Cheshire and Stilton, and the following concise yet comprehensive description of the most approved processes of manufacture is by Mr. John Chalmers Morton, as follows: The Cheddar cheese shall be described as it was carried on upon the farm of the late Mr. Harding, of Marksbury, Somersetshire, who was one of the best makers in England, and who did good work for cheese-making in Ayrshire and other counties and districts which he and Mrs. Harding visited on the invitation of Agricultural Societies and others, for the purpose of giving instruction in the manufacture of this kind of cheese. The morning's and evening's milk are together brought to a temperature of about 80° Fahr. If the night has been warm, a temperature of 78° will give as great effectiveness to a given quantity of rennett as one of 82° or 84° would give if the milk had been at a lower temperature for some hours of a cold night. The evening's milk, having been placed in shallow vessels during the night to cool, and having been stirred at intervals during the evening is skimmed in the morning, and the cream, with a portion of the milk, is heated up to 100° by floating it in tin vessels on the boiler. The whole of it is then poured through a proper sieve into the tub—into which the morning's milk is being also strained as it arrives—so as to raise the whole, as I have said, to from 78° to 82° Fahr. This tub may be a large tin vessel, capable of holding one hundred and fifty gallons, and provided with a false bottom and sides, enabling hot or cold water to be passed under and around its contents. The rennet, made from two or three dozen vells, in as many quarts of salt water, and allowed to stand three weeks, is added—half a pint to one hundred gallons—and the curd sets in about an hour. The small vells (rennets) of calves, which are killed at a week old, are preferred, and they should be eighteen months old before use. The curd is slowly cut with a single long blade to and fro throughout its depth, in lines forming a four-inch mesh upon the surface, and the whole mass is gently turned over from the bottom with a skimming dish and the hand. The whole is then again worked throughout with a shovel breaker—a four-fingered paddle, with wires across the fingers—great care being taken to do it gently, so that the whey shall not become too white. The curd is thus broken up into pieces not much larger than peas, and at least half an hour is taken in the process Hot water is then let into the space around and below the cheese tub, and the whole is raised to 100° Fahr.: and this, too, done gradually, so as to raise the whole by degrees, not heating any portion to excess. This also takes half an hour. The hot water is then drawn off, and the curd is stirred by the hand and a skimming dish for another half hour in the midst of its hot whey, being at length reduced to a mass of separate bits the size of small peas. The whey, after settling for half an hour, is then removed—ladled, syphoned, or drawn—to its vat, where it stands about six inches deep, and is skimmed next day, yielding a butter, which should not exceed in quantity six to eight ounces per cow per week The curd stands half an hour after the whey is drawn off, and it is then cut into four or five pieces and turned over and left for half an hour, after which it is again cut and left for a quarter of an hour. After this, according to Mr. Harding, it should be in the slightest degree acid to the taste. If allowed to become too acid, it will not press into a solid, well-shaped cheese, but will be apt to sink abroad misshapen. It is now torn into pieces by hand, and left to cool; and thereafter it is packed in successive thin layers in the vat—a cylindrical or wooden vessel twelve inches or more wide and twelve inches deep—whence, after being pressed for half an hour, it is taken out (it is then probably midday), and broken up by hand, and allowed again to cool. Then, when cool, and sour, and dry, and tough enough (all this, of course, being left to the judgment of the maker), it is ground up in the curd mill; two pounds of salt are added to the cwt. of curd, and the whole is allowed to cool, and, as soon as cold, it is put in the vat and taken to the press. It is then probably 3 p. m. The pressure on the cheese may be 1,800 to 2,000 pounds. The cloth is changed next morning. A calico coating is laced on it the second day, and on the third day the cheese may be taken from the press, placed in the cheese-room, bandaged, and turned daily, and afterwards less frequently. The cheese-room should be kept at nearly 65° Fahr. The cheese will not be ready for sale for three months. The process lasts nearly all the day, but it is believed to produce the best cheese in the world; and its use is everywhere extending. Taking its name from a single parish, it now prevails all over North Somersetshire, and is gradually extending into Wiltshire. Many dairies in Gloucestershire adopt the system; some of its characteristic details are followed in Cheshire; and it is well known in Lancashire, Ayrshire, and Galloway. The Cheddar cheese is made of various sizes, generally twelve inches wide and a foot high, but sometimes larger in both dimensions, and from seventy to one hundred and twenty pounds in weight: the object being to make all the milk of one day on a farm of thirty or forty cows into a single cheese. Cheshire cheese, like the Cheddar, is made only once a day. The evening's milk is placed, not more than six or seven inches deep, in tin vessels to cool during the night, on the floor of the dairy; it is skimmed in the morning, and a certain portion kept for butter—in early summer only enough, perhaps, for the use of the house, but in autumn more, and in some dairies at length nearly all the morning's cream is thus taken for churning. The skimmed cream, with a portion of milk, is heated up to 130° of Fahr. by floating the tins which hold it on the boiler—sufficient quantity being taken to raise the whole of the evening's and morning's milk together to 90° or thereabouts. The rennet is made the day before it is used; twelve or fourteen square inches of vell, standing in a pint of salt water, kept in a warm place, making rennet enough for one hundred gallons of milk. The Irish vell is used, as it is obtained from very young and wholly milk-fed calves. The curd is set about fifty minutes; it is then cut with the usual curd-breaker, a sieve-shaped cutter, very slowly. The whey is syphoned, pumped, or lifted out as soon as possible; but before it is all removed a portion is (on some farms where the Cheddar system is followed) heated and returned to the tub, and the curd is left in this hot whey for half an hour. The whey is then drained away and the curd is left to get firm. When firm enough to stand on the hand in cubes of about a pound weight—this is an intelligible indication—without breaking asunder, it is lifted out on the drainer (a false bottom of rods), in a long tub with a stop-cock to it, and there left covered up for forty-five minutes, after which it is broken up and well mixed by hand with three and a half to four and a half pounds of salt per cwt. (112 pounds.) It is then allowed to stand with a light weight upon it for about three-quarters of an hour longer, and is turned over once or twice during the time, being cut for the purpose into squares with the knife. It is then passed twice through the curd-mill, and at length put into the vat, a cloth being pressed first into the place by a tin hoop, and the salted curd being packed gently by hand within it. The vats will hold a cheese of seventy or eighty, up to 100 pounds; and tin hoops, placed within them, are used to eke them out, and give capacity for a larger quantity of curd, if necessary. After standing in the vat, with a weight upon it, from one to two hours, according to the state of the weather, it is turned over and put, still in its vat, into an oven—a warm chamber in or near the brickwork of the dairy-chimney—where it remains at a temperature of 90° to 100° during the night. Both when in in the press and here the cheese is skewered, skewers being thrust into it through holes in the vat, and every now and then withdrawn, so as to facilitate the drainage of the whey. The cheese is taken out of the vat next morning and turned upside down in a fresh cloth. It is in the press three days, and it is turned in the press twice a day, being dry-clothed each time. It is then taken out, bandaged, and removed to the cheese-safe. In some dairies all skewering is dispensed with, and no pressure is used at the time of making, nor for two days afterwards; but the whey is allowed to run out of its own accord. Cheese manufactured in this way requires from five to seven days in drying, but afterwards matures more quickly for market. The cheese varies considerably in quality throughout the year, the earlier make of March and April being considerably less valuable than that of summer and early autumn. Some of this varying quality is owing to the quality of the milk, the cows being house-fed; but more of it is, in all probability, owing to the necessity of holding a portion of curd over from day to day, when the quantity is insufficient to make either one, or it may be two, full sized cheeses daily. In such cases it is common to make one full-sized cheese, and hold the remainder of the curd over till the next day, keeping it wrapped up on the drainer or pan, and grinding it up in the curd-mill along with the curd of the next morning. Stilton cheese, manufactured chiefly in Leicestershire, is made from milk enriched by the addition of cream, and the curd hardens into cheese without pressure. The cream of the night's milk is added to the new milk of the morning, and the rennet is mixed with it when the whole is at the temperature of 84 deg. Fahr., enough being used to make it coagulate in an hour and a half. If it comes sooner it will be too tough. The curd is not drained of its whey in the ordinary manner, but is removed in slices with a skimming dish, and placed upon a canvas strainer, the ends of which, when it is full, are tied up, and the whey gently pressed out. It is then allowed to drain until next morning, when it is removed and placed in a cool dish, whence, cut in thin slices, it is put up in a hoop made of tin, about ten inches high and eight inches across, and pierced with holes. A clean cloth is placed within the hoop, and as the slices are laid in, a small quantity of salt is sprinkled between the alternate layers. It remains in the hoop, covered up, but without pressure. Next day the cheese is taken out of the hoop and clean cloths are applied;

after which it is inverted and replaced, and pricked with skewers through the holes of the tin hoop, to facilitate the extraction of the whey. In four or five days the curd becomes firm. During this consolidating process the cheeses are kept in a place where the temperature can be maintained at about 100°. When the cheese has become firm enough, it is pared smooth and firmly bound up in a strong fillet of canvas, wrapping it around several times. The binders and cloths are removed every morning; cracks are filled up with curd; and ultimately the coat becomes hardened, and the cheese is removed to the drying room. Dr. Augustus Voelcker, F. R. S., consulting chemist to the Royal Agricultural Society of England, a good authority, who has contributed much to the chemistry of cheese making, has contributed a paper, for English cheese-makers, from which we extract the following interesting and valuable matter to cheese-makers everywhere: Attention has been directed to the flavor of milk, and its liability to turn sour when it is produced from rank, immature herbage. Milk not only differs naturally in regard to flavor and keeping quality, but it is likewise prone to absorb bad smells when it is kept in ill-ventilated or damp places, or in close proximity to pig-stys, water-closets, or under ground house-drains. Milk thus tainted imparts a bad flavor to cheese, and even may spoil it altogether. Too much attention, therefore, can not be bestowed upon the treatment of milk before it is admitted into the cheese-tub. It is a matter of great importance to cool down milk as rapidly as possible after milking, and to get rid by this means of the peculiar animal flavor which characterizes newly-drawn milk. This especially is needful when the evening's milk is kept until next day, and made into cheese with the morning's milk. In many dairies a portion of the cream is removed from the milk, and the partially skimmed evening's milk being added to the new morning's milk, the cream will be equally distributed in the milk. But when the evening's milk is not skimmed and whole milk-cheese is made, care should be taken to amalgamate thoroughly the cream with the milk by gentle agitation before rennet is added. I need hardly say that the milk must be carefully strained through a cloth before it is placed into the cheese tub, and that the utmost attention must be paid to scrupulous cleanliness, and the avoidance of anything calculated to taint the milk. In good dairies no utensil is allowed to remain for a moment in an unclean condition; as soon as it is empty it is rinsed out with clean water—if necessary, scrubbed—and finally scalded with boiling hot water. Cleanliness, indeed, may be said to be the first qualification of a good dairy-maid. With regard to the materials of which the pails and cheese-tubs are made, metallic vessels appear to be preferable to wooden ones, for tin pails, and tin or brass cheese-tubs can be more easily kept clean, and, unlike a porous material such as wood, they do not absorb milk, which will generate acidity, or taint milk that is placed into wooden tubs or pails. Some people maintain that milk which has acquired a faint degree of acidity is none the worse for cheese-making. This may be so; nevertheless, I believe that the fresher milk is, and the less its natural condition has been disturbed, and the sweeter, or neutral, the state of the cheese, and of the whey also, is preserved throughout the process of cheese-making, the finer the flavor of the cheese—if the operation has, however, been well conducted, and the cheese been ripened properly. I have seen some of the finest Cheddar cheese made from sweet milk under conditions which allowed the whey to run off in a perfectly neutral state, so that I could not detect the faintest trace of acid by delicate litmus paper. There is no necessity whatever to harden the curd after its separation from a portion of the whey by scalding it with sour whey, nor is there any necessity for keeping the curd in the whey until it has turned slightly sour. The beneficial effect which is produced on the texture of the curd by scalding it with sour whey, or allowing it to remain in the whey until it becomes slightly acid, and at the same time raising somewhat the temperature of the contents of the tub, is due entirely to the increase in temperature, and has nothing to do with the acid of the whey. This beneficial change may therefore be as well effected by steam or hot water as by heated sour whey, or rather I should say, is preferable to introducing your whey into the manufacture of cheese, and to conduct the process of separation of the curd from the milk, and its subsequent consolidation into a state fit to go into the presses, by gradually raising the temperature either by warm water or steam in a manner whereby a minimum amount of acidity is generated in whey. Curd, in a practical sense, or more strictly speaking, the mixture of caseine and butter which cheese makers call curd, is a very peculiar and delicate substance, which is greatly affected by the temperature to which it is exposed. As curd at different temperatures has a direct bearing on the practice of cheese making, it will not be out of place to refer briefly to some of them. To new milk, cooled down to 60° Farenheit, was added a very large excess of rennet. It took three hours to complete the preparation of the milk into curd and whey. The curd was very tender, and the whey could not be properly separated from it. Milk at 65°, on addition of rennet, curdled in two hours; but the curd as before remained tender, even after long standing. At 70° to 72°, it only took from half an hour to three-quarters of an hour to curdle the milk, and the curd now separated in a more compact condition. The process was more expeditious and the curd in better condition when the temperature ranged from 80° to 84°. At 90°, the rennet curdled the milk in twenty minutes, and at 100°, an excess of rennet curdled the milk in about a quarter of an hour, separating the curd in a somewhat too close condition. By heating the whey and curd to 130°, the curd gets so soft that it runs like toasted cheese, and becomes quite hard on cooling. These experiments clearly show that the limits of temperature between which curd can be improved or become deteriorated in texture are not very wide. Too low a temperature—that is, a temperature under 75°—keeps the curd too tender, and renders it difficult to separate a sufficient amount of whey from the curd to allow the latter to be pressed into cheese that will ripen properly without leaving or acquiring a strong undesirable flavor. On the other hand, too high a temperature—that is, a temperature exceeding 100°—makes the curd unduly hard, in consequence of which the cheese does not acquire in the store-room the mellow texture and the fine flavor which the curd assumes in keeping and ripening when a less elevated temperature is applied in its manufacture. The exact temperature to be adopted depends upon the description of cheese which is desired to be produced. When thin cheese has to be made, a temperature ranging from 72° to 75° is sufficiently high before the rennet is added to the milk, and this temperature should be maintained throughout the process by the addition of warm water, or it may with convenience be increased 5° and raised finally to 80°, but not higher. On the other hand, if the object of the cheese maker is to produce thick Cheddar cheese, the temperature of the milk may with great advantage be raised to 80° to 84° before the addition of rennet. Sufficient rennet should be added to effect a complete separation of the milk into curd and whey in about three-quarters of an hour. The curd may then be cut into large slices, and a portion of the clear whey be run off; after which the temperature of the whole contents of the cheese-tub may be raised gradually, whilst the curd by degrees is broken into small bits, to about 95°, or at most 100°. Cheddar cheese is apt to get hard and dry, and not to ripen properly, when it is made at too high a temperature. On no account should the temperature rise above 100°: and if kept rather below 100°—say at about 95° to 97°—the cheese will turn out all the better, if the curd be carefully broken up, and put into the presses in a perfectly uniform condition. The amount of water which is left in the curd when it is ready to go into the cheese presses, is much larger, and ought to be larger, when thin cheese, made at about 72 to 75° is made than in the making of thick Cheddar cheese, in which a higher temperature is usually raised. In five specimens of curd, ready to go into the vat, and produced according to the custom of Gloucestershire and Wiltshire dairy farmers, the following proportions of water were found: First specimen, percentage of water 59.67; second, 56.93; third, 53.40; fourth, 52.80; fifth, 50.01; whilst four specimens of curd ready to go into the vat, and produced according to the Cheddar plan, contained: First specimen, percentage of water 41.53; second, 41.49; third, 38.20; fourth, 35.80. In the daries in which these curds were produced no thermometer was used to ascertain whether the temperature was such as to secure fairly uniform products from day to day, and hence it is not surprising that one day a much harder curd containing less water and better whey, which the water represents, than another day, when a more tender curd containing more whey was obtained. With reference to the first five named curds the best cheese was made from the curd in which was found fifty per cent of water—that is, the lowest proportion of the five samples. On the other hand, the curd in which was 35.80 per cent. of water, and which was evidently scalded at too high a temperature, a hard cheese of very inferior quality was produced. Too high a temperature not only makes the curd too close and hard, but it is liable also to melt out some of the butter, which passes into the whey, rendering it more or less milky. When the curd is properly managed the whey is almost clear, and scarcely any fatty matter passes into it. Curd requires to be handled very gently, more particularly at first, when it is tender and voluminous. As a rule, the curd is broken up in far to great a hurry. In consequence of careless treatment or heedlessness some of the curd is broken into fragments so small that they pass into the whey when it is drawn off, whilst other portions are not sufficiently broken up and remain soft. The result is, that the curd is not uniform in texture when it is put into the vat, and that in consequence less cheese, and of inferior quality, is produced than when the curd is first cut very gently into large slices, and then broken up by degrees into small fragments perfectly uniform as regards texture. Salting the curd is a simple operation; nevertheless care and judgment is necessary in properly salting curd. A certain amount of salt is used in making cheese, not so much for the purpose of imparting to the curd a saline taste, as for keeping in check the fermentation to which it, like most animal matters, is subject. If no salt were used the cheese would enter too readily into putrefactive fermentation, and acquire a very strong taste and smell. When an extra quantity of cream is put to the milk, it is not necessary, or even desirable, to salt the curd much; we might even do without salt altogether, for the large amount of fat (butter) in extra rich cheese, such as Chilton and Cream Cheddar, sufficiently preserves the curd. If salt is employed in excess the cheese does not ripen properly, nor acquire that fine flavor which depends upon the fermentation proceding in a sufficiently active degree. The saline taste of old cheese is not due to the common salt used in its preparation—at least not to any extent—but to certain ammoniacal salts which are generated during the ripening process from the elements of caseine and the fatty matters, or the butter in the cheese. These ammoniacal salts have a strongly saline, and at the same time aromatic taste and smell, and as they are products generated in the ripening process of the cheese, and not originally present in curd, we have at once an explanation of the fact that quite young cheese is insipid, and old cheese tastes strongly saline. In over-salted cheese the process of ripening sustains too great a check, salt being a powerful antiseptic substance, and hence over-salted cheese, after having been kept for six or eight months, has not nearly so saline a taste as under-salted cheese which has been kept for an equal length of time. For most cases one and a half pounds of salt is a sufficient quantity per 112 pounds of cheese, and when rich cheeses are made one pound will suffice. The salt used in dairies should be of the finest description, and should be sifted evenly through a fine sieve on the curd, after the latter has been passed through a curd mill, and thinly spread in shallow layers to cool. This plan of spreading the salt saves a great deal of labor, and is greatly to be preferred to the system of pickling the cheese in brine after it has been made, or of rubbing in salt. When salt is applied, either in solution or by rubbing it into the cheese after it has been in the presses, the outside is apt to get hard and close up too much. It is, of course, desirable to give the cheese a good and firm coat, but, at the same time, the pores should not be too much closed, for, if this is the case, the superabundance of moisture in newly made cheese can not escape with sufficient readiness. Thin cheeses may be salted after they have been in the press, inasmuch as they present a much larger evaporating surface than thick cheeses, in the making of which the curd is, and for good reasons, salted before it is placed in the vat.

As showing the magnitude of the cheese interest in the United States, from data in the office of the Chief of the Bureau of Statistics at Washington, we find that the exports of cheese for the year 1879 amounted to 141,654,474 pounds, worth $12,597,968. The production of cheese in the United States, is estimated at about 350,000,000 pounds per annum. Great Britain with a population of 32,000,000, consumes about 260,000.000 pounds annually, while the United States with a population of 50,000,000, consumes only about 200,000,000 per annum. The production of cheese is a great and growing industry, especially in the West, where flush pastures, and cheap grain allow the product to be manufactured at a minimum cost. Nevertheless, so constantly does the demand increase, that it is found difficult to meet this increasing demand, for cheese of first quality. Hence, this always finds an early sale, while skim-milk cheese and that adulterated with oleomargarine, or cheese badly cured, remains a drug on the market, and has tended much to depreciate all brands of American cheese in foreign markets, especially that of Great Britain. As showing something of this it may be stated, that although we exported 17,870,738 pounds of cheese more during 1879 than in 1878, we received $1,523,561 less for the product than in the previous year. (See also articles Creamery, Dairying, Dairy Fixtures, and Milk.)

CHEESE MAGGOT. The larva of a dipterous fly, (*Piophila casei*) found in decaying cheese.

CHEESE MITES. Minute, wingless insects with eight legs, (*Acarus siro.*) How they are introduced into cheese is not known, as they appear when no wounds are to be seen on the outside. The probability is the eggs are laid on the surface, and the mites, upon hatching, find their way inside.

CHELONIANS. All tortoises, turtles, etc., which are covered with a double shell.

CHEMISTRY. The science which investigates the nature of matter, and the laws which govern the movements of its atoms. The soil, plants, and manures, animals and all industries are topics of chemical examination. Without knowing something of chemistry no person can practice agriculture except in an empirical way; yet, without actually studying the science, all farmers acquire more or less knowledge of chemistry.

CHEMISTRY, AGRICULTURAL. Chemisty, "The corner stone," in its broad sense, as now understood, is that science which treats of events and changes in natural bodies not accompanied by sensible motion. According to Ure, it is that science which investigates the compensation of material substances and the permanent changes of constitution which their mutual action produce. Forcroy defines it to be that science which explains the intimate mutual action of all natural bodies. To accomplish the object decomposition and combination are the two great forces employed. By the first (analysis) the chemist resolves substances into component parts, and by combination (synthesis) they are brought together again. The older chemists (alchemists) were long employed in the endeavor to find the talisman which would convert the baser metals into gold, and later, in finding a universal solvent (*alkahest*). The Arabians first taught chemistry, but in a very crude way. Alchemists flourished up to the seventeenth century, but in the succeeding and more enlightened age, they were thrown into contempt. The science has since been prosecuted with a view to discover the natural properties and composition of matter. Agricultural chemistry seeks to explain all the actions of earth, air and water, upon plants, and their chemical relation to the geology, mineralogy and chemistry of the soil. Chemistry is the great force in nature and has aptly and correctly been defined as being the corner stone of agriculture. All soils are composed originally of rock, which has been carried about and ground down through successive epochs and ages in the earth's history. For this reason fertile soils do not necessarily overlie those rocks richest in the inorganic constituents of plants, for plants used as food are cultivated on every variety of rock foundation which the earth presents. The fertile soils of the West, (See article Geology) and those of the whole United States, as a rule, have been transported long distances; have been ground down by glacial action and floods, deposited as silt by water; have been decomposed by chemical action, and molded over, time and again, by chemical action through the growth of plants upon them; for the growth of plants is simply phases of that great and wonderful natural force, chemical action. Rocks are divided into two great classes: those formed by fire, and those formed by water. These divisions relate both to the origin and distribution. Dr. Dana says: In their origin, all rocks are truly igneous, or from fire. In their distribution they are aqueous, or by water. This is the only division necessary to the farmer. It is the division taught and demanded by agricultural geology. The first class includes all the highly crystalline rocks, granite, gneiss, sienite, greenstone, porphyry; it includes, also, basalt and lava. The products of volcanoes, whether ancient or modern, agricultural geology places in the same class, including thus all that portion which forms the largest part of the earth's surface. The second class includes sand, clay, gravel, rounded and rolled stones of all sizes, pudding-stone, conglomerates, sandstones, slates. When these various substances are examined, a large part of sand is found to be composed essentially of the ingredients of the igneous rocks. This is true, also, of sandstone, slate, of conglomerates, of bowlders. There is a large deposit, or formation, in some districts, composed almost wholly of some of the chemical constituents of the igneous rocks, united to air. The constituents are lime and magnesia; the air is carbonic acid, forming, by their union, carbonates of lime and magnesia. Marble, limestone, chalk, belong to this formation. These are not to be ranked as original igneous products subsequently distributed by water. The lime, originally a part of igneous rocks, has been separated and combined with air, by animals or plants, by a living process called secretion. The modern production of carbonate of lime is still going on, under the forms of shells and corals. Though belonging to neither division, the subject will be simplified by referring limestone to the second class of rocks; but it is truly a salt. The chemical constitution of rocks is similar. If rocks are divided into two classes, the first composed of those usually called primary, such as granite, gneiss, mica-slate, porphyry; and the second class, composed of rocks usually called trappean, as basalt, green-stone, trap, then the great difference in their chemical constitution is this: The first or granitic class, contains about twenty per cent. more of silex, and from three to seven per cent. less of lime and magnesia and iron, than the second or trappean class. If the language of geology is borrowed, and rocks which present the appearance of layers, or a stratified structure, are divided into two classes, fossiliferous and non-fossiliferous, or those which do, and those which do not contain remains of animals or plants, it will be found, that the fossiliferous are neither granitic nor trappean, yet are they to be classed with the last, agreeing with these, in containing less silica, and more lime, magnesia, and alumina. The stratified, non-fossiliferous rocks agree in chemical composition with the granitic, and the fossiliferous with the trappean and volcanic. The trappean and fossiliferous contain the most lime and magnesia; the granitic and non-fossiliferous the most silex. The great difference in chemical composition between the two classes, is produced by lime and magnesia, two substances which, more than all others, have been thought to influence the character of the soil. The amount of this difference is about from three to seven per cent.; yet notwithstanding this, the general chemical constitution of all rocks approaches so nearly to similarity, that this may be laid down as the first principal in agricultural chemistry, that there is one rock, consequently one soil. A survey of the geographical distribution of plants, used for food, will show that the common doctrine of the chemical influence of rocks on vegetation is not so well supported as to be considered an established principle. It is not intended to deny that rocks do, by their physical condition, affect vegetation. Unless it is shown that their physical state depends upon their chemical constitution, the second principle must be admitted as a general truth. It has been distinctly avowed by Johnston, in his Lectures, that where the soil forms only a surface layer of considerable depth of transported materials, it may have no relation whatever, either in mineralogical characters or in chemical constitution, to the immediately subjacent rocks. This is the general disposition of soil. It is admitted by the author above quoted, that, in Great Britain, in some counties, and in nearly all the coal-fields, the general character and capabilities of the soil have no relation whatever to the rocks on which the loose materials immediately rest. A distinguished authority in our country, Prof. Norton, of Yale, formerly the pupil and assistant of Prof. Johnston, speaking of fertile soils, says that these always contain appreciable quantities of some ten or twelve substances. It makes no difference from whence you bring such a soil, from what part of the world it comes, it will invariably contain these elements in greater or less quantity. Fertile soils are not confined to particular rock formations; they are found overlying all formations, —they are so independent of the rock beneath, that they invariably contain similar elements. Though it may seem premature to place before all who may read this work, the results of analyses, before they have become familiar with chemical names, yet those, here used, are so common that the proof adduced may not be misunderstood. The analysis of the ashes of plants grown on different geological formations, in soil which is stated to have proceeded from the decomposition of the underlying rock, proves how little dependent is the plant on the chemical constitution of the soil. The ashes of the grape-vine, grown on four different soils, afford:

Parts.	I.	II.	III.	IV.
Potash	34.13	24.93	26.41	37.482
Soda	7.59	7.00	8.57	1.336
Common salt	0.83	0.58	0.41	1.614
Lime	30.28	35.94	31.78	34.344
Magnesia	4.66	7.12	9.16	1.055
Phosphate of lime	....	....	....	15.694
Sulphate of lime	4.55	4.02	4.13	6.186
Peroxide of iron	0.16	0.24	0.19	
Phosphoric acid	16.35	19.55	16.87	
Silica	1.45	0.62	2.48	0.725

In No. 4, all the phosphoric acid is included in phosphate of lime, and iron. This analysis is by Crasso, the others by Hruschauer. No. 1 was grown on soil from the *debris* of quartzose rocks, by the decomposition of gneiss, mica-schist, clay-slate, chlorite, hornblende, quartz, and a little lime. No. 2, from soil formed of decomposed limestone, variety called transition. No. 3, from soil formed of decomposed mica-slate. No 4, from soil formed of decomposed porphyry. It is evident, that where the soil has not proceeded from geological drift, as in No. 1, widely different geological formations afford all the mineral elements of plants. Mr. Charles Fox in a work designed for the use of schools and colleges, thus defines the effects of light, and its chemical action: A ray of the sun's light consists of seven rays of different colors, which, uniting, form the ordinary white light. But, besides this, the sun's rays contain three different kinds of rays, as a ray of light, of heat, and a ray of chemical agency. The effect of these on vegetation is essentially different. Yellow light impedes germination, and accelerates that decomposition of carbonic acid, which produces wood and woody tissues. Under its influence, leaves are small and wood short jointed. Red light carries heat, and is favorable to germination if abundance of water is present, increases evaporation, supports the flowering quality, and improves fruit. Under its influence, color is diminished, and leaves are scorched. Blue light, (also called chemical action, or actinism,) accelerates germination, and causes rapid growth. Under its influence, plants become weak and long jointed. These three agencies exist in different proportions in the sunbeam in the spring, summer, and autumn, The blue is greater in spring; the yellow, in summer. The blue, (chemical ray) is less in the fall; and then the heating ray, red, predominates. Thus the sun's rays differ in their properties at different seasons of the year; and are adapted to the peculiar needs of the plant at the time. Still further, the proportions of these agencies vary in different latitudes and climates. Daguerreotypes, depending on these principles, are poor in England, better in France, superior in New York, but best in the Northwestern States. Probably the chemical rays are more abounding in the above proportion, but there is yet much to learn on this subject; and it is not unlikely that the many differences known to exist in animal and vegetable life in these countries will be found to be more or less controlled by these peculiarities of the sun's rays. Gardeners have attempted to make practical use of these facts by means of colored glasses, but, apparently, without much success. Agricultural Chemistry teaches of the composition of the soil and of manures, showing the relative quantities of soluble and insoluble pabulum contained. Thus a soil may contain the inherent principles of fertility, and yet it may be locked up, because insoluble. The air is the great reservoir of fertility, for into the air all organic matter ultimately escapes, and from thence it is again returned to the soil. Decay and decomposition convert organic matter into gases. As such they are held by the air until washed down by the rain, or set free by electrical action. Of these nitrogen is the most important. James F. W. Johnston, in his Lectures on Agricultural Chemistry, treats of the chemical changes by which the substances of which plants chiefly consist are formed from those on which they live. A digest of his remarks must suffice: Before a seed will begin to sprout, it must be placed for a time in a sufficiently moist situation. In the seed no circulation can take place—no motion among the particles of matter—until water has been largely imbibed; nor can the food be conveyed through the growing vessels, unless a constant supply of fluid be afforded to the seed and and its infant roots. A certain degree of warmth—a slight elevation of temperature—is also favorable, and in most cases necessary, to germination. The degree of warmth which is required in order that seeds may begin to grow, varies with the nature of the seed itself. In Northern Siberia and other icy countries, plants are observed to spring up at a temperature but slightly raised above the freezing point (32° F.,) but it is familiar to every practical agriculturist, that the seeds he yearly consigns to the soil require to be protected from the inclemency of the weather, and sprout most quickly when they are stimulated by the warmth of approaching spring, or by the heat of a summer's sun. The same fact is familiarly shown in the malting of barley, where large heaps of grain are moistened in a warm atmosphere. When germination commences, the grain heats spontaneously, and the growth increases in rapidity as the heap of corn attains a higher temperature. It thus appears that some portion of that heat which the growth of the germ and radicles requires, is provided by natural processes in the grain itself; in some such way as, in the bodies of animals, a constant supply of heat is kept up by the vital processes—by which supply the cooling effect of the surrounding air is continually counteracted. It has been observed that seeds refuse to germinate if they are entirely excluded from the air. Hence seeds which are buried beneath such a depth of soil that the atmospheric air cannot reach them, will remain long unchanged, evincing no signs of life—and yet, when turned up or brought near the surface, will speedily begin to sprout. Thus in trenching the land, or in digging deep ditches and drains, the farmer is often surprised to find the earth, thrown up from a depth of many feet, become covered with young plants, of species long extirpated from or but rarely seen in his cultivated fields. Yet light is, generally speaking, prejudical to germination. Hence the necessity of covering the seed, when sown in our gardens and corn fields, and yet not so far burying it that the air shall be excluded. When seeds are made to germinate in a limited portion of atmospheric air, the bulk of the air undergoes no material alteration, but on examination its oxygen is found to have diminished, and carbonic acid to have taken its place. Therefore, during germination, seeds absorb oxygen gas and give off carbonic acid. Hence it is easy to understand why the presence of air is necessary to germination, and why seeds refuse to sprout in hydrogen, nitrogen, or carbonic acid gases. They cannot sprout unless oxygen be within their reach. The leaves of plants in the sunshine give off oxygen gas and absorb carbonic acid,—while in the dark the reverse takes place. So it is with seeds which have begun to germinate. When exposed to the light they give off oxygen instead of carbonic acid, and thus the natural process is reversed. But it is necessary to the growth of the young germ, that oxygen should be absorbed, and carbonic acid given off—and as this can take place to the required extent only in the dark, the cause of the prejudical action of light is sufficiently apparent as well as the propriety of covering the seed with a thin layer of soil. During germination, vinegar (acetic acid) and diastase are produced. That acetic acid is formed is shown by causing seeds to germinate in powdered chalk or carbonate of lime, when after a time acetate of lime may be washed out from the chalk (Braconnot) in which they have been made to grow. The acid contained in this acetate must have been formed in the seed, and afterwards excreted or thrown out into the soil. When the germ has shot out from the seed and attained to a sensible length, it is found to be possessed of a sweet taste. This taste is owing to the presence of grape sugar in the sap which has already begun to circulate through its vessels. It has not been clearly ascertained whether the vinegar or the diastase is first produced when germination commences, but there seems little doubt that the grape sugar is formed subsequently to the appearance of both. The young shoot which rises upwards from the seed consists of a mass of vessels, which gradually increase in length, and after a short time expand into the first true leaves. The vessels of this first shoot do not consist of unmixed woody fibre. The vessels of the young sprout, therefore, and of the early radicles, probably consist of the cellular fibre of Payen. They are unquestionably formed of a substance which is in a state of transition between starch or sugar and woody fibre, and which has a constitution analogous to that of both. Having thus glanced at the phenomena which attend upon germination, let us now consider the chemical changes by which these phenomena are accompanied. The seed absorbs oxygen and gives off carbonic acid. Now it appears that in contact with the oxygen of the atmosphere, a portion of the starch is actually separated into carbon and water, the carbon at the moment of separation uniting with the oxygen, and forming carbonic acid. This acid is given off into the soil in the form of gas, and thence partially escapes into the air. The action of dilute acids gradually changes starch into cane sugar, and the latter into grape sugar. While it remains in the sap of the sprouting seed, the vinegar may aid the diastase in transforming the insoluble starch into soluble food for the plant, and may be an instrument in securing the conversion of the cane sugar, which is the first formed, into grape sugar,—since cane sugar can not long exist in the presence of an acid. The early sap of the young shoot is sweet; it contains grape sugar. This sugar is also derived from the starch of the seed. Being rendered soluble by the diastase formed at the base of the germ, the starch is gradually converted into grape sugar as it ascends. The water which is imbibed by the seed from the soil, forms an abundant source from which the whole of the starch, rendered soluble by the diastase, can be supplied with the elements of the two atoms of water which are necessary to its subsequent conversion into grape sugar. The diastase is formed when the seed begins to sprout, at the expense of the gluten or vegetable albumen of the seed. When the true leaf becomes expanded, true wood first appears in sensible quantity. When the true leaf is formed the plant has entered upon a new stage of its existance. Up to this time it is nourished almost solely by the food contained in the seed—it henceforth derives its sustenance from the air and from the soil. The apparent mode of growth is the same, the stem shoots upwards, the roots descend, and they consist essentially of the same chemical substances, but they are no longer formed at the expense of the starch of the seed, and the chemical changes of which they are the result are entirely different The leaf absorbs carbonic acid in the sunshine, and gives off oxygen in equal bulk. It is in the light of the sun that plants increase in size—their growth, therefore, is intimately connected with this absorption of carbonic acid. If carbonic acid be absorbed by the leaf and the whole of its oxygen given off again, carbon alone is added to the plant by this function of the leaf. But it is added in the presence of the water of the sap, and thus is enabled by uniting with it to form, as it may be directed, or as may be necessary, any one of these numerous compounds which may be represented by carbon and water, and of which the solid parts of plants are chiefly made up. There are two ways in which we may suppose the oxygen given off by the leaf to be set free, and the starch, sugar, and gum, to be subsequently formed. The action of light on the leaf of the plant may directly decompose the carbonic acid after it has been absorbed, and cause the oxygen to separate from the carbon, and escape into the air; while at the same instant the carbon thus set free, may unite with the water of the sap in different proportions, so as to produce either sugar, gum, or starch. Or the action of the sun's rays may be directed, in the leaf, to the decomposition, not of carbonic acid, but of the water of the sap. The oxygen of the water may be separated from the hydrogen, while at the same instant the latter element (hydrogen) may unite with the carbonic acid to produce the sugar or starch. The result here is the same as before, but the mode in which it is brought about is very differently represented, and appears much more complicated. Water is first decomposed and its oxygen evolved, then its hydrogen again combines with the carbon and oxygen of the carbonic acid, and forming two products—water and sugar or starch. This view is not only more complicated, but it supposes the same action of light to be—continually, at the same time, and in the same circumstances—both decomposing water and re-forming it from its elements. While, therefore, there can be no doubt, for other reasons not necessary to be stated in this place, that the light of the sun really does decompose water in the leaves of plants, and more in some than in others—yet it appears probable that the oxygen evolved by the leaf is derived in a great measure from the carbonic acid which is absorbed; and that the principal part of the solid substance of living vegetables, in so far at least as it is derived from the air, is produced by the union of the carbon of this acid with the elements of water in the sap. Prof. R. C. Kedzie, in an address before the Michigan Legislature, on The Application of Chemistry to Practical Agriculture and the Laws of Health, thus describes the duties of an agricultural chemist: One duty often assigned to the agricultural chemist by those who know little either of chemistry or agriculture, is to analyze the soil, as if the chemical analysis of the soil would determine every question of its agricultural capabilities, the kind, amount, and quality of the crops it would raise. In the early history of the science, analysis of certain barren soils revealed the cause of the barrenness in the sulphate of iron present. When this was removed or decomposed by lime, the soil was fruitful. A few instances of this kind gave great hopes of benefit from soil-analysis. But such instances of barrenness from purely chemical causes are extremely rare and exceptional. But it is often found that the most careful chemical analysis will not distinguish between a barren and a fertile soil. One reason is that the barrenness may be due to physical causes—for instance, want of drainage. Chemical analysis can only determine the chemical conditions of the soil, and will not always reveal physical evils. Agricultural chemists now regard the analysis of the soil as of only secondary importance. One duty of the chemist is to explain the facts which are already known in agriculture. By knowing the reason why we do a thing we may discover better ways of doing it, or that some other or easier process may accomplish the same result. We thus sift our processes and eliminate needless elements or introduce better ones. The chemist may benefit the farmer by making analyses of manures and determining their nature and value. Artificial manures are being largely introduced into this country, and farmers may want to know whether it will pay to buy and use them. The Sheffield Scientific School, of Connecticut, has done the farmers of the East good service by analyzing these manures—the superphosphates, guanos, etc —showing their composition and real cash value. The chemist may aid the farmer by showing the value of manurial matters within his reach, enabling him to secure at home what is now imported at such great expense from abroad. Deherain, of France, made the important discovery that when vegetable matter undergoes decomposition in presence of some alkaline substance, it combines with free nitrogen and retains it in a fixed form. This has been confirmed at the Sheffield Scientific School, and science may yet point out the means by which the farmer may make at home all the combined nitrogen he may need for his farm. Some late researches have shown many important and interesting facts in the relations of chemistry to agriculture. Thus the experiments of Prof. Goessman, of the Massachusetts Agricultural College, upon the culture of the beet, have shown that it is better that the organic matter in the soil should be decreased, while the assimilable inorganic matters should be increased. Therefore a crop of beets should not be planted on a soil to which barn-yard manure has been recently applied. It is better to delay the sowing until the organic matter has been decomposed, and only the mineral matter remains, thus reducing the size of the beet but greatly increasing its percentage of sugar. Deherain's experiments, at Grignon, furnished results of a very similar character generally. In experiments upon the exhalation of moisture by plants in air and in carbonic acid, Mons. A. Barthelemy obtained results which led him to the conclusion that this action may be effected in three ways: 1. By insensible exhalation from the entire surface of the cuticle by a true gaseous dialysis. 2. By sudden emission of saturated gases which escape from the stomata when the plant is submitted to a rapid elevation of temperature, especially when inclosed. 3. By accidental exudation resulting from a defect in the equilibrium between the absorptive action of the roots and the work of the parts exposed to the atmosphere in fixing carbon combined with the elements of water—work which ceases with the disappearance of light. He believes that it is also right to conclude that heat exercises a strong influence upon this function, and that, at the equal temperatures, carbonic acid, in the presence of light, has the effect of diminishing the evaporation. With regard to the exhalation of ozone by plants, Bellucci has found that the air is not ozonized by coming in contact with the living plants or with parts of plants recently cut, but that the re-action previously supposed to be due to the action of ozone produced in this way, is due to the action of free oxygen and light. The same test made with exclusion of light, other conditions remaining the same, gives no re-action. These facts support the opinions resulting from the previous experiments of Cloëz and Scoutetten, and are themselves supported by the experiments of Mr. Charles Kinzett, of England, who showed that ozone is not produced during the oxidation of essential oils, but that the re-action heretofore supposed to be due to ozone is, in such cases, due entirely to the influence of certain easily reducible organic compounds of oxygen. The results of both the above investigators have been confirmed in a similar manner in our laboratory. Haberlandt, by a series of important experiments, has shown that the limits of the temperature of germination of agricultural seeds vary from 3.8° Reaumer to 35° to 40° Reaumer, but that the most favorable temperature for germination seems to be from 13° to 20° Reaumer's thermometer. This thermometer has its zero at the freezing point, 32° Farenheit, and its boiling point at 80° or 212° of Farenheit. From 40° to 130° Farenheit is the range of germinating power in seeds. The most favorable temperature ranging from about 60° to 90°. Though these may be the limits under ordinary circumstances, Krausen has shown that if wheat-grain be thoroughly dried by gradual heating, and with the aid of chloride of calcium, it may then be heated to the temperature of boiling water without losing its germinating power. The presence of nitrate of potash as a definite compound in plants, has been fully demonstrated by at least two investigators during the past year. M. A. Boutin found in *Amarantus ruber*, in the dried condition, sixteen per cent., and in *A. purpureus* 22.77 per cent.; and he recommends the cultivation of these, as well as *A. blitum*, which he has previously shown to contain this compound, for the production of nitre. P. Gennadius has confirmed these statements, having obtained crystals of potassic nitrate from *A. albus* as well as from *Cannabis sativa, Lactuca sativa, Batata edulis, Lycopersicum esculentum, Lappa major*, and *Artemesia absinthum.* He has also demonstrated the presence of nitrous acid in a large number of other plants. We have also to note the contributions made to our knowledge of the assimilation of nitrogen and ammonia by plants, and the formation of assimilable compounds of nitrogen from the nitrogen of the atmosphere. Reasoning from the results of Deherain's experiments, we would conclude that the atmospheric nitrogen used by the plant is supplied through the medium of the soil, where it is fixed by means of the hydrocarbons (such as humus) with the assistance of alkalies. This action is said to be favored by the absence of oxygen. Deherain's work has been more elaborately carried out by Armsby, under the direction of Prof. S. W. Johnson. The results of his experiments showed that the loss of nitrogen in the decomposition of nitrogenous organic matters in the compost heap could be very materially increased by the addition of caustic or carbonated alkalies. Ville states that in such decomposition thirty per cent. of the nitrogen present in the material is lost. Armsby finds that compost containing three and a quarter per cent. nitrogen, most of it in organic combination, lost eleven per cent. of the nitrogen in two months. Addition of gypsum reduced this loss to six per cent., but when potash was added to the extent of five per cent. there was no loss, but an actual gain of fifteen per cent. on the amount originally present. Prof. Johnson's experiments in this particular, with caustic lime, will doubtless give similar results. Contributions of an important character have also been made concerning the absorption of ammonia by the aerial portion of plants. That plants can absorb ammonia is fully established by the investigations of Schloesing and Mayer; but the latter investigator considers that we can have normal growth only when the ammonia is supplied to the roots, and that leguminous plants have not the special power to absorb and assimilate atmospheric nitrogen. Again Dr. Hellriegel, of Dohme, prosecuted an elaborate series of experiments, from the results of which it appears that ammonia-salts should not be applied to soils deficient in lime, for as the ammonia is taken up by the plants mineral acids are liberated, which have an injurious action on the roots. The subject will be found treated of further in the articles Germination, Geology, Manures, Soils, and other subjects of a like character.

CHENOPODIACEÆ. A family of plants, of which *Chenopodium* is a genus. They are herbaceous, growing on very rich lands, have a solitary carpel, stamens of the same number as the divisions of the calyx, without bracts or petals. Wormseed (*Ch. anthelminticum*) is the only medicinal species. Beets, spinach, and goose foot belong to this family; the leaves, and indeed the whole plant, are mucilaginous, and may be eaten as food when not unpleasant to the palate.

CHERIMOYA. *Anona cherimolia*, a tree of tropical America. *Anona*, the custard apple. There are seventeen species, which grow from cuttings and seeds.

CHERRY. *Prunus cerasus.* The cherry of horticulturists was said to have been brought from Ceresus, a city in Pontus, to Italy, after the defeat of Mithridates, by Lucullus. About one hundred and twenty years afterwards, or in A.D. 55, it was taken to Britain by the Romans. A fruit universally cherished, it became disseminated where civilization extended, and is now cultivated, in some of its varieties, in every climate where the tree will survive the winter. West of Lake Michigan, only the Kentish and Morello varieties are generally cultivated, since the sweet varieties are so subject to bark bursting and exudation of gum, as to render their cultivation unprofitable. Along the Eastern shore of Michigan, however, the sweet varieties are cultivated with measurable success, well up to the Northern limit of the lake. As we proceed East and especially South, all varieties are more or less cultivated. The cherry is propagated both by grafting and budding, the latter preferably. Grafting is done in the spring before the appearance of the leaf, and budding as soon as the terminal bud is perfectly formed, at the North generally in August; and, in severe climates, at such height as is required for the head to be formed. For family use we incline to the opinion that it is preferable to bud on Mahaleb stocks, and under the surface if grafted, since they are apt to kill at the junction. Thus we have no suckers, and the fruit is larger. On Morello stocks, however, we get earlier and more profuse bearing, and for market purposes, it is undoubtedly best, in all that region where Early Richmond and Late Morello are the varieties planted, and this embraces the whole West and Northwest, except where previously noted. Below will be found a list of varieties, as revised by the American Pomological Society, and adapted to various latitudes of the United States.

The columns explain as follows. Size—l., large; m., medium; s., small. Form—ob. h., obtuse heart shape; r. ob. h., roundish obtuse heart shape; r. h., roundish heart shape; r., roundish or round. Color—l. r., lively bright red; d. r. dark red, almost black; a. m., amber mottled with red; y. r., yellow ground shaded and marbled with red. Class—H., Hearts, or

		DESCRIPTION.							I.—			
Number.	NAMES.	Size.	Form.	Color.	Class.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine	New Hampshire.
1	Arch Duke	l.	ob. h.	d. r.	D.	K. M.	L.	F.	..	..	..	..
2	Belle Magnifique	l.	r. h.	l. r.	D.	K. M.	L.	F.	..	..	*	..
3	Belle de Choisy	m.	r.	a. m.	D.	F.	M.	F.	+	..	■	..
4	Belle d'Orleans	m.	r. h.	y. r.	H.	F. M.	E.	F.	..	..	..	..
5	Bigarreau (Graffon, Yellow Spanish.)	l.	ob. h.	y. r.	B.	F. M.	M.	F.	■	..	..	..
6	Bigarreau of Mezel (Monstrueuse de Mezel, Bigarreau Gaubalis.)	l.	ob. h.	d. r.	B.	F. M.	M.	F.	..	..	..	..
6	Black Eagle	l.	ob. h.	d. r.	B.	F. M.	M.	F.	..	..	..	..
8	Black Heart	l.	r. h.	d. r.	H.	F. M.	M.	F.	*	..	..	..
9	Black Republican	l.	r. h.	b.	G.	F. M.	......	Am.	..	..	..	..
10	Black Tartarian	l.	r. h.	d. r.	H.	F. M.	M.	F.	*	..	..	..
11	Buttner's Yellow	m.	r.	y.	G.	F. M.	L.	F.	..	..	..	..
12	Carnation	m.	r.	a. m.	D.	K. M.	L.	F.	..	..	■	..
13	Coe's Transparent	m.	r.	a. m.	H.	F.	M.	Am.	..	..	..	..
14	Donna Maria	m.	r.	d. r.	M.	K. M.	L.	F.	..	..	■	..
15	Downer's Late	m.	r. h.	y. r.	H.	F. M.	L.	Am.	*	..	..	..
16	Early Purple Guigne	m.	r. h.	d. r.	H.	F. M.	E.	F.	..	..	.	.
17	Early Richmond	s.	r.	l. r.	M.	K. M.	E.	F.	..	..	■	..
18	Elton	l.	r. h.	y. r.	B.	F. M.	M.	F.	..		..	..
19	Governor Wood	l.	r. h.	y. r.	H.	F. M.	M.	Am.	..	..	..	..
20	Gridley	m.	r.	d. r.	B.	M.	M.	Am.	..	..	..	..
21	Hovey	l.	r. h.	y. r.	B.	F. M.	M.	Am.	..	..	..	..
22	Knight's Early Black	l.	ob. h.	d. r.	H.	F. M.	E.	F.	..	..	..	..
23	Late Duke	l.	ob. h.	d. r.	D.	K. M.	L.	.....	..	..	■	..
24	Late Kentish	m.	r.	r.	G.	K.	M.	F.	..	..	..	..
25	Louis Phillippe	l.	r.	d. r.	D.	K. M.	L.	F.	..	..	*	..
26	May Duke	l.	r.ob.h	d. r.	D.	K. M.	E.	F.	■	..	*	..
27	Morello (English Morello, Large Morello.)	l.	r. h.	d. r.	M.	K. M.	L.	F.	..	..	*	..
28	Napoleon (Royal Ann, in California and Oregon.)	l	r.ob.h	y. r.	B.	F. M.	M.	F.	..	..	..	..
29	Osceola	l.	r. h.	d. r.	H.	F. M.	M.	Am.	..	..	..	..
30	Ohio Beauty	l.	ob. h.	y. r.	H.	F. M.	M.	Am.	..	..	..	..
31	Plumstone Morello	l.	r.	d. r.	M.	K. M.	L.	F.	.	..	*	..
32	Pontiac	l.	ob. h.	d. r.	H.	F. M.	M.	Am.	..	..	..	..
33	Red Jacket	l.	ob. h.	y. r.	H.	F. M.	L.	Am.	..	..	..	..
34	Reine Hortense	l.	r.	l. r.	D.	F. M.	L.	F.	..	..	■	..
35	Rockport	l.	r.ob.h	a. m.	B.	F. M.	E.	Am.	..	.	..	..
36	Royal Duke	l.	r.	d. r.	D.	K. M.	M.	F.	..	..	.	
37	Tecumseh	m.	ob. h.	d. r.	H.	M.	L.	Am.	..	..		..
38	Tradescant's Black Heart (Elkhorn, Large Black Bigarreau.)	l.	r. h.	d. r.	B.	M.	L.	F.	..		..	..

8 A fine old variety, but by many supposed superseded.
14 Very hardy and productive.
20 An old variety, very firm flesh; carries well to market.

tender fleshed sweet cherries; B., Bigarreau, or firm fleshed cherries: D., Dukes, having a character in tree and fruit midway between the Hearts and Morellos; M., Morellos, having acid fruit, and the tree of small, slender growth. Use—F., family, for dessert; F. M., family or market; K. M., for kitchen or market; M., market. Season—E., early; M., medium; L., late. Origin—F., foreign: Am., American. Value—* signifies doing well, adapted to; ** well adapted, and † signifies on trial, or experimental.

CHERT. A silicious mineral resembling flint.

CHERVIL. *Chærophyllum sativum.* A pot-herb resembling parsley, used by the French and other European nations, notably the Germans and Hollanders, in soups and as salads. The seeds are sown in spring, in drills eight inches apart, the plants thinned to eight inches apart, and kept free of weeds. It flowers in the fall, but is little used in American cookery.

CHESHIRE SWINE. One of the breeds of swine, which have become more than locally popular are the Cheshire, originated in Jefferson county, N.Y. They are a modified form of the Suffolk, having, like the Suffolks, been formed by crosses of Yorkshire and other white breeds of that class. Cheshires are pure white in color, have but little hair, as a rule, but individual pigs of a litter will vary much in this respect. The snout is rather long, but fine. The ear erect and fine. The shoulders wide, and the hams full. The flesh is fine grained and yields a large amount of mess pork, in proportion to the offal. The breed is not widely disseminated and they are not now bred so largely in their native locality as formerly, since they do not differ sufficiently from the Suffolk or Yorkshire, to make them sought after in preference to this latter breed, and in fact they do not seem to be an improvement on this admirable class of swine. So the Suffolk, which are but modified Yorkshires, have of late years ceased to attract the attention among breeders they once did, even in England. In the United States, all white breeds, when bred very fine, are not adapted to the sun, rain, and other weather that must be encountered, in the ordinary way of keeping. Hence among feeders

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°										
Number.	Vermont	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland & D. C.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Missi-sippi	Louisiana.	Texas.	New Mexico.	Arizona.
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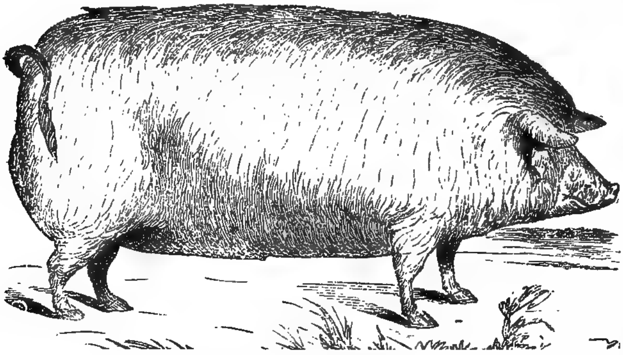
25 An old excellent sort; little known.

33 The latest ripening large sweet cherry.

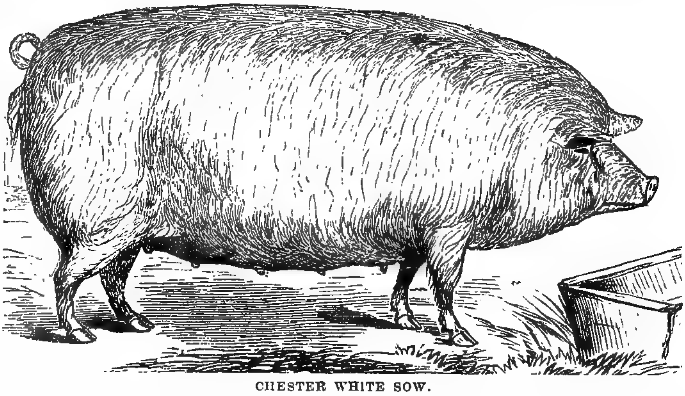
in the great corn-growing districts, the highly-bred black or black and white breeds are more popular than the finely-bred white breeds.

CHESS. *Bromus.* Brome-grass. Dr. Darlington, in Weeds and Useful Plants, carefully and tersely describes this pest of our winter wheat fields, and also controverts the popular idea of transmutation. We know some otherwise intelligent men, who still believe that wheat will turn to chess, nay, that oats will turn to timothy. It is needless to say it is a botanical impossibility, as much so as that wheat could turn to Indian corn. The description of chess is as follows: This foreigner is a well-known pest among our crops of wheat and rye,—and occasionally appears in the same fields, for a year or two, after the grain crop; but being an annual, it is soon choked out by the perennial grasses,—and the fallen seeds remain, like myriads of others, until the ground is again broken up, or put in a favorable state for their development. The best preventive of this and all similar evils, in the grain-field, is to sow none but good, clean seed. Among the curious, vulgar errors which yet infest the minds of credulous and careless observers of natural phenomena, may be mentioned the firm belief of many of our farmers, (some of them, too, good practical farmers) that this troublesome grass is nothing more than an accidental variety, or casual form, of degenerate wheat, produced by some untoward condition of the soil, or unpropitious season, or some organic injury, though it must be admitted, I think, by the most inveterate defender of that faith, that in undergoing the metamorphosis, the plant is surprisingly uniform in its vagaries, in always assuming the exact structure and character of bromus. A similar hallucination has long prevailed among the peasantry of Europe, in relation to this supposed change of character in the grasses. But, in the Old World, they were even more extravagant than with us; for they believed that wheat underwent sundry transmutations, first changing to rye, then to barley, then to bromus, and finally from bromus to oats. I believe the most credulous of our countrymen have not been able, as yet, to come up with their transatlantic brethren, in this matter. This grass has been cultivated within a few years as Willard's Bromus, and the seed sold at a high price. The farmers found that they not only did not get a valuable grass, but were really propagating a worthless and pernicious weed, being thus doubly cheated. The principal varieties are as follows: *B. secalinus.* Panicle spreading, even in fruit; spikelets ovate-oblong, eight and ten flowered; florets pubescent; awn short, sometimes very short or none; known as Cheat, Chess, Brome-grass. *B. racemosus.* Panicle erect, contracted in fruit; lower palea decidedly exceeding the upper, bearing an awn of its own length; known as Upright Chess, Smooth Brome-grass. It is a worthless species found in grain-fields, as is *B. mollis*, which resembles the preceding, but has long awned flowers which, as also the leaves, are downy, and the spikelets are closely imbricated. By some, the two are considered as forms of the same species. There are two native species of the genus, of no agricultural value. All the varieties of Chess, are of but little value in agriculture, and should be treated as weeds, and, in fact, are so treated by intelligent farmers in all sections.



CHESTER WHITE BOAR.

CHESTER WHITE SWINE. The Chester County, or Chester White hogs, originated in Chester county, Penn., sometime in 1818, through the introduction of a pair of pigs said to have been brought there, from Bedfordshire, England, by a sea captain, James Jeffries. These were bred, and crossed upon the best white hogs of the country about, and by selection and care through many years, the strain eventuated in a race whose characteristics became constant, forming large, quiet, good feeding, and easily fattened hogs, considered excellent lard and bacon hogs. Upon the introduction of Berkshire and also Suffolk, these breeds were intercrossed with the Chesters, but not satisfactorily. At one time they stood at the head of the large white breeds of the United States, East and West. They are exceedingly hardy in constitution, and will, North, still have many admirers among breeders of large hogs. The principal objection to them being that they



CHESTER WHITE SOW.

are rather coarse, from the stand point of fanciers of fine boned hogs, and they lack early maturity. They are, however, gradually giving way, in the corn-zone of the West, to other breeds, notably the Poland-China and Berkshires, but further North they are still extensively bred. The illustrations we give, of a boar and sow in breeding condition, will give a good idea of the breed. The Chester swine should have length and depth of carcass, a broad, even, straight back, large hams, and the shoulder carrying meat well formed, rather small bone, small head, with heavy jowl, face rather dished, and straight hair, and short neck. It is, however, undeniably true that this breed varies much, probably from the fact of the many crosses taken, and the infusion of native blood in an early day. Hence the reason why of late years they have not held their own, except in the case of particular breeders who have kept their strains comparatively even in form and quality.

CHEST FOUNDER. (See Founder.)

CHESTNUT. *Castanea Americana.* This most valuable timber and ornamental tree has a wide range, being found from Maine to Michigan and South. In the States west of Lake Michigan it is not indigenous, neither is it found, we believe, unless planted, west of the Mississippi river, either south or north. In the South it is common in the mountain forests. The chestnut requires a dry soil, but is not particular about its being rich. Rocky or dry, sandy or loamy ridges suit it admirably, and in all such situations it will well repay planting anywhere south of Central Iowa. The wood is most valuable for furniture and inside finishing, and the nuts always command a good price in any market. When the trees are large enough to fell, a new growth immediately springs from the stump, and thus the plantation is renewed. The European variety (*C. vesca*) closely resembles the American, grows to an immense size, and the nuts are nearly the size of black walnuts. It is not hardy north of Washington, D. C., but in a climate suited to it it is said to bear fruit in seven years from seed. To raise a plantation, prepare the ground by thorough and deep plowing; lay it off four feet apart, making the furrows so the nuts may be covered three inches; plant in these drills two feet apart. The second or third year, according to the growth, remove every other row, and the next year every other plant in the remaining row. Thus they will stand 8x4 feet. When the trees interfere, take out every other plant, and so continue until the trees stand one rod apart. At this distance they will make pretty large trees, but if they are to attain their full stature they must at length stand thirty-two feet apart, or even 32x64 feet. This rule will apply to forest tree planting generally. The nuts of the chestnut must be kept in moist sand, from the time of gathering until planted in the spring. Here again the rule will apply to all nuts, and forest tree seeds. All nuts may be planted in the autumn as soon as gathered, but thus they are liable to be destroyed by mice and other small animals Consequently it is better that they be kept in moist sand until signs of germination are seen. Thus they come up quickly, and much vexation is saved in weeding, as well as loss from the attacks of vermin.

CHEWING THE CUD. The animals which chew the cud (*Ruminants*) include the ox, deer, camel, and sheep. They are furnished with four pouches or stomachs; the grass gathered on the field is swallowed and reaches the first pouch, is moistened by water from the second, and afterward moulded into round balls, which are thrown up into the mouth and leisurely chewed, and re-swallowed into the third stomach, to be digested in the fourth. Such animals are essentially herbivorous, and require rest during rumination. Any interference with this process is a sign of disease. (See Cud, loss of.)

CHICCORY. *Cichorium.* This plant, also called Succory and Wild Endive (*C. intybus*), is a naturalized foreigner, and, being hardy, where it gets hold is a troublesome weed. *C. endivia*, in Europe, is esteemed and used as a salad plant, when about a foot high, the tops being tied together, over the heart, and the sides earthed up, in order to blanch them. The seed should be sown early in the spring in drills sixteen inches apart, covered three-quarters of an inch deep, and thinned, when large enough, to six or eight inches in the row. The cultivation and blanching of Endive is precisely similar and the plant is a much nicer bitter salad than chiccory. The principle use of Chiccory is for the roots, which when sliced and kiln-dried, are used in the adulteration of ground coffee. It is raised by sowing the seeds upon very rich, deeply-trenched ground, in drills eighteen to twenty inches apart, keeping the rows clear of weeds, and thinning to about six inches in the row. In the autumn the tops are cut and the roots raised by a peculiar plan, which cuts the tap root some eighteen inches below the surface, slightly lifting the roots; or by a plan which turns the roots out of the soil, at the same time covering the cut tops, the plan being to go around the field, one row being removed before the next is worked. With the sub-soil lifter, however, the earth is not turned, and this plan is preferable. The cultivation of Chiccory has been introduced into the United States several times, and abandoned. The following was the plan pursued at a plantation twelve miles east of Sacramento, California, in 1872, the cultivation having since, we believe, been abandoned. The yield was reported at fifteen tons per acre, of green roots; and the yield of the State was placed in that year at 5,000 tons. The farm near Sacramento, used for the cultivation of chiccory, consisted of 180 acres, of which seventy acres were rich bottom-land. Sixty acres of this were seeded to Chiccory in January and February, 1872, and were gathered in July, August, September and October. The land was prepared by deep plowing, replowing six or seven inches deep just before planting, thoroughly pulverizing with a harrow. The seed was put in by a drill-machine, in drills about one foot apart. As soon as the shoots appeared above ground, twenty-five to thirty Chinamen were employed in weeding and hoeing, working about ten weeks, till the weeds ceased growing. In harvesting, four Chinamen, with sharp hoes, cut off the tops, which were turned under by an eight-horse plow, while the roots were turned to the surface. Laborers following the plow threw the uncovered roots in piles, and others coming after with a potato-hook, uncovered whatever plants were not unearthed by the plow. The roots were then loaded and carried to the factory, where they were passed through a shoot in order to remove sand, etc. From thence the roots were passed to the cutter, a knife-armed cylinder which, revolving rapidly, cut them in strips two or three inches long by one-quarter-inch or more in thickness and width. These were raised to a large drying platform, where they were spread in a layer about two inches thick, and stirred daily for a week, at the end of which period they were sufficiently cured for roasting and storing. The roasting was done in the second story of the factory, which was three stories high. The roaster was a sheet-iron cylinder, four and a half feet long by two feet in diameter, supported by shafts, and revolving in a brick oven. Five bushels constituted a charge for the roaster, and two hours were required for roasting. When this was completed, the chiccory was poured out, cooled, and passed to the first floor, where it was ground in a mill. The chiccory was then sieved, the coarser portions reground, and the rest passed through a fine sieve before barreling. The factory turned out five tons of chiccory per week, running in the day-time only, employing a ten horse-power engine for motive-power. The cultivation of chiccory has never proved remunerative in the United States, unless it may have been in California. It is to be hoped it never will, since its cultivation is simply for use as an adulterant to coffee. While its use can not be distinctly stated as injurious, it is, nevertheless, a fraud upon the buyer of coffee when mixed therewith. If the good wife chooses to furnish chiccory as a family beverage, well and good, the pure chiccory can be bought or raised since its cultivation is as easy as that of the parsnip or carrot.

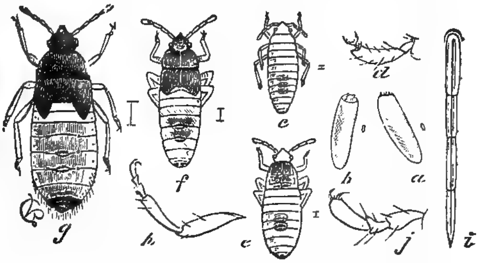
CHICK, or CHICKEN. (See Poultry.)

CHICK-PEA. *Cicer arietinum.* This is a pea much used in Europe, for flavoring soups and also for eating green in the south of Europe. Like the bean it will not stand frost. It is an upright, husky plant, requiring no support, and will mature where Indian corn will, but is not valuable for cultivation in the United States.

CHIGOE, or CHIGGER. An apterous minute insect, which abounds in southern and tropical America. It penetrates the skin of the foot and breeds therein, producing intolerable itching. Unless destroyed, or picked out with a needle, it finally brings about ulcerations.

CHILIAN CLOVER. (See Alfalfa.)

CHINCH BUG. *Micropus leucopterus.* This bug, when favorable seasons allow it to increase largely, is one of the most destructive of noxious insects. The Wheat Midge, the Grain Plant Louse, the Hessian Fly, destructive as they are in particular seasons, are, all combined, not to be so dreaded as this pest of the cereal crops. Insignificant as this minute scourge may seem, being little more than an eighth of an inch long, yet when they appear in countless millions, covering fields black, and sucking the life of the plants with their myriad beaks, the hopes of the farmer may well cease. Fortunately, they are assailed by numerous foes, and by fungus enemies. They may also be successfully destroyed by persistent effort. The illustrations give this insect in all its stages of transformation, the hair lines at the bottom of the perfect insect and at the sides of other figures showing the natural size.



Explanation: *a*, *b*, eggs; *c*, newly hatched larva; *d*, its tarsus (part of the foot to which the leg is joined); *e*, larva of the first moult; *f*, larva after second moult; *g*, pupa; *h*, leg of perfect insect; *j*, being the same still more highly magnified; *i*, proboscis in beak. Dr. Riley gives the natural history of this pest, including some observations on insects in general, which is so terse and comprehensive that we quote it nearly entire: In the four great and extensive Orders of Insects, namely, the Beetles (*Coleoptera*), the Clear-winged Flies (*Hymenoptera*), the Scaly-winged Flies (*Lepidoptera*), and the Two-winged Flies (*Diptera*), and in one of the four small orders in its restricted sense, namely, the Net-winged Flies, (*Neuroptera*) the insect usually lies still throughout the pupa state, and is always so far from being able to eat or to evacuate, that both mouth and anus are closed up by membrane. In the three small orders, on the contrary, namely, that of the Straight-winged Flies in its most extensive sense (*Orthoptera* including *Pseudo-neuroptera*), the Half-winged Bugs (*Heteroptera*) and the Whole-winged Bugs (*Homoptera*), the pupa is just as active and just as ravenous as either the larva or the perfectly developed and busy insect, and the little creature never quits eating as long as the warm weather lasts, except for a day or so while it is accomplishing each of its successive three, four or five moults. As the Chinch Bug belongs to the Half-winged Bugs, it therefore continues to take food, with a few short intermissions, from the day when it hatches out from the egg to the day of its unlamented death. Most insects—irrespective of the Order to which they belong—require twelve months to go through the complete circle of their changes, from the day that the egg is laid to the day when the perfect insect perishes of old age and decrepitude. A few require three years, as for example the Round-headed Apple-tree Borer (*Saperda bivittata*, Say) and the White Grub which produces the May-beetle (*Lachnosterna quercina*, Knoch). One species, the Thirteen-year Locust (*Cicada tredecim*, Riley) actually requires thirteen years to pass from the egg to the winged state; and another, the Seventeen-year Locust (*Cicada septemdecim*, Linn.) the still longer period of seventeen years. On the other hand there are not a few who pass through all their three states in a few months, or even in a few weeks; so that in one and the same year there may be two, three or even four or five broods, one generated by the other and one succeeding another. For example, the Hessian Fly (*Cecidomyia destructor*, Say) the common Slug-worm of the Pear (*Selandria cerasi*, Peck) the Slug-worm of the Rose (*Selandria rosæ*, Harris) the Apple-worm and a few others, produce exactly two generations in one year, and hence may be termed two-brooded. Again, the Colorado Potato-beetle in Central Missouri is three-brooded, and not improbably in more southerly regions is four-brooded. Lastly, the common House-fly, the Cheese-fly, the various species of Blow-flies and Meat-flies, and the multifarious species of Plant-lice (*Aphis*) produce an indefinite number of successive broods in a single year, sometimes amounting in the case of the last-named genus, as has been proved by actual experiment, to as many as nine. The Chinch Bug is two-brooded in North Illinois, and I find that it is likewise two-brooded in Missouri, and most probably in all the Middle states. Yet it is quite agreeable to analogy that in the more Southern states, it may be three-brooded. For instance, the large Polyphemus Moth is single-brooded in the Northern and Middle states, and yet, two broods are sometimes produced in this state, while in the South it is habitually two-brooded. Again, the moth known as the Poplar Spinner (*Clostera Americana*, Harris) is stated by Dr. Harris and Dr. Fitch to be only single-brooded in Massachusetts and New York, the insect spinning up in September or October, passing the winter in the pupa state, and coming out in the winged form in the following June. But Dr. Harris—no doubt on the authority of Abbott—states that in Georgia this insect breeds twice a year; and I have proven that it does so breed in Missouri, having bred a number of cocoons which were formed by a second brood of larvæ. It is quite reasonable, therefore, to infer that the Chinch Bug may produce even more than two broods in the more Southern states. It is these two peculiarities in the habits of the Chinch Bug, namely, first, its continuing to take food from the day of its birth to the day of its death and, secondly, its being either two-brooded or many brooded, that renders it so destructive and so difficult to combat. Such as survive the autumn, when the plants, on the sap of which they feed, are mostly dried up so as to afford them little or no nourishment, pass the winter in the usual torpid state, and always in the perfect or winged form, under dead leaves, under sticks of wood, under flat stones, in moss, in bunches of old dead grass or weeds or straw, and often in corn-stalks and corn-shucks. In the fall and winter of 1868, I repeatedly received corn-stalks that were crowded with them, and it was difficult to find a stalk in any field that did not reveal some of them, upon stripping off the leaves. I have even found them wintering in the gall made by the Solidago Gall-moth (*Gelechiagallæ solidaginis*,) described in the first report. In the winter all kinds of insect-devouring animals, such as birds, shrew-mice, etc., are hard put to it for food, and have to search every hole and corner for their appropriate prey. But no matter how closely they may thin out the Chinch Bugs, or how generally these insects may have been starved out by the autumnal droughts, there will always be a few left for seed next year. Suppose that there are only 2,000 Chinch Bugs remaining in the spring in a certain field, and that each female of the 2,000, as vegetation starts, raises a family of only 200, which is a low calculation. Then—allowing the sexes to be equal in number, whereas in reality the females are always far more numerous than the males—the first or spring brood will consist of 200,000, of which number 100,000 will be females. Here, if the species were single-brooded, the process would stop for the current year and 200,000 Chinch Bugs, in one field, would be thought nothing of by the Western farmer. But the species is not single-brooded and the process does not stop here. Each successive brood increases in numbers in geometrical progression, unless there be something to check their increase, until the second brood amounts to twenty millions, and the third brood to two thousand millions. We may form some idea of the meaning of two thousand millions of Chinch Bugs, when it is stated that that number of them, placed in a straight line, head and tail together, would just about reach from the surface of the earth to its central point—a distance of 4,000 miles. Dr. Shimer, of Mt. Carroll, Ill., a careful observer, held that the insect only takes wing during the impulse of the sexual season. Dr. Riley, in relation to this matter, says: It is a notorious fact that Chinch Bugs do not all mature at once, and if they took wing only when making their courtships, some of them would be flying during a period of several weeks and, as will be shown presently, there exists a dimorphous short-winged form of the Chinch Bug, which cannot possibly make any such aerial love trips. It seems more agreeable to analogy that they take wing only when they have become so unduly numerous that they are instinctively aware that they must either emigrate or starve. Be this however as it may, the fact of their being as a general rule, unwilling to use their wings, is well known to every practical farmer. It has long been known that the Chinch Bug deposits its eggs underground and upon the roots of the plants which it infests, and that the young larvæ remain underground for some considerable time after they hatch out, sucking the sap from the roots. If, in the spring of the year, you pull up a wheat plant in a field badly infested with this insect, you will find hundreds of the eggs attached to the roots; and at a somewhat later period, the young larvæ may be found clustering upon the roots, and looking like so many moving little red atoms. The egg is so small as to be scarcely visible to the naked eye, of an oval shape, about four times as long as wide, of a pale amber-white color when first laid, but subsequently assuming a reddish color, from the young larva showing through the transparent shell. As the mother Chinch Bug has to work her way underground in the spring of the year, in order to get at the roots upon which she proposes to lay her eggs, it becomes evident at once, that the looser the soil is at this time of the year, the greater the facilities which are offered for the operation. Hence the great advantage of plowing land for spring grain in the preceding autumn, or, if plowed in the spring, rolling it repeatedly with a heavy roller after seeding. And hence the remark frequently made by farmers, that wheat harrowed in upon old corn-ground, without any plowing at all, is far less infested with Chinch Bug than wheat put in upon land that has been plowed. There is another fact which has been repeatedly noticed by practical men. This insect can not live and thrive and multiply in land that is sopping with water;

and it generally commences its operations in early spring upon those particular parts of every field where the soil is the loosest and the driest. The female occupies about three weeks in depositing her eggs and, according to Dr. Shimer's estimate, she deposits about 500. The egg requires about two weeks to hatch, and the bug becomes full-grown and acquires its wings in from forty to fifty days after hatching. There are, as is well-known to entomologists, many genera of the half-winged bugs which, in Europe, occur in two distinct dimorphous forms, with no intermediate grades between the two; namely, a short-winged, or sometimes even a completely wingless type and a long-winged type. Frequently the two occur promiscuously together, and are found promiscuously copulating so that they can not possibly be distinct species. Sometimes the long-winged type occurs in particular seasons, and especially in very hot seasons. More rarely the short-winged type occurs in a different locality from the long-winged type, and usually in that case in a more northerly locality. We have a good illustration of this latter peculiarity in the case of the Chinch Bug, for a dimorphous short-winged form occurs in Canada, and Dr. Fitch describes it, from specimens received, as being a variety, under the name of *apterus*. Besides the cannibal foes of the Chinch Bug, and disease, heavy rains are destructive, sometimes killing them over large extents of country. In fact it is only in hot, dry seasons that they fairly swarm. So, also, they cannot hybernate in cold, damp ground, their natural home being in the dryest soils. The methods and agencies for the destruction of the Chinch Bug will be pretty much included in the following: Their natural enemies. The plan of anticipating their ravages by sowing grain so early, in the spring, as to get in advance of their depredations. The attempt to save a part of our crops by preventing the migration of the bugs from one field to another. The method of destroying them by burning corn stalks and other rubbish, in the fall of the year. The attempt to prevent their breeding, to any serious extent, by abstaining from the cultivation of those grains upon which they chiefly subsist. Among the important natural enemies of the chinch-bug, are the Spotted Lady-bird, (*Hippodamia maculata*); the Trim Lady-bird, (*Coccinella munda*); a Lace Wing Fly (*Chrysopa plorabunda*) and the Insidious Flower Bug (*Anthocoris insidiosus*). This last resembles the Chinch Bug, and and has often been mistaken for it. Quail also eat the Chinch Bug, The second plan is the early sowing of grain. A modification of this plan has been practiced as follows: With twelve bushels of spring wheat mix one bushel of winter rye, and sow in the usual manner. The rye not heading out, but spreading out close to the ground, the bugs will content themselves with eating it, until the wheat is too far advanced to be injured by them. There will, of course, be no danger of the winter rye mixing with the spring wheat. Take common fence-boards, six inches or less wide, and run them around the piece, set edgewise, and so that the bugs cannot get under them or between the joints, and then spread either pine or coal tar on the upper edge, and they will not cross it. The tar needs renewing till the edge gets saturated, so that it will keep wet and not dry in any more, and either kind of tar is effectual. Then dig holes close to the boards, about like a post-hole, once in four or five rods, and run a strip of tar from the top of the board to the bottom on the outside opposite the hole, and they will leave the board, and in trying to get around the tarred stripe will slide into the hole, where they will be obliged to remain till they can be buried at leisure, and new holes opened for more insects to drop into. In relation to the management of crops, etc., in the case of Chinch Bugs, Dr. Cyrus Thomas draws the following conclusions: That it is useless to attempt to raise spring wheat or barley where Chinch Bugs have been present in any considerable numbers the preceding year, unless we have reason to believe that they have been killed off by heavy rains. That in case the season should be favorable to the propagation of the Chinch Bug we always have it in our power to get rid of these pests by the abandonment of these two kinds of grain for one or two years. But to make this course effective there must be a concert of action by farmers over a considerable section of the country. That the presence of Chinch Bugs the preceding year will not prevent the raising of corn or any of the winter grains. With regard to oats the testimony thus far is that if this grain be sown where Chinch Bugs abound, and especially if it be sown exclusively, it will be damaged to a greater or less extent the first year, but that the bugs probably will not continue to breed in it to any great extent in succeeding years.

CHINESE SUGAR CANE. (See Sorghum.)

CHINQUAPIN. *Castanea pumila.* A small tree or bush found south of 40°, the latitude of Washington; the fruit is small and like a chestnut. The tree is small, seldom producing wood large enough for any mechanical purpose; what there is is very durable. In neglected lands in some portions of the South, the tree is considered a nuisance.

CHITINE. Chitine resembles cellulose. It is supposed by some to be nitrogenous; it forms the elytra and integuments of insects and the carapaces of *Crustacea.* It may be obtained by exhausting the wing-cases of cockchafers successively with water, alcohol, ether, acetic acid, and boiling alkalies. The final residue retains completely the form of the wing-cases.

CHIVE. (See Cives.)

CHITTAGONG FOWLS. (See Brahma Pootra.)

CHLORIDES. The origin of the chlorides in the soil is not well understood. Dr. A. A. Hayes has detected alkaline chlorides in the primary rocks of Vermont, and Dr. Samuel L. Dana says: The possible existence of chloride of silicon has been noticed, and if this is not the source of the chlorine of plants, that it may be supposed to be evaporated from the ocean, and consequently to exist in that state dissolved in the air. An examination of the rain-water of each fall during the year 1842, in Lowell, Mass., has shown that this suggestion is correct. Soluable muriates are universally contained in rain-water. As, therefore, common salt, the chlorine and soda of plants, is derived from sea-waters, then as sulphate of lime has been detected in snow and hail, it becomes a question whether other organic salts of plants may not have a similar origin, and exist dissolved in air. Chlorine has not been found beneficial when applied as a manure, though common salt, which contains largely of chlorine, has long been used and with benefit in certain cases, in stiffening the straw of grain.

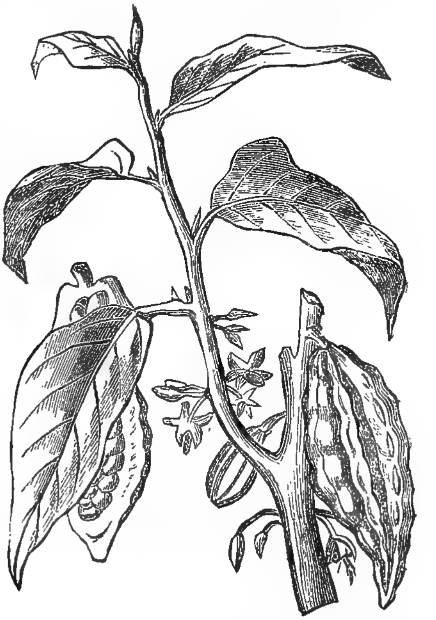
CHLORINE. A green-colored elementary gas, produced artificially. It is pungent, poisonous, and of great chemical activity. It exists only in combination in nature; equivalent 35.45. When combined with metals the substances are called chlorides, as chloride of sodium (common salt), chloride of hydrogen (muriatic acid). The latter is a powerful acid, much used in the arts, and known under the name of spirits of salts. Chlorine also unites with lime and soda, forming feeble compounds, the chlorides of lime and soda; these, especially the former, are extensively used in bleaching, from the continual escape of the chlorine. They are also disinfecting for the same reason. Chlorides are erroneously called muriates. Chlorine unites with five equivalents of oxygen, and forms chloric acid. One of its salts, the chlorate of potash, is of great value in the arts.

CHLORITE. A mineral of a greenish color, common in slates, etc. It is chiefly a silicate of magnesia and iron.

CHLORO. In chemistry, a prefix to substances containing chlorine, as chloro-carbonic acid, etc.

CHLOROPHYL. The green coloring matter of leaves. It closely resembles wax, and is converted in the fall into a true yellow fat. The presence of Chlorophyl is essential to the healthy functions of the leaf, which ceases to absorb carbonic acid from the air when yellow or red. The autumnal tints of leaves depend on a change of this coloring matter, the yellow being called Xanthophyll, and the red Erythrophyll. The tints of many flowers depend upon its compounds, which assume every variety between greens, reds, and yellows.

CHOCOLATE. From the fact that the preparation called chocolate, a product of the nut of the chocolate tree (*Theobroma cacao*), is now extensively used, makes it deserving of more than a passing notice. Its name, Theobroma (food of the Gods), was given by Linnæus, who was excessively fond of it. Its common name is from the Aztec (Ancient Mexican), name Chocolatl. This people it is said, were so expert that they raised the liquid preparation into a froth that was so firm, on cooling, that it could be eaten. There are several species indigenous to the inter-tropical regions of America, the oily nuts of which are used for food. The trade in the nuts, for manufacturing into the chocolate cakes of commerce, is now very extensive. The West Indies, Mexico, Central America, and Brazil are the chief places of production. The cut shows a branch of the Cacao, with its leaves and nuts, and also section of nut sliced lengthwise. The fruit when ripening changes from a green to a deep yellow color; when ripe, it is gathered by hand, split open, and the seeds removed. The latter are then cleaned of the pulpy matter surrounding them, and subjected to a process of fermentation, for the purpose of developing their color, and when this process is completed they are dried in the sun and packed for transportation. The seeds are prepared for use by roasting in revolving metal cylinders and then bruising them to loosen their skins, which are removed by fanning. The cotyledons, commonly called cacao-nibs, are separated in the same manner. The cleaned seeds are then crushed and ground between heated rollers, which softens the oily matter and reduces them to a uniform, pasty mass; this is then mixed with variable quantities of sugar and starch, to form the different kinds of cacao, or sweetened and flavored with vanilla or other substances for the formation of chocolate. The value of cacao as an article of food is very considerable, from the large quantity of nutritive matter it contains. In one hundred parts of cacao there are fifty-one of fat or butter, twenty-two of starch and gum, twenty of gluten, and two of the peculiar principle theobromine, which contains more nitrogen than the active principle of either tea or coffee. As a refreshing beverage, it is much inferior to either of these well-known articles, which are used as an infusion only; but as cacao is taken into the stomach as a substance, it is an important article of nutrition, as it is of commerce.


BRANCH OF CHOCOLATE TREE.

CHOKE. There are two forms of choke—the high and low choke. The high choke is the most quickly fatal unless relieved. The cause is some substance lodged in the throat, as an apple, potato, etc., in swallowing. Some stable-keepers foolishly put an egg down the throat of a horse, out of condition, under the absurd idea that in some mysterious way it is beneficial. An egg mixed in the food, or, indeed, three or four of them daily, is beneficial to a weak horse. In case of choking by a whole egg, it may be easily broken by pressure from the outside—not so a hard substance. Whenever the object can be reached by the hand, or the forceps, pull the tongue well out of the mouth and do so at once, first oiling the gullet. If it cannot be reached in this way, a probang must be used to push it down into the stomach. A probang is any strong, flexible rod, with an enlargement at one end. Gutta percha is best. The use of the probang in horses is somewhat difficult, but with cattle quite easy. To do this, raise the nose of the animal as high as possible, so that from the mouth down it is a straight line, and keep it so while operating. Introduce the probang carefully down the gullet. When it reaches the object, press gently, but firmly, on it, for a few seconds at a time, and so proceed, after a few moment's relaxation, again and again, until the obstacle gives way. Then keep it gently moving until the obstacle enters the stomach. Sometimes all such means fail. Assured of this, use the knife promptly to save life. While an assistant presses the off side of the neck to make a strong bulge, with a sharp knife cut fearlessly through skin, flesh and integuments down upon the offending substance, and remove it with the forceps. Make the cut long enough so there will be no difficulty in getting at the obstruction. Then bring the edges of the gullet together, stitch nicely with fine cat-gut, leaving the ends long enough to reach out of the cut. Then stitch the edges of the skin together in the same way, and feed on sloppy food until recovery. It should be remembered that a narrowing of the gullet is apt to follow this operation that may prevent the swallowing of solid food thereafter. Consequently, all other means should be exhausted before resorting to the knife. It should be used only to save life.

CHOKE-DAMP. A common term applied to foul air. Carbonic acid gas, with or without a mixture of nitrogen. When necessary to enter wells for the purpose of cleaning, or any underground place, a flame should be first let down. If it continues to burn freely, there is no danger to life.

CHOLEIC ACID. Liebig regards the animal matter of the bile as choleic acid, the secretion being a soap formed by its union with soda. *Choleic* and *choloidic* acids are separated by alcohol and other solvents, and are of secondary consequence. Redtenbacher discovered twenty-six per cent. of sulphur in choleic acid.

CHOLERA OF SWINE. There are many forms of malignant disease that go under the name of Hog Cholera. Three different forms of disease, however, are popularly included under this name: Charbon or Malignant Anthrax, Contagious Pleuro-enteritis, and Epizootic Catarrh. The first is destructive to cattle, as well as hogs. The difficulty in all malignant diseases in swine is the difficulty in administering medicine and thus, in all malignant diseases, once it is well defined, it is better to kill at once, bury deeply and disinfect thoroughly the premises inhabited by the animals. Malignant Anthrax, Charbon, White Bristle, or Splenic Fever, is a blood poison localizing itself in a carbuncular swelling usually on the throat. The bristles on the spot turn white and are brittle. There is an apoplectic form, both are acute and quickly fatal, and the blood, flesh and discharges spread the disease. Contagious Pleuro-enteritis is a specific contagious inflammation of the lungs and bowels, accompanied with red or purple blotches on the skin, and hence two of its names, Red Soldier, Purple and Blue Disease. Drinking water tainted with dead and decaying substances, filthy yards and pens, and also food inducing a sudden plethoric state are predisposing causes. Once it enters a drove, it is apt to attack swine of any age or sex. Like Anthrax, it is caused by *Bacilli*, rod-like minute vegetable organisms, found, not as in Anthrax, in the blood but in the serous fluids and tissues. It appears in an erysipelatous form, and in the form of malignant sore throat. In the first form the animal is dull, loses appetite, hangs its head, and sometimes makes efforts to vomit. The bowels are generally constipated, the dung hard and dark colored. There is a cough, and urine is dark colored and passed with difficulty. Then arise dark-red or purple blotches, which pass to a bluish-black color, labored breathing ensues and paralysis, the discharges become watery and fetid and the animal dies. In the form of malignant sore throat, there is also the deep-red appearance of the throat, passing into purple. There will be difficulty of breathing, sickness at the stomach, difficulty in swallowing, and the animal may sit on its haunches, gasping for breath, with its swollen and livid tongue protruded. Sometimes the animal suffocates or chokes to death even before the other characteristic symptoms are noticed by the unprofessional observer. There is little hope of cure once the symptoms are pronounced. The only hope is in preventive measures; something to check the virus. A specific agent is undoubtedly sulphate of iron. One pound of sulphate of iron, and a gallon of soft-soap boiled in four gallons of water, and mixed in the slop for twenty-five hogs, and as they begin to eat, add a solution of two pounds of soda in water, to make the whole foam well. Repeat the dose every three or four days, until three doses are given. The other remedy, chlorate of potash, (costing more than the other), may be used in special cases. One to two drachms of chlorate of potash, to one half pint of water for each hog, may be given in milk or slop, three times a day. Prof. Turner has had excellent success in preventing attacks, by means of the following: Two pounds each of flowers of sulphur, of sulphate of iron and of madder, one-half pound each of black antimony and of nitrate of potash, and two ounces of arsenic, mixed with twelve gallons of slop, for 100 hogs, or a pint to each hog. It is essential, in connection with any treatment, that absolute good care should be taken to guard from contagion. Thus, if the disease is feared, separate the sick from the well at once. Give all the swine a free range, in an open wood lot in the pasture, where there is only pure water. Let them have bituminous coal dust or charcoal and salt always within reach. Let their wallowing places be either pure water or pure clay and water. Feed plenty of roots, artichokes preferably, and let them have shelter from storms. In Malignant Epizootic Catarrh, the seat of the disease is the mucus membrane lining the nose, continuing to the wind-pipe and lungs. There is a hoarse cough, difficulty in breathing, a panting motion of the flanks, and the head will be held in a peculiar stooping, stretched-out manner. There is fever, the gait is tottering and stiff. There may be efforts to vomit, generally there will be constipation, but sometimes diarrhœa. There may also be affection of the brain, partial or total blindness, staggering gait, enlarged glands, and even scrofulous ulcers. The duration of the disease is from five to fifteen days. If constipation be serious, give one ounce of castor-oil together with one drachm oil of turpentine, in milk or gruel. Dr. Detmars recommends to give at once, as an emetic, fifteen or twenty grains of powdered white hellebore in a half-pint of milk and, in two hours after this has acted, give two or three grains of tarter emetic if the disease is in the lungs, or the same amount of calomel if the disease is in the bowels; repeat two or three times a day, as may be necessary, giving the medicine in a piece of boiled potato. Rub also the lungs or the abdomen (as the case may be) with the following blister: one ounce powdered cantharides and four ounces of olive oil, the whole to be heated for half an hour over a moderate fire. Repeat at the end of two or three hours if a good blister does not raise. As the hog gets better, give ten to twenty grains of sulphate of iron every day for a few days; and if the lungs have been severely affected add thirty or forty grains of carbonate of potash to each dose. Cleanliness, well ventilated quarters and pure water are of course essential. There has been much written on Hog Cholera by various professionals of repute both medical and veterinary. It must be remembered that swine are particularly susceptible to inflammatory diseases from their artificial breeding, and the artificial manner in which they are kept. Prof. Law, of Cornell University, a high and practical authority on veterinary matters, doubts the existence of Charbon or Malignant Anthrax in swine. On the other hand, Dr. Tellor believes swine to be subject to true Anthrax, fully as much as cattle or sheep, and he gives one of the forms, known as White Bristle, a carbuncular swelling, generally on the throat which extending inwards, involves the windpipe, ending in convulsions and death. Dr. Law however, in a report to the United States Government, in an enumeration of various names, as included in the general term Hog Cholera, enumerates Typhoid Fever, Enteric Fever, Typhus Carbuncular Fever, Carbuncular Gastroenteritis, Carbuncular Typhus, Pig Distemper, Blue Sickness, Blue Disease, Purples, Red Soldier, Anthrax Fever, Scarlatina, Measles, Diphtheria, and Erysipelas. His definition of the above, and the symptoms are as follows: A specific, contagious fever of swine, characterized by congestion, exudation, ecchymosis, and ulceration of the mucous membrane of the intestines, and to a less extent of the stomach; by general heat and redness of the skin, effaceable by pressure; by small red spots, complicated or not by elevations and blisters; by black spots and patches of extravasated blood on the integument, the snout, nose, eyes, mouth, and other visible mucous membranes, and on internal organs, ineffaceable by pressure and tending to sloughing; usually by liquid and fetid diarrhœa, and by a very high and early mortality. The earliests ymptoms are slight dullness with, sometimes, wrinkling of the skin of the face, as if from headache; shivering or chilliness, and a desire to hide under the litter, are not uncommon. Some loathing of food, intense thirst, elevation of the temperature of the rectum to 104° Fahrenheit, and increased heat and redness of the skin are usually the first observed symptoms, and occur one or two days later than premonitory signs above mentioned. The increased heat of the skin is especially noticeable inside the elbow and thigh, and along the belly. By the second day of illness the whole surface feels hot, and in white pigs is suffused with a red blush, which may pass successively through the shades of purple and violet. It is usually more or less mottled at particular points, and a specific eruption appears as rose-colored spots of from one to three lines in diameter, sometimes slightly raised so as to be perceptible to the touch, and either pointed or more frequently rounded. The redness fades under the pressure of the finger, but only to re-appear immediately. The eruption is usually abundant on the breast, belly, and haunches, the inner side of the forearm and thighs, and the back of the ears. It stays out for two or three days, and may be followed by one, two, or more successive crops of the same kind. The cuticle is sometimes raised in minute blisters, a feature which distinguishes this from the rash of typhoid fever, and the liquid of such blisters inoculated on other pigs communicates the disease. In addition to the rash, and simultaneously with it, or soon after, there appear on the skin numerous spots of a dark red or black color, varying in size from a line to an inch in diameter, on the color of which pressure has no effect. These are due to the extravasation of blood, or of its coloring-matter from the blood-vessels into the tissue, and they dry up into thin scabs or sloughs if the animal survives. Similar petecchial spots appear on the muzzle, in the nose, and on the eyes, and in some instances they are confined to these parts. The tongue is covered by a brownish fur. From the first the animal is sore to the touch; but, as the disease develops, the handling of the animal is especially painful, and causes grunting and screaming. The pig lies on its belly and, if compelled to rise and walk, moves stiffly, feebly, unsteadily, and with plaintive grunting. This weakness and prostration rapidly increases, and often ends in utter inability to rise or support the body on the hind limbs. A watery discharge from the nose, followed by a white muco-purulent flow is not uncommon. A hard, barking cough is frequently present from the first, and continues to the last. Sickness and vomiting may be present, but are far from constant. The bowels are often confined at first, and in certain cases, and even in nearly all the victims of particular outbreaks, may remain so throughout, nothing whatever being passed, or only a few small black pellets covered by a film of mucus. These cases are quickly fatal. More frequently, however, they become loose by the second or third day, and diarrhœa increases at an alarming rate. The passages are first bilious, and of a light or brownish yellow when not colored by ashes, charcoal, or the nature of the food. But soon they assume the darker shades of green and red, or become quite black and intolerably offensive. In such cases the elements of blood, inspissated lymph, and membraneous pellicles sloughed off from the ulcerated surfaces are usually to be found in them. The diarrhœa becomes more profuse, watery, and fetid; the pulse sinks so as to become almost imperceptible; the cough becomes more frequent, painful, and exhausting; the breathing is more hurried and labored, and the weakness increases until the patient can no longer rise on his hind limbs. At this period the petecchiæ (the peculiar purple spots of malignant fevers) become far more abundant. Before death the animal is often sunk in complete stupor with, it may be, muscular jerking or trembling, or sudden starts into the sitting posture, and loud screams. In the last stages involuntary motions of the bowels are common. Exceptionally swellings appear on the flank, with extreme lameness, and extensive sloughs of the skin of the ears or other parts. Palpitations of the heart also occasionally occur as precursors, attendants, or sequels of disease. If the disease should take a favorable turn, slight causes may make an early and perfect recovery, a complete convalescence being established in three or four weeks. A considerable proportion of the survivors, however, linger on in an unthrifty condition for months, evidently suffering from the persistent ulceration of the intestines, or infiltration of the lungs. The mortality often reaches eighty or ninety per cent. of all swine exposed, and in case of a certain number of the survivors recovery brings no profit to the owner. Dr. J. H. Detmars, who was employed for years by the United States Government in investigating so-called Hog Cholera in swine, classifies the diseases under the general head of epizootic and enzootic diseases of swine, or Epizootic Influenza of swine, but assuming different characteristics, as the catarrhal-rheumatic form, the gastric-rheumatic form, the cerebro-rheumatic form, and the lymphatic-rheumatic form. The treatment which he recommends is as follows: The treatment may be divided into two parts, a hygienic and a medical. The former, which includes a removing of the causes is, in this, like in most other causes, of very great importance. If the causes are promptly removed, a great many sick animals not already too far gone may be saved. If the same are not, the very best medical treatment will be of little avail. The sick animals must be separated from the herd, must be provided with a clean and dry resting-place, must have pure air to breathe, clean water to drink and healthy, clean and easily digested food to eat. He recommends giving to each hog at the beginning of the disease a good emetic, composed either of powdered white hellebore (*Veratrum album*) or of tartar-emetic, in a dose of about one grain for each month the sick animal is old, provided the latter is of good average size. The largest dose to be given a full-grown animal should not exceed fifteen or sixteen grains. The emetic is best administered by mixing the same with a piece of boiled potato, or, if the hellebore (which he prefers) is chosen, strewing the powder on the surface of a small quantity of milk, as neither boiled potato nor milk will be refused by any hog unless the animal is very sick, and in that case it will be too late to make use of an emetic. After the desired action has been produced the animal will appear to be very sick, and will try to hide itself in a dark corner; but two or three hours later it will make its appearance again, and will be willing to take a little choice food, such as a few boiled potatoes, a little milk, etc. At this time it will be advisable to again give a small dose of medicine, either a few grains (two or three to a full-grown animal and to a pig in proportion) of tartar-emetic or of calomel. Mix with a piece of boiled potato, or, if the symptoms should not have returned, mix with a small pinch of flour and a few drops of water (sufficient to make a stiff dough) and form into small round pills. The doctor here remarks that a sick hog should not be drenched with medicine under any circumstances, for a drench, given by force, is very apt to pass down the windpipe into the lungs as soon as the animal squeals, and frequently causes instant death. The tartar-emetic has to be chosen if the disease has its principal seat in the respiratory organs or presents itself in its catarrhal-rheumatic form, and the calomel deserves preference if the gastric or bilious-rheumatic form is prevailing, but especially if the liver is seriously affected. Either medicine may be given in such small doses as mentioned three times a day for several days in succession, or until a change for the better becomes apparent. It is also advisable, particularly if the disease exhibits a very typhoid character, to now and then mix for each animal a few drops of carbolic acid with the water for drinking or with the slops. Convalescent animals, which have become very weak and emaciated, will be benefited by giving them once a day from a few grains to half a drachm of sulphate of iron (copperas) mixed with their food, but the use of iron must be discontinued if the patients become constipated or if the excrements turn black. Those convalescents in which the lungs have become hepatized to a considerable extent may receive repeatedly small doses of carbonate of potash for the purpose of promoting the absorption of the exudations deposited in the tissue of the lungs. The size of the dose of carbonate of potash as well as of iron depends upon the size and the age of the animal. A local or external treatment is also of considerable importance. A good counter-irritant or blister, composed of cantharides, or Spanish flies, and oil, made by boiling one ounce of the former and four ounces of the latter for half an hour over a moderate fire, or for one hour in a water-bath, should be applied on both sides the chest in all such cases in which the organs situated in that cavity are seriously affected. Such a counter-irritant has usually a very beneficial result. In most cases one application will prove sufficient to relieve the animal to a considerable extent, provided the oil is thoroughly rubbed in before the disease has made too much headway, or before the vitality of the organism has been destroyed. If the effect of the fly-blister proves insufficient, it may be applied again the next day; but if the same produces no effect at all, it may be taken as an indication that the animal is going to die, and that any further treatment will prove of no avail. Fontanels (an issue or rowel) and setons have really the same effect as a fly-blister, but they act slower, are less reliable, and may otherwise cause damage, especially if the typhoid character of the disease is very much developed, by weakening unnecessarily the constitution of the patient. In relation to prevention and treatment, Dr. Detmars, in a late report, says: The worst thing that possibly can be done, if swine-plague is prevailing in the neighborhood, is to shelter the hogs and pigs under or in an old straw or hay stack, because nothing is more apt to absorb the contagious or infectious principle, and to preserve it longer or more effectively than old straw, hay, or manure-heaps composed mostly of hay or straw. It is even probable that the contagion of swine-plague, like that of some other contagious diseases, if absorbed by, or clinging to, old straw or hay, etc., will remain effective and a source of spreading the disease for months, and may be for a year. Therapeutically, but little can be done to prevent an outbreak of swine-plague. Where it is sufficient to destroy the infectious principle outside of the animal organism, carbolic acid is effective and, therefore, a good disinfectant; but where the contagious or infectious principle has already entered the animal organism its value is doubtful. Still, wherever there is cause to suspect that the food or the water for drinking may have become contaminated with the contagion of swine-plague, it will be advisable to give every morning and evening some carbolic acid, say about ten drops for each animal weighing from 120 to 150 pounds, in the water for drinking; and wherever there is reason to suspect that the infectious principle may be floating in the air, it will be advisable to treat every wound or scratch a hog or pig may happen to have immediately with diluted carbolic acid. During a time, or in a neighborhood in which swine-plague is prevailing, care should be taken not to ring nor castrate any pig or hog, because every wound, no matter how small, is apt to become a port of entry for the infectious principle, and the very smallest amount of the latter is sufficient to produce the disease. Still, all these minor measures and precautions will avail but little unless a dissemination of the infectious principle, or disease-germs, is made impossible, as, 1. Any transportation of dead, sick, or infected swine, and even of hogs or pigs that have been the least exposed to the contagion, or may possibly constitute the bearers of the same, must be effectively prohibited. 2. Every one who loses a hog or pig by swine-plague must be compelled by law to bury the same immediately, or as soon as it is dead, at least four feet deep, or else to cremate the carcass at once, so that the contagious or infectious principle may be thoroughly destroyed, and not be carried by dogs, wolves, rats, crows, etc., to other places. Another thing may yet be mentioned, which, if properly executed, will at least aid very materially in preventing the disease; that is, to give all food either in clean troughs, or if corn in the ear is fed, to throw it on a wooden platform which can be swept clean before each feeding. If the cause and the nature of the morbid process and the character and importance of the morbid changes are taken into proper consideration, it cannot be expected that a therapeutic treatment will be of much avail in a fully developed case of swine-plague. Specific remedies, such as are advertised in column advertisements in certain newspapers, and warranted to be infallible, or to cure every case, can do no good whatever. They are a downright fraud, and serve only to draw the money out of the pockets of the despairing farmer, who is ready to catch at any straw. No cure has ever been found for Glanders, Anthrax, and Cattle-plague, diseases that have been known for more than two thousand years, and that have been investigated again and again by the most learned veterinarians and the best practitioners of Europe, and yet there is to-day not even a prospect that a treatment will ever be discovered to which those diseases, once fully developed, will yield. Neither is there any prospect or probability that fully developed swine-plague will ever yield to treatment. It is true that the *bacilli suis* and their germs can be killed or destroyed if outside of the animal organism, or within reach on the surface of the animal's body. Almost any known disinfectant—carbolic acid, thymic acid, chloride of lime, creosote, and a great many others—will destroy them. But the *bacilli* and their germs are not on the surface of the body, except in such parts of the skin and accessible mucous membranes (conjunctiva and gums) that may happen to have become affected by the morbid process. They are inside of the organism, and not only in every part and tissue morbidly affected, in every morbid product, and in every lymphatic gland, but they are also in every drop of blood, and in every particle of a drop of blood circulating in the whole organism. Who, I would like to ask, will have the audacity to assert that he is able to destroy those *bacilli* and their germs without disturbing the economy of the animal organism to such an extent as to cause the immediate death of the animal? But even if means should be found by which these *bacilli* and their germs can be destroyed without serious injury to the animal, a destruction of the same will not be sufficient to effect a cure. Important morbid changes must be repaired; extensive embolism is existing in some very vital organs; a rapid proliferous growth of morbid cells has set in; some of the intestines (*cæcum* and *colon*) may have become perforated; exudations have been deposited in the lungs, in the thoracic cavity, in the pericadium, and in the abdominal cavity; the heart itself may have been morbidly changed, and every lymphatic gland in the whole organism become diseased. How, I would like to know, will those quacks who advertise their sure cure and their high-sounding specifics to swindle the farmer out of his hard-earned dollars and cents—how, I ask, will those quacks restore, repair, stop, and reduce all those morbid changes? Still, I do not wish to say that a rational treatment can do no good; on the contrary it may, in many cases, avert the worst and most fatal morbid changes, and may thereby aid nature considerably in effecting a recovery in all those cases in which the disease presents itself in a mild form, and in which very dangerous or irreparable morbid changes have not yet taken place. A good dietetical treatment, however, including a strict observation of sanitary principles, is of much more importance than the use of medicines. In the first place, the sick animals, if possible, should be kept one by one in separate pens. The latter, if movable—movable ones, perhaps six to eight feet square, and without a floor, are preferable—ought to be moved once a day, at noon, or after the dew has disappeared from the grass; if the pens are not movable, they must be kept scrupulously clean, because a pig affected with swine-plague has a vitiated appetite and eats its own excrements and those of others, and, as those excrements contain innumerable *bacilli* and their germs, will add thereby fuel to the flame; in other words will increase the extent and the malignancy of the morbid process by introducing into the organism more and more of the infectious principle. The food given ought to be clean, of the very best quality and easy of digestion, and the water for drinking must be clean and fresh, be supplied three times a day in a clean trough, and be drawn each time, if possible, from a deep well. Water from ponds and water that has been standing in open vessels, and that may possibly have become contaminated with the infectious principle, should not be used. If the diseased animal has any wounds or lesions, they must be washed or dressed from one to three times a day with diluted carbolic acid or other equally effective disinfectants. (See Disinfection.)

CHOLESTERINE. Fatty matter resembling spermaceti, found in the bile and biliary concretions.

CHONDRINE. Gristle, or cartilage. It consists of proteine with water.

CHORD. A straight line drawn between the two extremities of the arc of a curve. The chord of an arc is its span.

CHOROID MEMBRANE. The membrane of the eye within the white coat.

CHRONIC. Diseases which are slow in their progress, or of long standing, are called chronic.

CHRYSALIS. The grub or inactive state of changeable insects. The terms pupa and aurealian are synonymous. Some are enclosed in cocoons, others are destitute of covering, and buried in the earth or in trees. Moths usually have rounded and butterflies angular chrysalides.

CHUFA. Earth Almond. *Cyperus esculentus.* This nut grass, allied to the notorious *cyperus repens* of the South, was originally introduced from Spain, and first and last, has been more or less cultivated in every state in the Union. In portions of Kentucky and Tennessee, and South, it survives the winter; North it is killed. The tubers, when ripe and dry, are sweet and pleasant to the taste, somewhat resembling almonds. Hence, one of its common names. In the South it is cultivated to a considerable extent as food for swine. They are said to prefer the chufa to the pea-nut, a crop also raised in the South as food for swine. Stock of every kind are fond of the chufa, and the yield is from 200 to 500 bushels per acre, on good land. As in the case of the pea-nut, swine are allowed to gather the crop themselves. They are planted in the spring, in drills thirty to thirty-six inches apart, and every six inches in the row. One bushel is the quantity usually planted per acre. A single nut is dropped at intervals of ten to twelve inches in the drill, and covered about two inches. The crop requires to be kept free from weeds, until the tops pretty well cover the land.

CHURN. (See Churning.)

CHURNING. The improvement in the manufacture of butter within the last few years, has led to the invention of a great many modifications of the barrel-churn, where it is to be propelled by power. Dairymen each have their preferences, but as a rule, the revolving principle is found in the churns used in large dairies. The barrel churn, bulging only enough to make the hoops drive well, is a good form. It should have a journal or bearing at each head, and stationary short arms inside to cause due agitation of the cream, as the churn is being turned. There is an opening for pouring in cream, and taking out butter, capable of being firmly screwed in place, and near it a hole filled with a plug, for testing the state of the cream and drawing off the buttermilk. The temperature of the cream should not be less than 58°, nor more than 62°, when put in the churn, depending upon the heat of the weather, since sometimes it gathers heat faster than at other times. The churning should last from thirty to sixty minutes, about forty minute's churning being an average time for churning cream, to properly separate the butter. At one of the most extensive butter factories in the East, where the churning is done by steam, the following is the plan: The churns are barrel-formed, with a bottom head eighteen inches in diameter, inside measure, and thirty inches high, holding one and a quarter barrels each. The dashes or floats are unusually large. They cover three-quarters of the area of a horizontal section of the churn. Two forms are used. One of them, recently introduced, is made of two-inch ash plank, and is a solid circle sixteen and a quarter inches in diameter, made concave on the under side. The hollowing out on the under side is done so that when the dash, after being raised above the cream, goes down, a cushion of air will strike the cream instead of the hard wood. By this means the least possible injury is done to the grain of the butter. The other style of dash is made in the usual way, with cross floats which are large enough to cover as much surface as the solid circle. The churning is done with a slow stroke, counted at thirty-four to the minute, and at a temperature of 58° in summer and 60° in cool weather, and requires from one to two hours to bring the butter, the cream being varied a little in temperature and quantity, so that the churns shall not all come off at once. When the butter begins to appear in granules, the pace is slackened down to half speed, or below, and cold water enough put in to increase the contents of the churn so much that the dash, in its upward stroke, will not rise quite out of the cream. In this way the dash is prevented from pressing the granules together, and they become hard without adhering, and the butter is gathered in a granular form, in lumps of the size of peas and grains of wheat, which the cold water added makes very hard.

CHYLE. The milky fluid resulting from digestion. It is almost identical with milk, and owes its white color to fat suspended in it. The chyle is carried directly into the veins, and serves to repair the blood employed in maintaining the functions of the body. It is alkaline, and contains albumen and fibrin.

CICADA. Harvest flies, incorrectly called locusts, are not especially injurious, although in three stages of their existence, as larva, pupa, and in the perfect winged state, they live on the sap of plants. The true locust, incorrectly called grasshopper, will be treated under the name Locust. The Cicada belongs to the order *Hemiptera*, sub-order *Homoptera*; insects having four membranous, deflexed wings, usually lying over the back when the insect is at rest. The insects are quite large in size, some of them measuring two inches or more from the front of the head to the tip of the closed wings. The males alone are musical. The musical apparatus producing the peculiar prolonged trilling chirp or cry made by the male is situated on the under side of the body, on the basal ring of the abdomen, and consists of a pair of large plates, largely covering the anterior part of the body, which, acting like a drum, at the will of the insect produces the prolonged tremulous sound we hear. In relation to the natural history of the Cicada we find that, the female deposits her eggs in slits or incisions made in trees or plants, which she cuts with her ovipositor. The eggs remain in these longitudinal incisions for some time, according to the warmth of the season; when hatched by the heat of the sun, the young larvæ drop to the ground, and immediately bury themselves in the soil, feeding upon the tender subterranean roots, which they pierce with their beak and then suck out the sap. It is a popular but erroneous idea that the females of this Cicada are capable of piercing the skin of mankind and then ejecting a poisonous fluid into the wound, producing violent inflammation and pain. The insect itself is frequently carried off by a large burrowing wasp or hornet (*Stirus speciosus*), which forms deep holes or burrows in the earth, where it deposits its egg or eggs in a half-killed Cicada, which is intended to form a supply of fresh food for the larva until it changes into the pupa state, when it ceases altogether to feed until it emerges as a perfect wasp or hornet The manna of druggists is said to be the concrete juice of a species of *Fraxinus*, or ash, in flakes, which is produced by a species of Cicada or, most probably, some other insect of the sub-order *Homoptera*. The insects themselves are destroyed in great numbers by hogs, poultry, and various small animals; but as they never appear in such immense numbers as their relatives, the seventeen-year locusts, they do very little, if any, damage to the farmer. *Cicada septemdecim*, or the seventeen-year locust, derives its specific name from the fact that it makes its appearance at stated intervals of seventeen years in immense numbers, when the millions of them, swarming on the forest and fruit trees, almost deafen the observer with their trilling calls to the females, and form an abundant feast to the swine, fowls, etc , and wild animals on the land and, if near a river or lake, to the fishes in the water. They sometimes injure fruit and forest trees by making their longitudinal slits or incisions in the young branches or terminal twigs, in which to deposit their eggs, many of the branches thus injured dying down as far as the injury, and afterward being broken off by high winds and literally almost covering the ground. The perfect insects make their appearance from the last of May to July, according to latitude, in immense swarms, and the earth in certain localities is literally honey-combed with the round holes which are made by the insects when issuing from the earth, these holes being bored sometimes through the hardest ground, and sometimes even through well traveled country roads. After pairing, the females deposit their eggs, from ten to twenty or more, in longitudinal slits, made in pairs, and penetrating to the pith in the terminal shoots and small branches of oak, apple, and other deciduous trees. These slits are made by the ovipositor of the female. The young larvæ hatch out in about six weeks, fall to the ground, and immediately bury themselves under the earth, where they are said to remain nearly seventeen years in the larva state, feeding on succulent roots of trees and shrubs. When about to change into pupæ, the larvæ work their way to the surface of the ground, shed their outer skins, and assume the pupa state, somewhat resembling the perfect insect, but having thick and strong fossorial or digging fore legs, with only wing-cases, and utterly incapable of flight. This pupa state is said to last only a few days, during which the pupa lies near the top of its subterranean tunnel Besides the foregoing, there is a species that appear once in thirteen years. Both these species appear with great regularity. The *Cicada pruinosa* would seem to be irregular in its appearance, since every year there seems to be more or less of this species or an allied one The general color of the seventeen-year Cicada is of a rich yellow or orange-brown, varied with a darker color; the outside edges of the wings are of a light, rich buff or orange-brown, by which alone it can be distinguished from its relative *Cicada pruinosa*, which is of a green color, with the edges of its wings also green. It is also much smaller. In relation to the constant recurrence of the thirteen-year and the seventeen-year locust, Dr. C. V. Riley, the well-known entomologist, says the seventeen-year locusts may be looked for in 1881 in very plentiful numbers in Marquette and Green Lake counties, Wisconsin, in western North Carolina and north-eastern Ohio, a few in Lancaster county, Penn., and in Westchester county, N. Y. They will also appear in the neighborhood of Wheeling, West Virginia, and perhaps in parts of Maryland and Delaware. The thirteen-year brood may be looked for in Southern Illinois, throughout Missouri, and in Louisiana, Arkansas, Indian Territory, Kentucky, Tennessee, Alabama, Georgia, North Carolina and South Carolina. It is a singular coincidence that this is the year for the appearance of both these broods. Observations extending for more than two hundred years prove that they never fail. The earliest appearance of the periodical Cicada, or locusts, so far as we have any record, occurred at Plymouth, Mass., in the year 1634. Each seventeenth year they have appeared again without fail. The naturalist calculates as confidently on the future appearance of the locust in a given month in a given year for all time to come, as the astronomer does an eclipse or a transit on some particular day. In the intervals between the appearance of the insect they are down in the earth, in the shape of a worm, living on the sap of young rootlets. In following these they penetrate very deep into the ground, sometimes going as far down as ten or twelve feet. The season for their appearance and disappearance differs somewhat with the latitude, though not so materially as one would suppose. They appear a little earlier in the South than in the North; but the last half of May can be set down as the period during which they emerge from the ground in many parts of the country, which they generally leave by the 4th, of July. As is the case with a great many other insects, the males make their appearance several days before the females, and also disappear sooner. Hence in the latter part of the Cicada season, though the woods are still full of females, the song of but very few males will be heard.

CICATRIX. The scab of a wound in the act of healing.

CICHORIUM. The generic name of a number of composite plants, of which the *C. intybus* is chiccory or succory, and *C. endivia*, endive. (See Chiccory.)

CIDER. Cider is the juice of the apple after it undergoes the natural or vinous fermentation. Sweet cider is that fresh from the press and which has undergone only a slight fermentation. Good cider is only made from sound, ripe apples, and its use and manufacture has been known ever since the cultivation of the fruit became general. The use of the modern mills and presses will enable any person of intelligence to make good cider, by allowing the juice to stand in the pulp a longer or shorter time, according as a lighter or darker color is required in the juice. When ready for pressing the juice should be placed in barrels, and these in a cellar, where the temperature will not fall below 60°, nor increase above 75°, Fahrenheit. An active saccharine fermentation will commence in a few hours; this should be permitted to continue with the bung loose until the hissing sound, so readily discernible where carbonic acid gas is escaping, shall cease. The cider may now be racked or drawn off into clean barrels, separating it from its sediment, and again suffered to ferment after being bunged up for a few days, the bungs, of course, being loosened as before. This fermentation will be of short duration. The cider may now be racked again, the bungs should be tightly closed, and if intended for draught use it should be kept in a cool cellar; if intended for bottling, it should be bottled early in the spring. The old-fashioned rule is to do so before the appearance of apple blossoms. This prevents an undue fermentation or acetification, and secures a proper degree of life inside the bottle. Bottlers in cities sometimes use ripening agents but, for well made cider, bottled at a proper season, these are unnecessary. Isinglass, fish sounds, etc., are sometimes used to clarify and refine cider. All these, however, may be dispensed with if the cider is well made, and the rules before given are strictly adhered to. The addition of ripe quinces, when this fruit is grown, very much improves the flavor of cider. The following is a simple and excellent plan for making cider wine: Take sweet and sour apples in about equal parts by measure. Let them be sound, pleasant-flavored and free from rot and worm-holes. Grind them in a mill, and let the pomace stand twenty-four hours, stirring it up often so as to expose it to the air. After the juice is expressed, add two pounds of refined sugar to each gallon of cider, and put it in a perfectly clean barrel for fermentation. Rack off after fermentation ceases, and cleanse the cask well, then return it and bung it up closely. Cider wine, prepared in this way and bottled after four months, is nearly equal to the best champagne wine, and is, in fact, very much like it; but if very light colored wine is desired, the juice should be pressed from the pulp as soon as it attains the proper color desired. If a wine of less strength is desired, use four pounds sugar and one gallon of water to each gallon of apple juice. All apples will not make cider. The best eating and dessert apples are too juicy, and do not furnish rich juice. Among the more celebrated of cider apples are Campfield, Harrison, Hewes' Virginia Crab, Whitney's Number Twenty (crab), Plumb's Cider, Gilpin, or Red Romanite, Smith's Cider, and Waugh's Crab. The farmer, however, must cultivate such varieties as do well with him, or in his locality. The varieties mentioned, except Gilpin, are not adapted to general cultivation. The juice of this apple is, however, exceedingly rich and, if mixed with the orchard varieties generally cultivated, will make excellent cider. Red Romanite furnishes very heavy, rich juice and, within the last few years, it is found that Ben Davis, an apple that bears heavy crops, in various soils and situations, gives a rich, heavy juice for cider making. It should be stated, in this connection, that Gilpin and Little Red Romanite are identical, and Carthouse is also a synonym. (See also article Gallizing.)

CILIA. Minute hairs on the margins of leaves, angles of the bodies of insects, etc. Ciliate is a derivative.

CIMEX. The general term for insects resembling the bed-bug.

CINEREOUS. Ash colored.

CINNAMON. *Laurus cinnamomum.* This is a small tree, from twenty to thirty feet high, indigenous to Ceylon and the Eastern islands, but cultivated in Cayenne, Egypt and Brazil. The spice consists of the inner bark of the branches; its flavor is due to an essential oil easily distilled.

CINQUE-FOIL. Five fingers. *Potentilla.* Of the varieties found in the United States, *P. canadensis* is most common. It is a worthless weed but, as a rule, is not particularly troublesome, but is indicative of a poor soil, or shiftless farming. In the Middle states there is an introduced species, *P. norvegica*, an erect, homely, weed, that is giving some trouble Some pastures seem to have a tendency to produce Cinquefoil. The remedy is plowing, manuring and cultivation, to clear and renovate the soil.

CIRCINATE. In botany, the manner in which the buds of ferns and some other plants are folded, resembling a crosier.

CIRCULATION. In physiology, the route which the blood of animals and fluids of plants take through the system. It differs with the species of animals, but is nearly uniform in the higher classes. The circulation of the blood in man and quadrupeds may be said to commence on the right side of the heart, from whence it is driven along the pulmonary arteries into the structure of the lungs; being here changed by the action of air, the bright crimson blood is conveyed by the pulmonary veins into the left side of the heart, and thence driven by its contraction along the aorta and throughout the body in the system of vessels called arteries. The arterial blood ultimately reaching the skin and membranes, moves through them and becomes of a dark color; in this state it enters the veins, and is conveyed back to the heart again to pass through the same course. The circulation in the lungs is termed the lesser or pulmonic circulation; that through the body, the systemic circulation. The object of this movement is to supply every part with its proper nourishment. The force which accomplishes it is the chemical action taking place in the minute or capillary vessels.

CIRCULATION OF THE SAP. The circulation of the sap in plants was, until within a few years past, a source of wonderment, and various theories, some of them ridiculous enough, were advanced by learned (?) men of the scholastic class. Even now, comparatively little is positively known as to some of the processes by and through which the plant lives and grows. It is very generally supposed that there is an upward and downward flow of sap in trees dependent upon the season. It is even now taught that the crude sap is taken in by the roots, ascends through the wood to the leaves, is then evaporated of its water to a certain degree, and elaborated by functional offices of the foliage, and thence descends through the inner bark, to nourish these tissues along its course, and form new growth. Many intelligent persons believe that the flow of sap is, like the current in a river, continuous. This latter proposition is so far true that when the leaves are transferring moisture steadily, and the supply of moisture at the root is sufficient, the flow of sap is steady. The flow of sap in the maple has often been quoted to prove this, yet it certainly did bother the savants, as well as the simple, to know how the sap got up through frozen roots in frozen earth. The facts in relation to the exudation of sap in the maple, and some other trees, in the spring, when wounded, is to be accounted for in the most simple manner. It is nonsense to suppose there is any regular flow of sap, in a tree, leafless, its buds entirely dormant, its bark impervious to moisture and its roots wrapped in frost. A maple, for instance, will not bleed, if wounded, when the temperature has fallen below a certain point. Thearand, in Saxony, found, in direct antagonism to the popular belief, that the proportion of water, both in the live bark and the wood of trees, varies considerably, at different seasons of the year, the range in beeches felled, being from thirty-five to forty-nine per cent; the greater proportion of water in the wood of fresh felled trees being in the months of December and January, and the least quantity in May, June and July. In the bark the greatest quantity was found from March to May; but, in the bark, great irregularity occurred. The stem of the maple is therefore fully charged with water at the time of sugar-making. Whenever the sun's rays are of sufficient strength to create heat sufficient to expand the moisture and air of the tree, sap will flow. When the heat declines, the sap ceases to flow. That water is produced by chemical action in the trunk is by no means improbable. That the supply originally came from the roots is certain; and that a continual supply is passed up from the roots during the sugar-making season is as certain and proved from the fact that, although the ground be frozen, the roots will not be, neither will the earth next them be frozen; and thus they furnish a passage for the flow of sap. The absorbing power of these deep roots remaining constant from day to day, in consequence of the uniform temperature, they furnish an equable quantity to supply the exhaustion consequent upon an increase of temperature in the trunk from the sun's power. That is, if this heat were constant the flow of sap would be equable, only limited by the supply from the roots. When the foliage expands, the flow from incisions of course will cease, since there is then an outlet for the escape of vapor through the pores of the leaves. When this takes place we have a different and normal flow of sap. Hence, we easily see why the vine bleeds profusely when cut before the expansion of its leaves and immediately ceases when the buds expand and the leaves perform their normal functions. In the exudation of sap through the effect of heat on the air, and on the moisture, contained in the cells of the wood, the temperature of the atmosphere is not always a sure indication of that of solid bodies. Since these take in, retain and increase in temperature, many degrees above that of the air. This is well known in the great heat of the soil, of iron, etc., when long exposed to solar influence in summer. Thus in trees, having a sunny exposure, the sap is earlier and crops are faster advanced in warm (sandy) soils, if moisture enough be present. Hartig has shown one mode by which changes of temperature in the trunks of trees influence the flow of sap. The wood-cells contain, not only water but air. Both are expanded by heat and both contract by cold. Air, especially, undergoes a decided change of bulk in this way. Water expands nearly one-twentieth in being warmed from 32° to 212°, and air increases in volume more than one-third by the same change of temperature. When, therefore, the trunk of a tree is warmed by the sun's heat the air is expanded, exerts a pressure on the sap, and forces it out of any wound made through the bark and wood-cells. It only requires a rise of temperature to the extent of a few degrees to occasion from this cause alone a considerable flow of sap from a large tree. A very conclusive experiment was conducted by Duchartre. He passed the stem of a vine, situated in a grapery, outside the house and back again, so that a middle portion of the stem was exposed to a winter temperature ranging from 18° to 10° Fahrenheit, while the remainder of the vine, in the house, was surrounded by an atmosphere of 70° Fahrenheit. The buds within developed vigorously, but those outside remained dormant and did not open sooner than buds upon another vine whose stem was all out of doors. That sap passed through the cold part of the stem was shown by the fact that the interior shoots sometimes wilted but again recovered their plumpness which could only happen from the partial suppression and renewal of a supply of water through the stem. At the conclusion of the experiment Payen examined the wood of the vine and found the starch, which it originally contained, to have been equally removed from the warm and the exposed parts. In this experiment, curiously enough, when the leaves of the vine wilted, it was at night and in the early morning, but recovered during the heat of the day, even when the temperature of the air outside was freezing. Thus we see that the diminished power of the stem to transmit moisture, was in consequence of cooling at night, but during the day it absorbed and stored heat enough to cause the leaves inside the conservatory to regain their turgid or succulent condition. Prof. S. A. Johnson, in How Crops Grow, says the conditions under which sap flows are various, according to the character of the plant. Our perennial trees have their animal period of active growth in the warm season, and their vegetative functions are nearly suppressed during cold weather. As spring approaches the tree renews its growth, and the first evidence of change within is furnished by its bleeding when an opening is made through the bark into the young wood. A maple, tapped for making sugar, loses nothing until the spring warmth attains a certain intensity, and then sap begins to flow from the wounds in its trunk. The flow is not constant, but fluctuates with the thermometer, being more copious when the weather is warm, and falling off or suffering check altogether as it is colder. In relation to the different kinds of sap, Prof. Johnson says: It is necessary to give prominence to the fact that there are different kinds of sap in the plant. The cross section of the plant presents two kinds of tissue, the cellular and vascular. These carry different juices, as is shown by their chemical reactions. In the cell-tissues exist chiefly the non-nitrogenous principles, sugar, starch, oil, etc. The liquid in these cells, as Sachs has shown, commonly contains also organic acids and acid-salts, and hence gives a blue color to red litmus. In the vascular tissue albuminoids preponderate, and the sap of the ducts commonly has an alkaline reaction towards test papers. These different kinds of sap are not, however, always strictly confined to either tissue. In the root-tips and buds of many plants (maize, squash, onion) the young (new-formed) cell-tissue is alkaline from the preponderance of albuminoids, while the spring sap flowing from the ducts and wood of the maple is faintly acid.

In many plants is found a system of channels (milk-ducts) independent of the vascular bundles, which contain an opaque, white, or yellow juice. This liquid is seen to exude from the broken stem of the milk-weed (*Asclepias*) of lettuce, or of celandine (*Chelidonium*), and may be noticed to gather in drops upon a fresh-cut slice of the sweet potato. The milky juice often differs not more strikingly in appearance than it does in taste, from the transparent sap of the cell-tissue and vascular bundles. The former is commonly acrid and bitter, while the latter is sweet or simply insipid to the tongue. In relation to the motion of the nutrient matters of the plant, the occasional rapid passage of a current of water upwards through the plant must not be confounded with the normal, necessary, and often contrary motion of the nutrient matters out of which new growth is organized, but is an independent or highly subordinate process by which the plant adapts itself to the constant changes that are taking place in the soil and atmosphere as regards their contents of moisture A plant supplied with enough moisture to keep its tissues turgid is in a normal state, no matter whether the water within it is nearly free from upward flow or ascends rapidly to compensate the waste by evaporation. In both cases the motion of the matters disolved in the sap is nearly the same. In both cases the plant develops nearly alike. In both cases the nutritive matters gathered at the root-tips ascend, and those gathered by the leaves descend, being distributed to every growing cell; and these motions are comparatively independent of, and but little influenced by, the motion of the water in which they are dissolved. The upward flow of sap in the plant is confined to the vascular bundles, whether these are arranged symmetrically and compactly, as in the exogenous plants, or distributed singly through the stem, as in the endogens. This is not only seen upon a bleeding stump, but is made evident by the oft-observed fact that colored liquids, when absorbed into a plant or cutting, quite visibly follow the course of the vessels, though they do not commonly penetrate the spiral ducts, but ascend in the sieve-cells of the cambium. The rapid supply of water to the foliage of a plant, either from the roots or from a vessel in which the cut stem is immersed, goes on when the cellular tissues of the bark and pith are removed and interrupted, but is at once checked by severing the vascular bundles. The proper motion of the nutritive matters in the plant—of the salts dissolved from the soil and of the organic principles compounded from carbonic acid, water, and nitric acid or ammonia in the leaves—is one of slow diffusion mostly through the walls of imperforate cells, and goes on in all directions. New growth is the formation and expansion of new cells into which nutritive substances are imbibed, but not poured through visible passages. When closed cells are converted into ducts or visibly communicate with each other by pores, their expansion has ceased. Henceforth they merely become thickened by interior deposition. Prof. Johnson adds: When a cutting, from one of our common trees, is girdled at its middle and then placed in circumstances favorable for growth, as in moist, warm air, with its lower extremity in water, roots form chiefly at the edge of the bark just above the removed ring. The twisting, or half-breaking, as well as ringing of a layer, promotes the development of roots. Latent buds are often called forth on the stems of fruit trees, and branches grow more vigorously, by making a transverse incision through the bark just below the point of their issue. Girdling a fruit-bearing branch of the vine near its junction with the older wood has the effect of greatly enlarging the grapes. It is well known that a wide wound made on the stem of a tree heals up by the formation of new wood, and commonly the growth is most rapid and abundant above the cut. From these facts it was concluded that sap descends in the bark and, not being able to pass below a wound, leads to the organization of new roots or wood just above it. Nearly all the organic substances (carbohydrates, albuminoids, lignin, etc.), that are formed in a plant are produced in the leaves, and must necessarily find their way down to nourish the stem and roots. The facts just mentioned demonstrate, indeed, that they do go down in the bark. We have, however, no proof that there is a downward flow of sap. Such a flow is not indicated by a single fact, for, as we have before seen, the only current of water in the uninjured plant is the upward one which results from root-action and evaporation, and that is variable and mainly independent of the distribution of nutritive matters. Closer investigation has shown that the most abundant downward movement of the nutrient matters generated in the leaves proceeds in the thin-walled sieve-cells of the cambium, which, in exogens, is young tissue common to the outer wood and the inner bark—which, in fact, unites bark and wood. The tissues of the leaves communicate directly with, and are a continuation of the cambium, and hence matters formed by the leaves must move most rapidly in the cambium. If they pass with greatest freedom through the sieve-cells, the fact is simply a demonstration that the latter communicate most directly with those parts of the leaf in which the matters they conduct are organized. In endogenous plants and in some exogens (*Piper medium, Amaranthus sanguineus*) the vascular bundles containing sieve-cells pass into the pith and are not confined to the exterior of the stem. Girdling such plants does not give the result above described. With them, roots are formed chiefly or entirely at the base of the cutting, according to Hanstein, and not above the girdled place. In all cases, without exception, the matters organized in the leaves, though most readily and abundantly moving downwards in the vascular tissues, are not confined to them exclusively. When a ring of bark is removed from a tree, the new cell-tissues, as well as the vascular, are interrupted. Notwithstanding, matters are transmitted downwards, through the older wood. When but a narrow ring of bark is removed from a cutting, roots often appear below the incision, though in less number, and the new growth at the edges of a wound on the trunk of a tree, though most copious above, is still decided below—goes on, in fact, all around the gash. Both the cell-tissue and the vascular thus admit of the transport of the nutritive matters downwards. In the former, the carbohydrates—starch, sugar, inulin—the fats, and acids, chiefly occur and move. In the large ducts, air is contained, except when by vigorous root-action the stem is surcharged with water. In the sieve-ducts (cambium) are found the albuminoids, though not unmixed with carbohydrates. If a tree have a deep gash cut into its stem, but not reaching to the colored heart-wood, growth is not suppressed on either side of the cut, but the nutritive matters of all kinds pass out of a vertical direction around the incision, to nourish the new wood above and below. Girdling a tree is not necessarily fatal if done in the spring or early summer when growth is rapid, provided the young cells, which form externally, are protected from dryness and other destructive influences. An artificial bark, that is, a covering of cloth or clay to keep the exposed wood moist and away from air, saves the tree until the wound heals over. In these cases it is obvious that the substances which commonly preponderate in the sieve-ducts must pass through the cell-tissue in order to reach the point where they nourish the growing organs. Evidence that nutrient matters also pass upwards in the bark is furnished, not only by tracing the course of colored liquids in the stem, but also by the fact that undeveloped buds perish in most cases when the stem is girdled between them and active leaves. In the exceptions to this rule, the vascular bundles penetrate the pith, and thereby demonstrate that they are the direct channels of this movement. A minority of these exceptions again makes evident that the sieve-cells are the path of transfer, for, as Hanstein has shown, in certain plants (*Solanaceæ*, *Asclepiadaceæ*, etc.), sieve-cells penetrate the pith unaccompanied by any other elements of the vascular bundle, and girdled twigs of these plants grow above as well as beneath the wound, although all leaves above the girdled place be cut off, so that the nutriment of the buds must come from below the incision. The substances which are organized in the foliage of a plant, as well as those which are imbibed by the roots, move to any point where they can supply a want. Carbohydrates pass from the leaves; not only downwards to nourish new roots, but upwards, to feed the buds. flowers and fruit. In case of cereals, the power of the leaves to gather and organize atmospheric food nearly or altogether ceases as they approach maturity. The seed grows at the expense of matters previously stored in the foliage and stems to such an extent that it may ripen quite perfectly although the plant be cut when the kernel is in the milk, or even earlier, while the juice of the seeds is still watery and before starch-grains have begun to form. In biennnial root-crops, the root is the focus of motion for the matters organized by growth during the first year; but in the second year the stores of the root are completely exhausted for the support of flowers and seed, so that the direction of the movement of these organized matters is reversed. In both years the motion of water is always the same, viz., from the soil upwards to the leaves and this because the soil always contains more water than the air. If a plant were so situated that its roots should steadily lack water while its foliage had an excess of this liquid, it cannot be doubted that then the sap would pass down in a regular flow. In this case, nevertheless, the nutrient matters would take their normal course. The summing up of the whole matter is that the nutrient substances in the plant are not absolutely confined to any path, and may move in any direction. The fact that they chiefly follow certain channels, and move in this or that direction, is plainly dependent upon the structure and arrangement of the tissues, on the sources of nutriment, and on the seat of growth or other action. From what has been shown, it will be seen that the circulation of the sap, like all other forces in nature, is guided by simple and yet perfect laws. The study of vegetable physiology is a most intricate and, at the same time, most interesting study. Scientists are constantly conducting experiments, bringing out something new. Nevertheless, there are very many questions still wrapped in obscurity, and probably always will be, since it is not likely that all the processes of nature will ever be laid open to the human mind, and for one reason, if for no other—the processes of nature are ever changing, according to the conditions present.

CISTERNS. In all countries subject to a lack of water at certain seasons of the year, resort is had to cisterns or tanks for holding a supply. Few persons appreciate the large amount of water which may be supplied by the roofs of ordinary farm buildings, for family and stock uses. Throughout the West, from the Falls of St. Anthony north, to Vicksburg south, the average rain-fall is almost thirty inches. Thus the roof of a barn thirty by forty feet, would give annually 400 hogsheads of water; a hogshead holds sixty-four pailfuls. Thus we have 25,600 pailfuls, sufficient to afford nearly four pailfuls each, per day, to twenty animals, the year round. A hogshead is about eight and a half cubic or solid feet. A hole or cistern two feet two inches square and the same depth, will hold one hogshead of water; one twice that size and depth will hold eight hogsheads; one eight feet each way will hold sixty-two hogsheads; one ten feet each way will hold 120 hogsheads. A round cistern or well four feet in diameter and six feet deep, will hold over forty-six hogsheads of water; one of the same diameter and nine feet deep will hold about fifty-five hogsheads; one twelve feet deep, same diameter, about ninety-three hogsheads. The foregoing form a convenient basis from which to calculate. The roofage of a good dwelling will usually collect about as much rain-water as the barn roof, portions of which, if desired, may be collected in a reservoir in the upper story, for convenient use in bathing tubs, etc. Cisterns at the house, for drinking and culinary purposes, should be deeper and narrower than at the barn, say ten to twelve feet, (not a great depth from which to raise it,) that the water may be cooler and better settled. They should also be divided by partition walls through the middle, made of soft porous brick, without mortar, and with some style of filter near the bottom, through which the water may all pass before being used. Into one of these apartments the water should be conducted from the eaves, but should be drawn out as used from the other; the one into which the water falls being a few inches deeper, that all impurities and sediment may settle to the bottom, and not be allowed to get into the other apartment, by which process there will always be clear water for use. Where the soil is clay, the wooden cistern is unnecessary, and will cost more than three times as much as the labor and material to cement the cistern in the best manner, by plastering the cavity, which is the best and cheapest mode of making cisterns water-tight. One coat is sufficient if the cement is good, and the mortar well mixed. A practical mason states the following: So much depends upon both cement and sand, that one can not direct any certain proportion of either to be used, unless we can give the material a practical test. Mixtures of one-fourth cement to three-fourths sand may make better mortar than some other qualities of cement when using equal proportions of both; so that we must be governed more by the working of the material when well mixed, by its tenacity, readiness to slip off the trowel, and quickness to set, than by measurement on proportions of the two substances without the working test. Measure each and test the mixture till you find the proper proportion, then continue to use those proportions. A coat of good cement mortar directly on the earth, one-quarter of an inch in thickness, is generally better than greater thickness; if too thick it is liable to crack in drying and settling. It is sometimes necessary to add two coats of mortar, where spots of the earth wall are softer by removal of stones or roots, etc. In cases of cracks, mix a thick wash of cement and sand, and apply it to the cracks with a brush. To make good cement mortar, the sand and cement should be thoroughly and carefully mixed and incorporated before any water is applied; and as soon as practicable after it is wet it should be used. Cement work should not be exposed to frost for at least three or four months after being finished, as freezing would destroy it before it is thoroughly set. In relation to reservoirs: low places in the fields, reservoirs for water, may be easily made in a dry time, to which water will flow during heavy rains. These should be as deep as possible, to prevent excessive evaporation; for instance, an excavation two feet deep will evaporate in about one third the time that one four feet deep will, and the deeper the tank the slower the evaporation from a given surface on account of the cooler temperature of the water. For the same reason the sides should be as steep as possible, say at about an angle of 45°, or a slope of one to one, except just where stock go to drink. Here it may be less sloping and should be thickly graveled, or otherwise protected from poaching, so the water will not become muddy. When there is underdrained land on the farm the outfall of water should always be led into the tank, since it will furnish a large supply of cool, pure water, a most important consideration. So where a single line of tile runs through a field; in depressions where the tile comes nearer the surface than in others, cemented cisterns holding a good supply may be made, and the water easily pumped from thence to the surface. Indeed, we have seen many situations, where the water may thus be brought quite to the surface, so stock may drink at will, the outflow being carried away in tiles laid at a lower depth than that at which the water enters.

CITRIC ACID. The sour principle of lemons. (See Acid.)

CITRUS. The generic name of the orange, lemon, and lime tree. Citron is a fruit larger than the lemon, the rind of which is the citron of commerce.

CIVES or CHIVES. *Allium schœnoprasum.* A small species of onion growing in tufts. It is propagated by dividing the roots. Early in the spring set the bulbs eight inches apart, and eight or ten offsets together. Keep free from weeds. The leaves may be used for soups. In the fall, as soon as the tops die, dig the Cives and store for winter. The leaves possess the flavor of onions, are used in soups, stews, salads, and the making of omelets. If not cut excessively, a bed (annually top dressed lightly) will continue to produce for years.

CLARIFICATION. The process of clearing or refining fluids, by which they are freed from sediment. The white of egg, the clear portions of blood, clay, membranes of fish and charcoal powder are clarifiers.

CLARY. A species of sage. *Salvia sclarea.* It is seldom cultivated in the United States, being inferior to the *Salvia officinalis.*

CLASS. A general division of natural objects, as classes of annual plants, etc.

CLAVATE. In botany, being club-shaped.

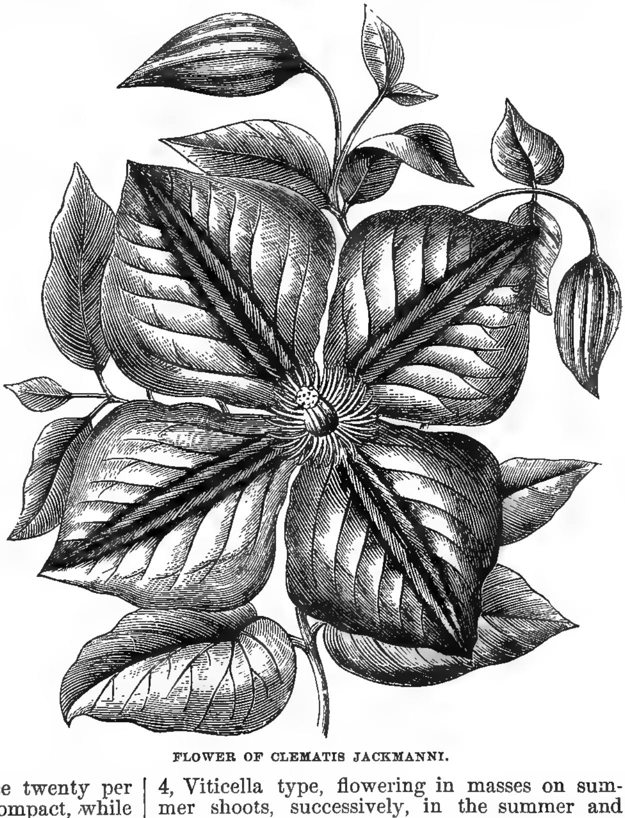
CLAY. The general name, clay, is commonly applied to all tenacious sub-soils of a homogeneous nature. The name signifies viscous, or sticky. Pure clay is a mixture of silex (of which quartz, flint, and most sand and sand-stones are composed) and alumina—this latter being composed of the metal aluminum and oxygen. Alumina is the characteristic ingredient in common clay, and is sometimes called pure clay. One of the purest kinds of clay is derived from the decomposition of granitic rocks, which rocks have been considered the original source of clay. In relation to varieties of clay, we find that silica combined with alumina, and holding a definite proportion of water, is deposited, and constitutes the purest form of clay, or kaolin. When separated from the uncombined silica and undecomposed feldspar that may be present, the plastic portion consists of alumina, 44.5; silica, 40.0; and water, 15.5, in 100 parts. The water, from the difficult solubility of the compound in acids, does not appear to be chemically combined to form a hydrous silicate of alumina. But this simple compound of one atom of alumina and one of silica, with two of water, is not met with unmixed with other ingredients which modify the properties of pure clay. Iron almost always manifests its presence, when the clay is burned, by the red color of its peroxide. Carbonates of lime and magnesia are detected by their effervescence with acids, and their rendering the substance fusible, an effect also produced by the salts of potash and soda derived from the feldspar. Mica, in a fine state of division, and some other minerals, may also be present. As clay-beds, in the process of accumulation, are often the habitats of shell-fish, and may constitute a soil covered with a vegetable growth, organic matters are also often found in it. According to its purity it is infusible, and retains its color unchanged when burned. In a dry state it adheres to the tongue, is very absorbent of water, and possesses a peculiar odor called argillaceous. Clay, being gradually heated, parts with its water and diminishes in bulk without cracking. Heated to redness, it forms a solid mass, which retains its form even if placed, when cool, in water and allowed to absorb this into its pores. Free from foreign substances, it bears the most intense furnace-heat without melting, and is hence well suited for the manufacture of crucibles and fire-brick. When impure, it may melt at a high heat and form a glaze. Substances are mixed with it to produce this effect, as in the manufacture of porcelain. In the manufacture of brick and other objects, it is tempered with sand in order to counteract its tendency to shrink. The most important varieties of clay are those used for the manufacture of porcelain, called China clay, or kaolin; potter's clay, for the manufacture of earthenware; common clay, for the manufacture of brick; fire clay for fire-brick and crucibles; pipe clay, and a clay used in Europe, for making light, porous, bricks which float upon water. Brick clay is usually obtained from alluvial deposits, and the color depends upon the oxide of iron contained. At Milwaukee, Wisconsin, is a brick clay entirely free from iron, and hence the burned brick are of a straw or light cream color. Its brick has given the city the name of Cream City. Clay soils may be classified as follows: Pure clay, or pipe clay, consisting of sixty per cent. of silica and forty per cent. of alumina, with or without some oxide of iron, and from which no sandy matter can be mechanically separated by decantation.—Brick clay is the most tenacious clayey soil, consisting of pure clay with five to ten per cent. of sand added.—Clay loam. This is pure clay, containing besides fifteen to twenty per cent. of sand. Loamy clay is composed of pure clay, with thirty to sixty per cent. of sand added. This last is, with the addition of organic matter, the most fertile and easily worked of all the soils. Besides these mentioned all so-called sandy loams or sandy soils (except pure sands, rarely found) contain more or less clay, some of them containing not more than ten per cent. of clay and yet, from the organic matter naturally contained or supplied, many of these soils are extremely fertile if plenty of moisture be present, for the more sandy the soil the less moisture will it absorb and hold, unless a supply be present below, to be supplied by capillary attraction. Pure sands are always infertile. So are pure clays, but from entirely different causes: Sand because it is too open and porous, and clay because it is too close and compact. Hence pure sands are made fertile by adding clay. Not so pure clays by adding sand, since twenty per cent. of clay renders a sandy soil compact, while it would require eighty per cent. of sand to render the clay friable.

CLEAVAGE. Minerals which have a regular crystalline form can only be split or cleaved with ease in planes corresponding to their sides; hence to discover the shape of the crystal, the mineral is split. The cleavage of wood is always in the direction of the grain, hence if the grain is straight the cleavage will be free, but if contorted the cleavage will be twisted and difficult.

CLEFT GRAFTING. (See Grafting.)

CLEFTS. In farriery, cracks in the heels of horses.

CLEMATIS. Virgin's Bower. There are fifty species and many varieties of this beautiful genus of plants, mostly climbers, and many varieties being too tender to stand northern winters. The hardy herbaceous kinds are propagated by divisions of the roots, and the hardy deciduous kinds by layers. They thrive in any good, well drained garden soil. The stove and green-house species, are grown in light loam and peat soil and are propagated from cuttings. The Clematis is divided, in England, into sections or types, according to peculiarities, habit of blooming, etc., as, 1, Patens type, varieties which bloom in late spring or early summer, from the old or ripened wood. 2, Florida type, those flowering in the summer from the old or ripened wood. 3, Lanuginosa type, varieties with dispersed flowers, blooming during the summer and autumn, successively, on short lateral summer shoots. 4, Viticella type, flowering in masses on summer shoots, successively, in the summer and autumn. 5, Jackmanni type, varieties flowering in continuous masses, on summer shoots, during autumn and winter. The illustration shows the blossom and leaves, one half natural size, of Clematis Jackmanni, considered one of the finest.

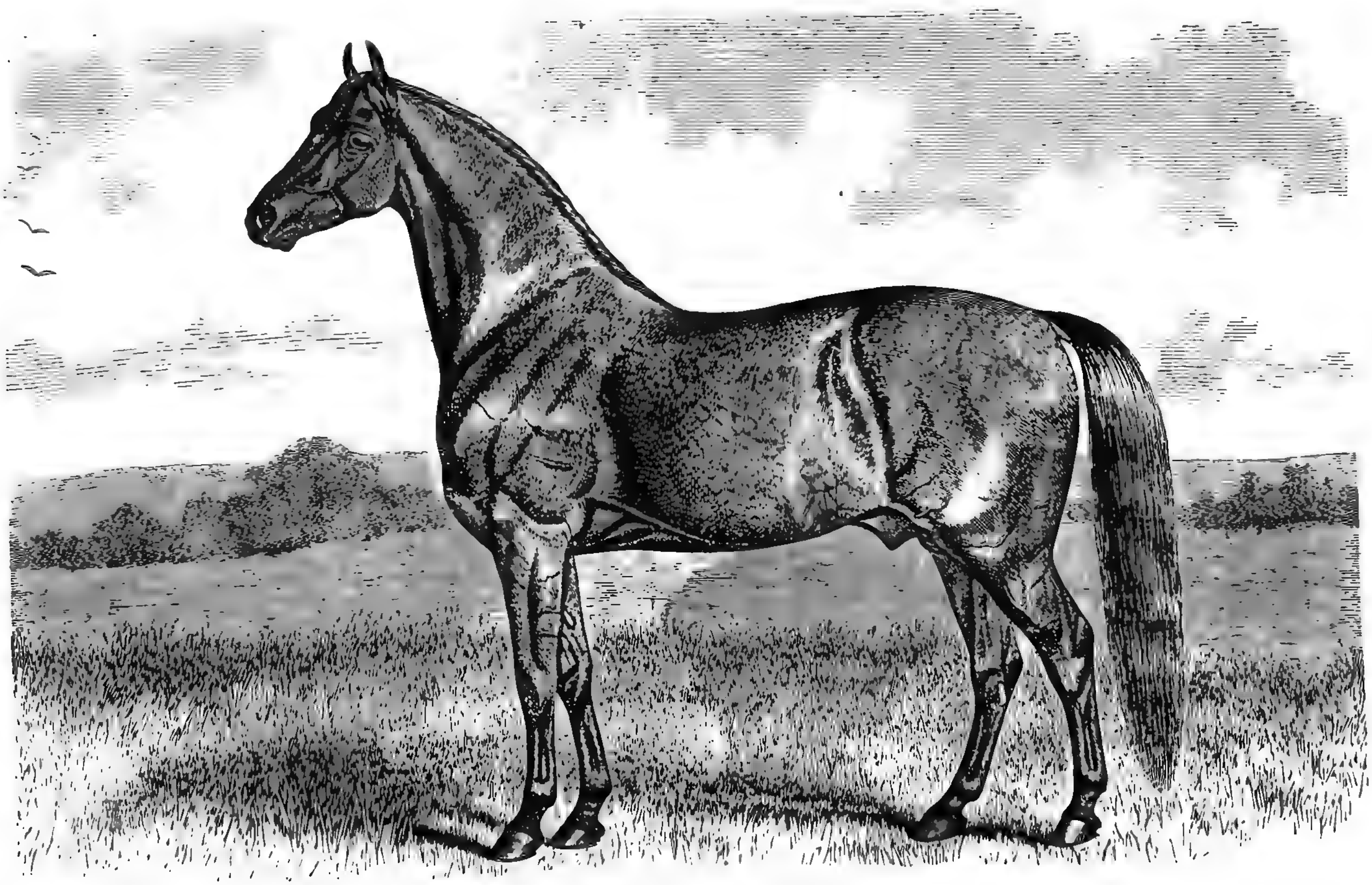


FLOWER OF CLEMATIS JACKMANNI.

CLEVELAND BAY HORSE. From remote times the Cleveland and the Vale of Pickering, in the East Riding of Yorkshire, have been celebrated for their breeds of horses, adapted to general work, hunting, carriage horses, and all that class of labor requiring style, a good turn of speed, and excellent bottom—a term used to designate staying qualities in the horse. As time passed, especially since the beginning of the present century, very many modifications of this admirable kind was brought about by crossing and selection, which, while preserving all the good points of the old Cleveland Bay, have modified them, so that to day, there is not an animal to be found, even in the East Riding of Yorkshire, of the pure, unmixed and unimproved blood. The improvement has been brought about by crossing staunch thoroughbreds upon the original stock, and by selection, so they are acknowledged now to stand as a type of all that is excellent, in a horse of medium weight, (1,200 to 1,300 pounds) combining style, muscular activity, spirit, bottom, and good form in an eminent degree. On another page we give an illustration of the Cleveland Bay, of the present day, in his best form. They are constantly gaining favor, especially in the West, where they are bred for horses for light and medium hauling, carriage horses, and all work where style and muscle are especially required. William Henry Herbert, Esqr , (Frank Forester) graphically describes the original Cleveland Bay, and the gradations by which he was bred up. From this we extract as follows: The Cleveland Bay, in its natural and unmixed form, is a tall, powerfully-built, bony animal, averaging, I should say, fifteen hands three inches in height, rarely falling short of fifteen and a half, or exceeding sixteen and a half hands. The crest and withers are almost invariably good, the head bony, lean, and well set on. Ewe necks are, probably, rarer in this family than in any other, unless it be the dray-horse, in which it is never seen. The faults of shape, to which the Cleveland Bay are most liable, are narrowness of chest, undue length of body, and flatness of the cannon and shank bones. Their color is universally bay, rather on the yellow bay than on the blood bay color, with black manes, tails and legs. They are sound, hardy, active, powerful horses, with excellent capabilities for draught, and good endurance, so long as they are not pushed beyond their speed, which may be estimated at from six to eight miles an hour, on a trot, or from ten to twelve—the latter quite the maximum—on a gallop, under almost any weight. The larger and more showy of these animals, of the tallest and heaviest type, were the favorite coach horses of their day; the more wiry and lightly built, of equal height, were the hunters, in the days when the fox was hunted by his drag, unkennelled and run half a dozen hours, or more, before he was either earthed, or worn out and worried to death. Then the shorter, lower and more closely ribbed up, were the road hackneys; a style of horse unhappily now almost extinct and having, unequally, substituted in its place, a wretched, weedy, half-bred or three-quarter-bred beast, fit neither to go the pace with a weight on its back, nor to last the time From these Cleveland Bays, however, though in their pure state nearly extinct, a very superior animal has descended, which, after several steps and gradations, has settled down into a family, common throughout all Yorkshire, and more or less all the Midland counties, as the farm-horse, and riding or driving horse of the farmers, having about two crosses, more or less, of blood on the original Cleveland stock. The first gradation, when pace became a desideratum with hounds, was the stinting of the best Cleveland Bay mares to good thoroughbred horses, with a view to the progeny turning out hunters, troop-horses or, in the last resort, stage-coach horses or, as they were termed, machiners. The most promising of these half-bred colts were kept as stallions; and mares of the same type with their dams, stinted to them, produced the improved English carriage horse of fifty years ago. The next step was putting the half-bred fillies, by thoroughbreds out of Cleveland Bay mares, a second time, to thoroughbred stallions; their progeny to become the hunters, while themselves and their brothers were lowered into the carriage horses; and the half-bred stallions, which had been the getters of carriage horses, were used as the sires of new, improved cart-horses. Within the last thirty years, the Cleveland Bay has still further improved by careful selection. Yet they are constant and uniform in color, fully as much so as the Devons among cattle. The illustration we give would seem to leave but little to be desired in conformation and style. The editor has always regretted that this admirable breed could not have been disseminated in the United States, about the time the Morgan horse fever raged. If so, the horse stock of the country would not have been degraded in size, and many millions of money would have been saved to the country. It will take many years to breed out the mischief the Morgans have done, in dwarfing the size of our ordinary horses as found among the average farmers.

CLEVIS. The draught iron of the plough; whippletrees, etc., any iron segment of an oval connected by a pin.

CLIMATE. Climate affects the agriculturist, so far as the product of the soil is concerned, in an important degree; heat, rainfall, humidity, air currents, all operating for or against the fertility of the soil. The principal points collected from a variety of sources, as relating to the United States generally, are summed up as follows: The climate of the United States is a peculiar one. Most of it lies within the dry belt of the trade-winds, which, in our summers, make the dryness of the California climate and of New Mexico, where the corn crop is dependent on irrigation. There are two of these dry belts, one on each side of the equator, and their dry winds blow diagonally into each other, producing by their mutual action a belt of rain about five hundred miles in width under the equator, and directly under the sun. These winds are concentrated by the lofty range of mountains in South America and Mexico, and turned northwards, carrying with them this belt of rains. In our summer they extend west as far as the middle of Texas; thence north, through the middle of Kansas; they curve gradually eastward and pass to the Atlantic by the line of the great northern lakes, covering all the old States with the rains from this equatorial belt; extending no further west than the middle of Texas and Kansas, they leave the western portions of them to the dry California climate. These rains, from causes not yet fully ascertained by science, are irregular as to time, quantity and duration. In the spring they are more concentrated, giving us the heavy, beating rains of March and April, and in July and August they cease almost entirely. We have no rains from the evaporations of our country; these we see in the form of dew only or, at most, they but slightly increase the amount of our equatorial rains. From this source of our rains results the extremes so peculiar to the



CLEVELAND BAY STALLION.

American climate. At one time our ploughed lands are saturated with water, our clay soils are melted and, in drying out, are compacted, so as to be much harder than the frosts left them in spring, before they were broken up. Then quickly follow droughts, parching and baking the soil, making it unfit, if worn, for profitable production. These influences of the climate so act upon the soil that the standing topics of our agricultural writers are drainage, thorough ploughing and constant stirring of the soil. The following tables show the rainfall at various points in the United States and also in Europe. They will be found an interesting study:

AMERICAN PACIFIC CLIMATES.
Inches of rain.

Stations.	Spring.	Summer.	Autumn.	Winter.	Total.
California.					
Sacramento	3.3	0.1	3.2	6.9	13.5
San Francisco	4.6	0.7	3.7	8.8	17.8
Los Angeles	2.5	0.1	1.6	5.5	9.7
New Mexico.					
El Paso	0.6	6.6	4.9	0.3	12.4
Albuquerque	0.6	5.6	1.2	1.0	8.4

AMERICAN ATLANTIC CLIMATES.
Inches of rain.

Stations.	Spring.	Summer.	Autumn.	Winter.	Total.
Cincinnati	11.9	14.2	10.0	11.3	47.5
Cleveland	9.1	11.6	9.8	6.9	27.4
Ann Arbor	7.3	11.2	7.0	3.1	28.6
Pittsburg	9.5	12.3	7.6	7.4	36.8
St. Louis	12.7	14.6	8.7	7.0	42.5
Nashville	14.1	14.0	12.3	12.4	52.8

EUROPEAN CLIMATES.
Inches of rain.

Stations.	Spring.	Summer.	Autumn.	Winter.	Total.
Turin, Piedmont	8.2	9.0	11.5	7.8	36.5
Valley of the Rhone	10.2	9.5	10.4	4.3	34.4
Vevay, Switzerland	7.9	10.8	11.1	3.9	33.8
Manheim, Rhine	6.3	8.0	7.4	5.3	27.0
Bordeaux, West France	7.3	7.4	10.3	9.0	34.0
Dijon, East France	7.1	7.5	9.3	7.3	31.2
Chalons, Northeast France	5.4	6.2	6.1	5.6	23.3
St. Michael's, Azores	6.6	3.6	9.5	11.7	31.4

These tables exhibit an average fall of rain during summer in California of 0.3 of an inch, and in the Atlantic States of thirteen inches nearly, and in European vine-growing countries of 7.7 inches. The climate of California would be more favorable if it had more rain in summer but, in moist situations, or where irrigation may be employed, it presents all that invites to grape production and, in fact, to the production of fruit generally. Stock also should be remunerative, since the dry summer climate enables the grass to retain its nourishment even when dry. In the smaller cereal grains also, the yield is good; but Indian corn can not be successfully grown except where the soil may be irrigated. The climate of the Pacific coast of America is a peculiar one in many respects, and especially interesting to the meteorologist. Prof. E. C. Merrick has compiled much valuable matter, in this direction, from which we extract as follows: The annual isotherm of 50° Fahrenheit passing through London, England, latitude 51° 30′ north, is depressed southward more than 10° in crossing the Atlantic, striking the American coast near New York City, latitude 40° 42′ north. The northern deflection of this isotherm on the European coast is obviously the result of the system of warm water currents springing from the Gulf Stream. These currents bear the heated waters of the tropical seas diagonally across the Atlantic, ameliorating the rugged northern coast climates of Europe, and placing them upon a par with opposite American coast climates, at least 10° further south. The same isotherm of 50° Fahrenheit passes nearly west across the American continent to longitude 103° west, where the elevation of the Rocky mountain plateau causes it to dip suddenly southward as far as the latitude of Sante Fé; thence crossing the Rocky mountains westwardly it trends northwest, almost parallel with the Pacific coast, to the north end of Vancouver's Island, latitude 51° 30′ north, about the same northing as upon the European coast. Mr. Blodgett's later examination of the meteorological observations made in Alaska by the Russian government during a series of years, presents remarkable confirmations of the northward tendency of the isotherms on our western coast. The annual isotherm of 40° Fahr., coasting northward through the southern part of the Aleutian islands, bends rapidly southward on approaching the Asiatic coast. Maury, in his Physical Geography of the Sea, indicated the cause of this isothermal elevation in a system of warm-water currents, similar to the Atlantic Gulf Stream, and its branches. Only the rudimentary points of the Pacific system of currents were then known; but Maury's theory has since been amply verified by later and very careful observation. Captain Kerhallet, of the French imperial navy, in his General Examination of the Pacific Ocean, has clearly traced the analogue of the Atlantic Gulf Stream in the Japan current of navigators, called by the Japanese, themselves, Kuro Siwo, or black stream, from its dark color, in which, as well as in other remarkable points, it strongly resembles its Atlantic congener. This Japanese current, or Kuro Siwo, results from two currents of heated water from the Indian ocean, one passing through the straits of Malacca and the China sea, and the other skirting the eastern coast of the Philippine islands, at the northern extremity of which they unite opposite the Japan islands; this united current again divides its main branch, trending east-northeast, and strikes our Pacific coast about midway between Vancouver's Island and Sitka Island. The waters of the current near its southern edge, latitude 12° 20′ north, longitude 163° 20′ west, were found by M. De Tessau, commander of the French frigate Venus, to be 4° 30′ Fahrenheit hotter than those just outside the current; a difference which would have been much greater if the observation had been made with water from the main axial line of the current. The impact of the Kuro

Siwo upon our western coast is more feeble, on account of the greater mass of intervening ocean water, than the impact of the Atlantic Gulf Stream upon the European coast, and consequently it is less potential in directly elevating temperatures. But any deficiency resulting from this cause is amply compensated by the narrowness of Behring's strait, through which a much smaller volume of floating ice and cold Arctic waters is discharged than those immense masses of both which sweep down into the Atlantic, rapidly absorbing the heat brought up by the Gulf Stream. The projecting peninsula of Alaska, with its out-lying islands, also deflects far to the westward the reactionary arctic currents, and protects our western climates from their depressing influence. The southeast winds, laden with moisture from the tropical atmosphere of the ocean, prevail along the coast during the winter or rainy season. Their latent heat, set free by precipitation, combines with the general influence of the Kuro Siwo in elevating the temperature and and bending northward the isothermals. These facts are sufficient to show why Puget Sound is on a par with New York City, while British Columbia and the southern part of Alaska are found within the same climatic parallels as northern New York and New England. Another and very important difference between the climates of our Pacific coast and those of Europe is found in the comparatively narrow range of barometric and thermometric oscillation. These are but the scientific expression of those conditions of majestic equability which first suggested the name Pacific, a name the significance and appropriateness of which become more striking as our knowledge of it increases. For this very remarkable exception from extremes of variations our western coast is indebted to the great width of the Pacific ocean. The hurricanes generated in that mighty cauldron of atmospheric forces, the Gulf Stream, are hurled across the narrower volume of the Atlantic with a force sufficient to be severely felt upon the coast of Europe. Storms entirely analogous, and accompanied by electric and calorific changes equally marked, prevail upon the Asiatic coast, and have been traced some distance along the Kuro Siwo; but the mighty mass of the Pacific waters calmly absorbs their fury, and prevents their disturbing force from reaching our shores. The atmospheric changes of the Pacific coast are consequently more uniform and of minor range. Comparing the averages of winter and summer temperature along the isothermal line of 50° Fahrenheit, the variations on the Atlantic coast are found to be double those on the Pacific. As a specimen of extreme variation a little further south, it may be stated that the mean range of winter temperature at San Francisco from the mean of July is only 8° 30′ Fahrenheit, whereas the variation at Washington, D. C., is 44° 30′ Fahrenheit, or more than five times as great. A still more prominent point of difference between our Pacific climates and those of Europe is found in the periodicity of rain. The arrangement of the year into two seasons, wet and dry, instead of four, is found only in the lower latitudes of Europe and Africa. On the Pacific coast it is observable, north of the Columbia river, as far as the forty-eighth parallel. Nearly all the rain of California falls between November and June. According to Blodgett's hyetal (relating to, or the distribution of, rain) charts, the annual fall of rain in that State is about twenty-two inches, decreasing southward to the Colorado desert, where it is almost nothing. In the northern part of the State, and on the western slope of the Sierra Nevada, the range is stated at thirty-five inches per annum. The general average is about half that of the States east of the Mississippi. This average increases northward. At Humboldt it is about forty-five inches, and at Vancouver's Island about sixty-five inches per annum. At Port Townshend, on Puget Sound, the distinction between the wet and the dry season is practically obliterated, the fall of rain being distributed throughout the year. On Sitka Island it becomes excessive, the mean annual deposit being 89.90 inches. Coming now to the climate of the West and Northwest, east of the meridian near which Omaha is situated, we find a climate often intensely cold or at least variable in winter, but with plenty of rainfall, equably distributed, and with summers of strong heat so the grape may be ripened well up to and even into Minnesota. So the more prolific varieties of Dent corn, thrives as nowhere else in the world; also all cereal grains, sweet potatoes, tomatoes, egg plant, pepper. melons, and many other tropical and sub-tropical annuals. As a fruit growing region the prairie districts are not especially adapted thereto, yet with a little care many varieties adapted to the climate may be raised, and the timber districts are unsurpassed in the production of fruit, the peach and sweet cherries flourishing on the east shore of Lake Michigan, nearly to 45° north latitude. West of Omaha the climate becomes dryer and dryer until passing the hundredth meridian, or the central part of Kansas, the climate becomes too dry in summer for general agriculture, or the successful cultivation of fruit and the cereal crops without irrigation, but is eminently adapted to pasturage. Further north there is more rain, so that, in the latitude of Minnesota, cereal crops may be raised in the valleys through to the Pacific coast. Some years ago, Mr. James Lippincott, of New Jersey, gathered together a mass of facts in relation to climate and vegetation, and the geographical distribution of vegetable and, generally also, of animal life in the earth. A glance at this work shows that the geographical distribution of plants is a subject of vast extent and importance. The nature of the vegetation covering the earth varies, as we have remarked, according to the climate and locality; and plants are fitted for different kinds of soils, as well as for different amounts of temperature, light and moisture. From the poles to the equator this constant variation in the nature of the flora is a shifting scene, passing from the lichens and mosses (the lowest vegetable forms in the arctic and antarctic regions) to the noble palms, bananas, and orchids of the tropics by a series of regulated changes through all the multiform aspects of the vegetable kingdom. The same progress and graduated fitness is observed in the vegetation of lofty mountains under the equator, when descending from the summit to the base. From the scanty vegetation of Greenland, where the only woody plants are the Arctic willows, trees scarcely a finger-length in height, we may trace the expansion of vegetation as we move southward over the lichens and mosses to the saxifrages and cruciferous plants, those resembling the cabbage and turnip in their mode of flowering; then to grassy pastures, and by coniferous or fir-like trees, and amentaceous or birch and alder-like trees, to the northern borders of the United States. Extending our glance further southward we shall perceive that we enter the region of oaks, hickory and ash, of tulip, (*Liriodendron*) cottonwood buttonwood, walnut, red and white cedars, sugar and other maples, sassafras, sumac, laurel, and many other trees and shrubs of the temperate regions of North America. In the districts further south we find an increase both of species and of genera, and more tropical forms show themselves, such as magnolia, Osage orange, honey locust, cypress, holly, bay, wax myrtle, the cotton plant, rice, the live oak, and enter the borders of the regions of the palmetto and the orange; thence to those of the sugar cane and pineapple, the coffee plant and the cocoanut, and the luxuriant vegetation of the equator and torrid heats. In this progress, as Humboldt, the father of geographical botany remarks, we find organic life and vigor gradually augmenting with the increase of temperature. The number of species continues to increase as we approach the equator, and each zone presents its own peculiar features; the tropics their variety and grandeur of vegetable forms; the north its meadows and green pastures, its evergreen firs and pines, and the periodical awakening of nature in the spring-time of the year. Many causes intimately connected with the aspects of our globe have an influence in modifying the conditions of climate, and thus affecting the distribution of animals and plants on its surface. The geographical forms of contour, the relief or elevation and depression of the terrestrial surface, the relations of size, extent, and position, each exert a very marked effect upon the climatic peculiarities of a district. The bearing or direction of the shores of a continent, the elevation of a mountain in one place rather than in another, the subdivision of a continent into islands or peninsulas, and other minor differences, have very important bearings upon the climate of a district. The depression of a few hundred feet over some wide areas would reduce some regions to the level of the sea, or sink them beneath its waves, or so modify the climate of the higher portions left above the waters as to render them no longer tenable by the life that once enjoyed a congenial clime. This is shown by the observation that some low islands scattered in clusters are covered with a vegetation entirely different from that of extensive plains, though lying in the same latitude. A change in the bearing of the shores would modify the currents of the ocean, which would react upon vegetation. Mountain-chains have oftentimes an influence upon the prevailing winds, and their height, or the plateaus from which they arise, modify the climate, and render it temperate or arctic under the fervent heats of the torrid zone. A mountain-chain extending from east to west may form a barrier between the colder regions on the north and the warmer on the south, and thus protect the northern plains from the warmer winds of more temperate regions, and increase the heat on the southern slope. This is exemplified by the Alps of Switzerland, which reduce the temperature of Germany below the mean that would otherwise prevail but for their cooling influence. Under some of the high towers of this mountain-barrier against the assaults of winter, the palm, the pomegranate, the orange and the olive grow, in the open air, while a few miles to the eastward, in valleys open to the north, through which the hurricane-blasts of the Borra rush with terrific force and severity of cold, often sweeping vessels from anchorage, these more tender plants can not exist. A few thousand feet in elevation, which is insignificant compared with the mass of the earth, changes entirely the aspect and the character of a country. For evidence of this assertion we may compare the burning region of Vera Cruz—its tropical productions and its fatal fevers—with the lofty plains of Mexico, their temperate growths and perennial spring, or the immense forests of the Amazon, where vegetation puts forth all its splendors, and where animal life is abundantly prolific, with the desolate paramos or Alpine regions of the summits of the Andes, rude, ungenial and misty. Or imagine the interior plains of the United States, east of the Rocky mountains, to be slighty inclined towards the north, and the Mississippi river to empty into the Frozen sea or Arctic ocean, or into Hudson's Bay, and the new relations of warmth and moisture incident upon this single change of direction of the current of this river would effect the most important modifications in the conditions of the vegetable and animal world, would exert a still greater influence upon the welfare of the inhabitants and, through them, upon the destinies of society yet to be, and perhaps, upon the entire human race. The climate that would result from latitude alone is greatly modified by the presence or absence of extended sheets of water; and the distribution of heat through the year, for any place, whatever, depends essentially on its proximity to, or its distance from, the ocean or large lakes, and the relative frequency of the winds that blow over them. The equalizing influence of large bodies of water, the temperature of which is less liable to sudden changes than the atmospheric air, is quite apparent. While in Ireland and the southwestern part of England the myrtle grows in the open air, as in Portugal, fearless of the cold of winter, the summer sun of these so genial isles does not succeed in perfectly ripening the plums and pears which grow and ripen well in the same latitude on the continent. On the coast of Cornwall shrubs as delicate as the camellia and orange are green throughout the year in the gardens, though in a latitude at which, in the interior of the continent of Europe, trees the most hardy can alone brave the winter cold. The mild climate of England can not ripen the grape almost under the same parallel where are grown the vines of the Rhine, nor will our Indian corn ever mature or attain there, even the size it will reach on our most northern border, even of Maine, or in Canada. In relation to the definite amount of heat required by plants, it appears that the conditions which define the limits of a plant require that we should know the degree of temperature at which its vegetation begins and ends; that at which it will flower and will mature its seeds or fruit; and also the sum of the mean daily temperatures during these periods respectively. The hypothesis that a definite amount of heat is required in order to develop each plant in its progress from one stage of growth to another was first advanced by Reaumer, better known in America from the thermometer which bears his name than through the scientific labors which added largely to the wealth of his native France. This philosopher proposed to calculate the amount of heat demanded by a plant, by multiplying the number of days required to pass through its growth by the mean temperature of the period. To Michael Adanson, a French naturalist, we are indebted for the hypothesis that, by adding together the mean temperatures of each day from the commencement of the year, it will be found that when the sum shall have reached a certain figure the same phenomena of vegetation will be exhibited, such as foliation, blooming, and maturation of the fruit. Boussingault revived the hypothesis of Reaumer and enlarged its application. Many years' residence in South America, engaged in scientific observation and research, where vegetation upon mountain sides appears under almost every aspect and condition, combined with experience in the pursuits of agriculture on his farm at Brechelbronn, in Alsace, had taught him that if we multiply the number of days—the length of time a summer plant endures—by the mean temperature of this period, the product will be the same in all countries and in all years. Baron Quetelet, of Brussels, experimented upon the amount of heat required by plants, and proposed that it should be measured not by the simple product of the temperature of the several days by the number of days required, but that the squares of the mean temperatures should be employed in lieu of the daily mean. The younger De Candolle has, however, sought in vain in the researches of Quetelet and others for any positive facts showing the direct advantages of the variations of heat over continuous even temperatures, or for the evidence fully determining that one day having a mean of 20° centigrade, is of equal value with four days having each a mean of 10° centigrade, as is assumed by Quetelet. Babinet compared the action of temperature to that of a force, which produces effects proportioned to the intensity of the cause and the square of the time. He has not, however, made experience the basis of his hypothesis, and it is rejected by Quetelet as unsound. According to the latter philosopher, by the hypothesis of Babinet, if one day at 20° centigrade produces a certain effect, two days having a mean of 10° centigrade should produce four times 10° or the effect of 40° centigrade, and four days at 5° centigrade should exert an influence equal to sixteen times 5° or 80° centigrade—results which the general experience of horticulturists will not permit us to accept as true. Count Adrien de Gasparin, in his Course of Agriculture, suggests that the mean heat of the day should be derived in part from the direct heat of the sun, and not alone from that of the air, as is in general measured by meteorologists, because the motive power which induces the circulation of the sap is the heat derived from the atmosphere and the soil in conjunction with the direct rays of the sun. The rate of decomposition of the carbonic acid absorbed from the air must be measured by the activity of the chemical rays of the sun, and the growth of the plant is accelerated, we are aware, by exposure to its full measure of sunshine. This method can not, however, be readily verified in the present actual state of meteorological knowledge. This observer followed the vegetation of one variety of vine growing near Orange, in France, from foliation to maturity, noted the minima of heat for each day in the shade, and the maxima shown by the thermometer in the sunshine, but protected by a slight covering of earth. The mean between these minima and maxima give, according to Gasparin, a more satisfactory number than that derived from other processes; and when multiplied by the number of days during which vegetation is influenced by this particular mean, results in a sum total of heat which varies but little from year to year at the locality where the observations were made. So nearly do these sums agree that the presumption is strengthened that the process may be the correct one, and deserving of much more attention than has been awarded to it. The result of de Gasparin's experiments in 1844 was a sum of 4195°; in 1845, 4203°; in 1846, 4057°, and in 1847, 4100° centigrade. The principle that we must combine the values of temperature and time in our inquiries into this subject can not be controverted, for all must perceive that heat acts proportionally as regards its duration and force. Boussingault, therefore, asserts that if a plant has required twenty days to ripen its seed, numbering from the period of flowering, and the mean temperature during those twenty days has been 50°, it will be found that the plant will have received 1000° of heat. The same number of degrees of heat might have influenced the plant during a lesser number of days had the mean temperature been proportionally higher. This is well illustrated by the rapidity with which some annual plants germinate in Arctic regions on the return of midsummer heats. In these northern regions, where for a short time plants are subjected to an intense heat, often as high as 109° Fahrenheit in the shade, and which enjoy a longer continuance of the sun above the horizon than in more southern latitudes, the growth of some vegetables is said to be so rapid under assiduous culture and in genial situations that their progress may be traced from hour to hour. In Norway, in latitude 70° north, peas grow at the rate of three and a half inches in twenty-four hours for many days in summer, and some of the cereals, probably barley and oats, grow as much as two and a half inches in the same time. Not only is the rapidity of growth affected by the constant presence of the sun's heat and light, but those vegetable secretions which owe their existence to the influence of the actinic force on the leaves are all produced in far greater abundance than in more southern climes; hence the coloring matter is found in greater quantity, the tints of the colored parts of vegetables are deeper, the flavoring and odoriferous matters are more intense, though in saccharine properties the plants of Norway are not equal to those of the south. While there can be no doubt that different plants require different amounts of heat, from the time of sprouting to full maturity, though the time through which this may be furnished may be different in different instances, and that a great heat may produce the same effect on plants which is produced by a lower degree operating during a longer term, another principle of much importance must be observed in order to the successful cultivation of plants under natural or artificial circumstances. This second principle is that each species requires for each one of its physiological functions a certain minimum of temperature or, as has been well said, each species of vegetable is a kind of thermometer which has its own zero or lowest degree at which it will vegetate. A temperature above a certain minimum of heat is found necessary for germination, another one for chemical modification, and a third for flowering, a fourth for the ripening of seeds, a fifth for the elaboration of the saccharine juices, and a sixth for the development of aroma or bouquet. A certain intensity of light is also demanded to render green the tissues, and a due supply of humidity in the air and in the soil to furnish a vehicle for the materials of growth and prevent undue desiccation. A plant is thus not only under all the influences which affect the thermometer, but is likewise acted upon as is a hygrometer by humidity and dryness. Knowing as we do how much local influences, as supply of moisture, currents of air, elevation, capacity of soil for absorbing and holding heat and moisture, and the various other conditions that may be seen by every observing person, alter the range of production in localities, we have the key to many of the difficulties in the cultivation of crops, and thus may easily see why certain plants may be hardy and prolific in one locality and yet impossible to be successfully cultivated in another, not far distant. For instance the peach is at home in Western Michigan, near the lake shore, while in Illinois, not more than forty miles west, it can not be raised at all. The climate of that State, modified by the unfathomable depths of Lake Michigan, is cooler in summer and warmer in winter and they escape spring frosts, prevalent in Illinois in the same latitude.

CLIMATOLOGY. (See Climate.)

CLINANTHIUM. The flat surface in which many composite flowers are arranged, as the sunflower.

CLINKSTONE. A hard, slaty mineral.

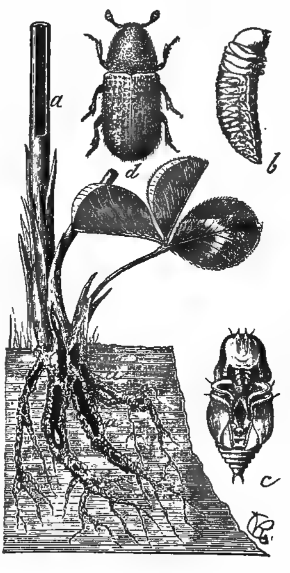
CLIPPING OF HORSES. The clipping or shortening of the hair of a horse, in winter, is as vicious as it is distressing to the animal, unless in the case of horses used for fast driving, and which, both in and out of the stable, receive the very best of attention and clothing. So the clipping of the long hair, about the lower limbs and fetlock, should never be allowed except the horse be kept out of cold drafts, when standing, and also is thoroughly washed and dried, by rubbing, when brought into the stable. This applies to animals on the farm, and those used for slow draft. So far as horses in cities are concerned, if the owners have careful and conscientious grooms, there is no objection to clipping whatever. On the other hand, proper clothing not being provided, and used out of and in the stable, the case is very different. It may be commended both on the score of appearance and of comfort to the animal, while being driven fast; but blanketing in no case must be forgotten, when the animal is not in motion.

CLOACA. The common cavity in which the intestines and urinary apparatus terminate in fish, birds, reptiles, and some larger animals.

CLOT BUR. (See Burdock.)

CLOUD. A mass of vapor suspended in the air. The height varies with the density, but seldom exceeds two miles. Clouds differ in form, transparency, etc., according to the amount of vapor of water they contain and the wind which drives them. Meteorologists divide them into three classes, thus: *Cirrus*, which is a light, branching cloud; *Cumulus*, a conical mass of clouds; *Stratus*, which consists of horizontal layers. Every variety occurs, compounded of these primary forms. Clouds owe their origin to a partial condensation of the vapor of water, which air naturally contains. The condensation is produced by cold, and the operation of winds blowing in directions contrary to one another, and also to electrical action. A fog is a cloud. Its condensation is mist which falls from rain in drops larger or smaller, according to the latitude. (See Air, Electricity, Rain, etc)

CLOVER. *Trifolium.* Of the true clovers the principal varieties are, the Common Meadow clover; Mammoth, sometimes called Grapevine clover; Medium clover or Zigzag clover; Alsike clover or Swedish clover, and White or Dutch clover. Other varieties of inferior merit, or else worthless, are Stone clover or Rabbit-foot, (*T. arvense*); Buffalo clover, (*T. reflexum*); and its near relative, with its creeping runners, Running Buffalo clover, (*T. stoloniferum*); Yellow or Hop clover, (*T. agrarium*); Low Hop clover, (*T. procumbens*). Some varieties of *Melilotus* are also sometimes designated as clover, as the Tree or Bokhara clover, White-flowered Melilotus; also the Yellow-flowered variety. Among the varieties of *Medicago*, sometimes denominated clover, are the Alfalfa, (*M. sativa*) of the Spanish, or Lucerne of the French, a most valuable plant in dry soils where it will withstand the winter, also Black Medick, or Hop-like Medick, (*M. lupulina*). Of all these, the red clovers, in common cultivation, Alsike clover, White or Dutch clover and Lucerne have been found generally valuable. Bokhara clover, so-called, and the other species mentioned, may be set down as of but little or no value for general cultivation. Two varieties of the clover family, *Lespedeza striata* or Japan clover, and *Richardsonia scabra* or Mexican clover, lately introduced into the southern portion of the United States, have proved of value. We give illustrations of these, and their description will follow further on. The clovers belong to the great pulse family, a family containing many plants most valuable to man. Of all the varieties, the Red clover, or Meadow Trifolium, is the most valuable in the North, the Middle States, and the West, growing on various soils except those wet. One of the worst scourges of the crops is the clover stalk borer, *Hylesenus trifolii*, which attacks the pith of both the stalk and root. We give a cut of the clover plant and insect, showing its work. The description is as follows: *a*, clover stalk and root, showing the work of the insect in the crown and root; *b*, larva or grub; *c*, pupa; *d*, beetle or perfect insect; the figures all enlarged. The young larva, natural size, is shown by the mark at



CLOVER ROOT AND STALK BORER.

bottom of boring in the orifice of the root. Red clover is beginning to be especially valued in the South, on rich and dry bottom lands, and also on the hill loams, as a pasture for swine, for hay and, especially, as a renovator of the soil. If pastured close, however, it is said to be killed. White clover is also well spoken of for thickening up the bottom of other grasses, particularly Bermuda grass. Lucerne is also being experimented with, and is well spoken of. There are two varieties of annual clover sometimes cultivated in gardens. The French Crimson clover and the Neapolitan clover, neither of which have any special value in agriculture. Besides the great value of clover as pasture and for cutting green for soiling and for hay, for all farm animals, except horses, its value in the rotation should not be overlooked. It not only destroys weeds from its dense shade upon rich land, but also by shading the soil causes the accumulation of nitrogen. The deep roots of clover penetrate far into a dry sub-soil, bringing up mineral matter and depositing it near the surface. When turned under, both its roots and its burthen of tops furnish a large amount of humus to the soil, and the rotting of its deep tap roots affords drains to carry off superabundant moisture. Clover should be sown in the spring, if possible upon a crop of wheat, as soon as the frost begins to leave the soil. If sown alone, it will generally produce a cutting late in the season, and if sown with wheat, will give valuable pasture after the grain is harvested. The quantity sown may be from ten to sixteen pounds, according to the use for which it is intended—for seed, the first-named quantity; for hay and pasture, the latter quantity. When sown in connection with grasses, from four to ten pounds of clover should be used according to the quantity required in the mixture. The following analyses of the two principal varieties of clover, and also of Lucerne, will show their constituents and also their value economically, these all having been made at the time of flowering, at which time both stalks, leaves and blossoms are richest in assimilable constituents. The analyses of these important varieties, in the green and dry state, used for both fodder and hay, substantially, as given by Einhof and Crome, are as follows:

Green State.	Red clover.	White clover.	Lucerne.
Water	76.0	80.0	75.0
Starch	1.4	1.0	2.2
Woody fibre	13.9	11.5	14.3
Sugar	2.1	1.5	0.8
Albumen	2.0	1.5	1.9
Extractive matter and gum	3.5	3.4	4.4
Fatty matter	0.1	0.2	0.6
Phosphate of lime	1.0	0.9	0.8

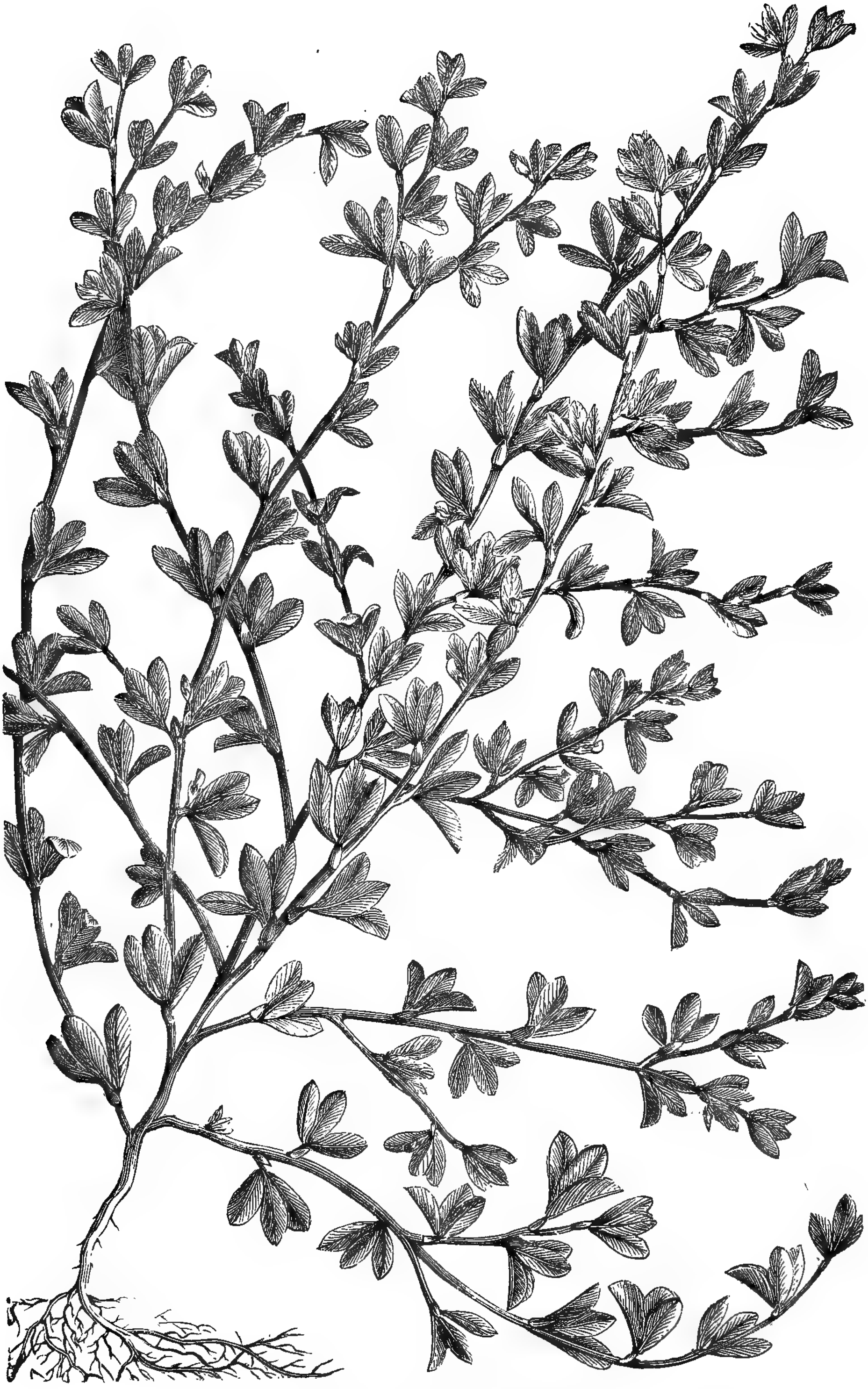
Or, economically:

Green State.	Red clover.	White clover.	Lucerne.
Water	76.0	80.0	75.0
Flesh formers	2.0	1.5	1.9
Fat formers	3.6	2.7	3.6
Accessories	17.4	14.9	18 7
Mineral matter	1.0	0.9	0.8

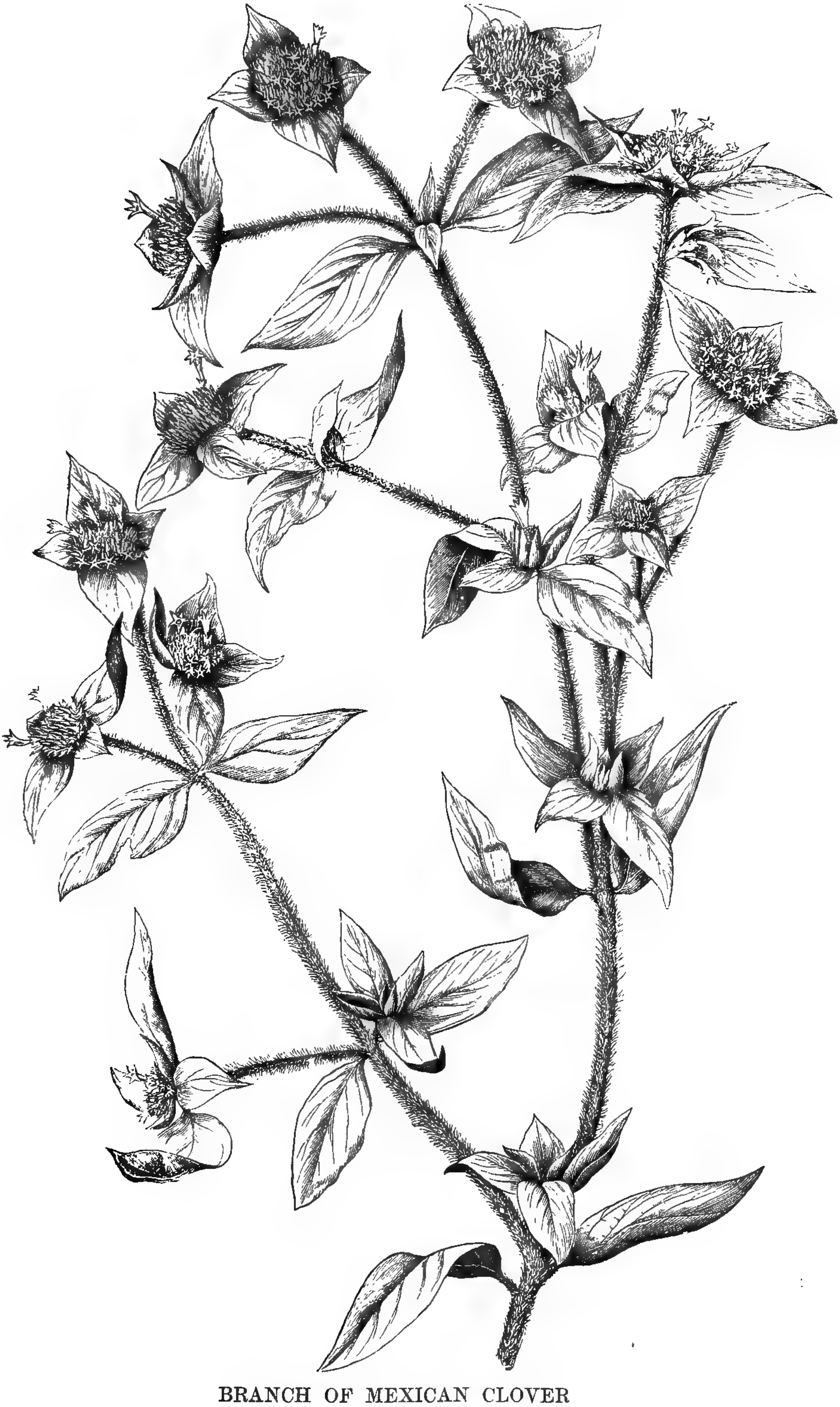
As with the hay of the true grasses, the dried clover is more valuable than the green, as shown by the following table:

Dry State.	Red clover.	White clover.	Lucerne.
Flesh formers	22.55	18.76	12.76
Fat formers	44.00	40.00	38.00
Accessories	24 00	30.00	36.00
Mineral matter	9.45	11.25	13.24

The value of clover is increased instead of diminished (as with the grasses) by a slow process of curing. It requires a longer time to cure it properly, and if exposed to the scorching sun it is soon injured even more than the natural grasses, since its succulent leaves and tender blossoms are quickly browned, and lose their sweetness in a measure, and are themselves liable to be wasted in handling over. Clover should be cut, therefore, while dry and free from dew; it should be exposed to the sun only enough to thoroughly wilt it, when it should be formed into small cocks, and permitted to dry until fit to place in the barn. Thus the tender and succulent leaves are secured in a form nearly resembling the green plant, which is a matter of vital importance in the economy of all tender leaved forage plants. From the oily nature of clover seed, its small size and heavy character, it soon deteriorates when kept in bulk. For this reason many farmers prefer to keep it in the dry chaff, until ready for sowing Thus in buying seed one should always be assured that it is sound, and of the previous season's growth. Many of our best farmers test the seed, before sowing, by strewing it between folds of damp cloth and placing it in a warm situation, or by sowing the seed in a box, in the window, and keeping it moist until sprouted. If good, it should germinate inside of two weeks. In raising clover, for seed, the first crop should be mown as soon as it is in blossom and the seed taken from the second, or after-crop, since the first blossoms are usually infertile. The heads for seed should be left until quite brown, mowed, allowed to dry thoroughly, and then be placed on a scaffold in the barn, or carried up in narrow, ventilated stacks properly thatched, or covered with marsh hay, to secure all from wet. When properly cured it may be threshed by means of flails or, better, by a clover huller and separater. Much has been said and written in the Southern States concerning Japan clover, a recent emigrant from Japan. It is a low, perennial plant, not rising much above the ground but spreading widely on the surface. It belongs to the leguminous family of plants, which includes the common clover, bean, pea, etc. The leaves are very small, trifoliate, and very numerous. The flowers are exceedingly small and produced in the axils between the leaf and stem, and the fruit is a small flattish pod. Prof. Killebrew says concerning it: About the year 1849 it was noticed in the vicinity of Charleston, S. C., the seeds having been brought from China or Japan in tea boxes. A short time afterwards it was discovered at a distance of forty miles from Charleston, and still later near Macon, Ga. It seems especially adapted to the Southern States, not flourishing above 36°, but growing with



PLANT OF JAPAN CLOVER.



BRANCH OF MEXICAN CLOVER

great luxuriance on the poorest soils, and retaining vitality in its roots in the severest droughts. It is said to be a fine plant for grazing and, being a perennial, needs no re-sowing and but little attention. On soils unfit for anything else it furnishes good pasturage and supplies a heavy green crop for turning under and improving the land. Mr. Samuel McRamsey, of Tennessee, says: This clover made its appearance in that locality in 1870. It is fast covering the whole country; it supplies much grazing from the first of August until frost. It is short, but very hard. Sheep are very fond of it, and cattle will eat it. Mr. Chas. Mohr, Mobile, Ala., says: It was introduced from Eastern Asia and has, during the last decade. overspread the Southern States from the Atlantic slope to the banks of the Mississippi. Cattle and horses eat it. Of its value as a nutritive food the writer does not state definitely. Mexican Clover (*Richardsonia scabra*) is an annual plant of the Natural Order *Rubiaceæ*, which contains the coffee, cinchona, and ipecacuanha plants. It is a native of Mexico and South America. It has, within a few years, become extensively naturalized in some parts of the South. Under favorable circumstances it grows rapidly, with succulent, spreading, leafy stems, which bear the small flowers in heads or clusters at the ends of the branches, and in the axils of the leaves. The flowers are funnel-formed, white, about half an inch long, with four to six narrow lobes and an equal number of stamens inserted on the inside of the corolla tube. The stem is somewhat hairy, the leaves opposite and, like other plants of this order, connected at the base by stipules or sheaths. The leaves are oblong or elliptical and one or two inches long. Mr. John M. McGehee, of Florida, writes as follows: We here call the plant Florida Clover, others call it Water Parsley, and others Bell Fountain. This plant is now attracting more interest in this section than any other article of farming interest. It is very troublesome to farmers in the cultivation of their crops; its growth is very rapid. It contains a great deal of water, and is hard to cure as a hay. Some call it very good hay, others say it is worthless. For the last fifty years it has been regarded as a great pest to farmers. It is now coming into notice as an element in green-soiling, which has never been practiced in this section heretofore. Mr. Matt. Coleman, of Florida, writes: The tradition is that when the Spanish evacuated Pensacola this plant was discovered there by the cavalry horses feeding upon it eagerly. Hearing of this I procured some of the seed and have been planting or cultivating it in my orange grove from that time to the present as a forage plant and vegetable fertilizer. I find it ample and sufficient. It grows on thin, pine land from four to six feet, branches and spreads, in every direction, forming a thick matting and shade to the earth, and affords all the mulching my trees require. One hand can mow as much in one day as a horse will eat in a year; two days' sun will cure it ready for housing or stacking, and it makes a sweet, pleasant-flavored hay; horses and cattle both relish it. The bloom is white, always open in the morning and closed in the evening. Bees and all kinds of butterflies seek the bloom.

CLOVES. The unexpanded blossoms of an Eastern tree, the *Eugenia caryophyllata.* They contain an oil highly aromatic, and grateful to the stomach in minute quantities. It is a tropical production.

CLUPEA. The generic name of the herring and shad fishes, anchovies, sprats, etc.; most of the species are migratory.

CLUSTER. A bunch; in botany a raceme.

COAGULATION. The formation of a solid body of a jelly-like character. Milk coagulates in souring. The juices of fruit coagulate in the preparation of jellies.

COAL. Numerous varieties exist: that of Pennsylvania and Wales (Eng.) is anthracite, difficult of combustion, producing no flame, but intense heat; it is nearly pure carbon. Bituminous coal, such as that of Virginia and Ohio and the Western States, contains hydrogen as well as carbon, and gives off gas and flame in burning. Wood coal resembles charred wood, and shows the marks of wood: it produces much light. All coal is of vegetable origin, being, indeed, the remains of plants and trees. The chief beds of it are arranged in a curved form; hence the term coal basins. This variety lies above the old red sandstone, and is covered with sandstones and conglomerates. It is, therefore, a secondary formation in the West generally overlaid by shales and limestone. (See Geological Maps.)

COAL TAR. A tarry fluid of a complicated nature, produced during the distillation of bituminous coal for gas. It is a cheap and excellent paint for iron-ware, railings, etc., and has sometimes been used on rough work. It preserves the timber, and is not used except as a preservation against wet, in damp situations.

COCCINELLA. The generic name of the lady-bird beetles. (See Lady-bird.)

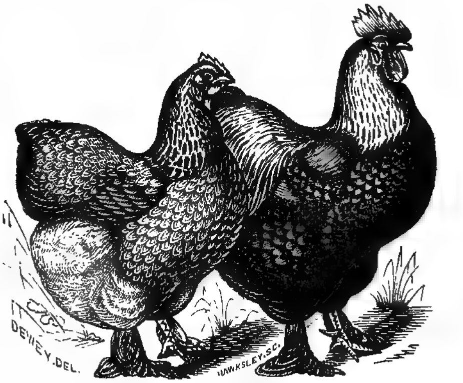
COCCULUS INDICUS. A poisonous Eastern berry used in medicines; it is sometimes employed, to cause intoxication, in beer, or thrown into fish ponds to stupefy fish, which can be caught with the hand while suffering from its effects. The poisonous principal is *picrotoxia.*

COCCUM. A dry, elastic seed-covering.

COCCUS. The bark lice or scale insect family.

COCCYX. The termination of the spinal column.

COCHIN CHINA FOWLS. The introduction of these fowls into England dates back to 1843, and soon after that date, they were introduced into the United States. As an indication of the admirable qualities of these fowls, it will only be necessary to give the principal varieties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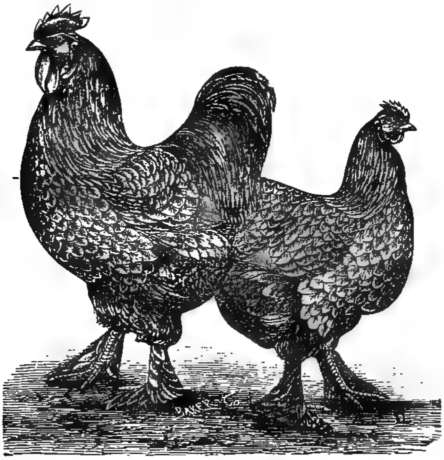
PARTRIDGE COCHINS.

into which they have been broken up, to show the estimation in which they are held. These are, White, Buff, Cinnamon, Grouse or Partridge Cochin, Lemon, Silver Buff, Silver Cinnamon, Black Cochin, Cuckoo, and Silky-feathered Cochin. We illustrate two of the best known of the breeds, the Partridge Cochin, and the Buff Cochin. Although among the largest of barn-yard fowls, they endure confined quarters fairly well. It must be admitted, however, that they are better adapted to the farm, where they can have range, than to the confined quarters of the city. On the farm, the White Cochins are sturdy birds and will forage, if allowed, long distances in search of insects. If kept in confinement they must have animal food, and also green food, daily, and if possible they should be allowed a short ramble late in the afternoon, when they will not trespass much. As winter layers of eggs the hens are among the best of all the breeds of Gallinaceous fowls. They also cross kindly with other barn-yard fowls, and live contentedly with other breeds. The objection to them is that they are rather coarse boned, inclined to undue accumulation of fat. The general characteristics of the Cochin cock are: comb single, fine, rather small, upright and straight with well defined serrations, stout at the base and tapering to a point. Head small and carried rather forward; eye bright and clear; deaf ears pendant and large; wattles large and well rounded on the lower edge. The hackles of the neck full and abundant, reaching well to the back. Back broad, with a gentle rise from the middle to the tail, and with abundant saddle feathers; wings small, the primaries well doubled under the secondaries, so as to be out of sight when the wings are closed. Tail, small, curved feathers numerous, the whole tail carried rather horizontally than upright. Breast deep, broad and full; thighs large and strong, well covered with soft feathers. Vulture hocks, those with long stiff feathers, are objectionable; the fluff should be soft and abundant, well covering the thighs and standing well out behind. Legs rather short, thick and bony, wide apart, and well feathered on the outside to the toes; toes stout and strong, the anterior and middle toes well feathered. The carriage not so upright as in other breeds. The hen should correspond with these points, but be more feminine in appearance, for instance, the comb should be single, very small, fine, low in front, perfectly straight with well defined serrations, and the tail, of course, lacking the sickle feathers. If birds are intended for exhibition they must not only be perfect in markings and make-up generally, but they must also be in the highest possible condition. The best age is just when the pullets are ready to lay. If strictly kept from intercourse with the male birds, they will then be in their full development and beauty of form and color. The cockerels should be two or three months older than the pullets. This, of course, applies to young fowls and not to fully matured birds.



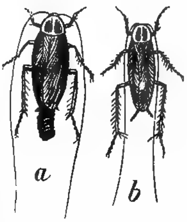
BUFF COCHINS.

COCHINEAL. The *Coccus cacti*, a Mexican insect which feeds on a *Cactus opuntia*, a prickly pear. The best should be of a grayish exterior, and the lines of the body clearly defined. The brilliant scarlet of Cochineal is fixed in dyeing by a mordant of alumina and solution of tin, and brightened by cream of tartar.

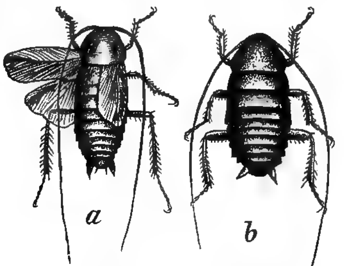
COCHLEATE. Twisted like some shells.

COCKLE. *Agrostemma*, which grows amid wheat, and whose black seed impair the color of flour if not well separated by screening. It is an annual, to be destroyed only by a succession of fodder crops, cut for soiling before flowering, or by a clean fallow.

COCKROACH. Of the cockroaches, the most common and the most destructive species, in this country, is the Oriental Cockroach. This insect is said to have been introduced from Asia into Europe, and from Europe into America, and it is presumed that there is not now a maritime nation in the world where it does not exist. This species is generally found in and near human habitations, prowling about at night in search of food, and is both destructive and offensive; but we have also a number of native species, found in fields and woods, under stones, timbers and bark of trees. The female cockroach may be sometimes seen running around with a seed-like egg or capsule protruding from the caudal segment of the abdomen, nearly half its size. This is not a single egg, but contains two sets of cells, arranged something like a double row of cartridges in a cartridge box, in each of which there is an egg. When the young are hatched from the eggs within the capsule, they secrete a liquid which dissolves the mucilage with which the vent is united, and thus they make their escape, leaving their receptacle as entire as it was before they quitted it. After moulting, or casting off their skins several times—for a few hours after which the insect is entirely white, but gradually changes to black or dark or light brown, according to the species—these insects are finally developed into the full-grown individuals we see, all the males acquiring wings capable of bearing them in flight, whilst the females are either wingless or have these appendages only short or rudimental. The remedies for the destruction of cockroaches are many, among which the following have been regarded as effectual: Mix a tablespoonful of red lead and Indian meal, with as much molasses as will make a thick batter, and place the mixture in and about such places as are infested with these insects at night. Another remedy is to mix a teaspoonful of powdered arsenic with a tablespoonful of mashed potatoes, and crumble it at night in such places as are infested with the insects, where they may discover and devour it, continuing these remedies every night successively until all are destroyed. Various rat and roach remedies, kept for sale at the drug stores and elsewhere, have also been considered as effectual for the destruction of these offensive insects. Great care should be taken, however, in the use of these remedies, as they are very poisonous. Various kinds of traps have been also recommended from time to time, which are nightly baited, and the contents thrown into the fire or scalding water in the morning. As these insects love heat and are usually found in and about ovens and fireplaces, this peculiarity in their economy may suggest the most proper places where traps or poisons should be deposited, in order to secure them, or effect their destruction. A deep bowl, glazed or smoothed inside, with rough and easy approaches from the outside, and baited with some substance that will attract these insects by its odor—old cheese, for instance—is considered a good form for a cockroach trap. Boxes partly filled with water, and having a nicely adjusted tilting lid, form good traps. Roaches are nocturnal in habits and hide in corners and crevices during the day, but at night they emerge from their retreats to feed. They devour both animal and vegetable substances and, not only eat books, clothing, paper, leather, etc., but they also render the substances, over which they run, filthy and disgusting by discharging from the mouth a dark-colored, nauseous-smelling liquid. There are some few parasitic insects which destroy them both in the egg and insect state, but they are too few to be of any practical benefit in lessening their numbers. One of our most plentiful and destructive species is the croton-bug, or German Cockroach, (*Ectobia Germanica*) *a*, male; *b*, female. This is a medium-sized, or rather small, cockroach, generally of a light yellow or deep fawn color; both sexes are provided with wings and are, sometimes, in summer, found under the bark of trees in the South. These insects are especially destructive and abundant in houses heated by hot-water pipes, as they seem to thrive best and multiply most where there is a combination of heat and moisture. They are almost omnivorous and devour cakes of paint, vermilion, cobalt and umber alike. Another very troublesome species is the Oriental Cockroach, (*Stylopyga orientalis*) *a*, male; *b*, female.) This is a very large and common species, and is generally found most abundant in or near seaport towns. This insect is generally supposed to have been imported from India. It varies in color from chestnut to almost black, according to age and exposure. The wings of the males are much shorter than the body, while the wings of the females are wanting, or are very rudimentary. They are very fond of heat, and hide in cracks near furnaces and fire-places. Their general habits and the manner in which the eggs are deposited are much the same as with the croton-bugs. The injury these insects do when numerous is very great, as they are almost omnivorous. There are several other genera and species of cockroaches in this country, but they all have very similar habits to the above, and are neither so plentiful nor do so much injury; some of them live in old rotten wood, under bark of trees, and live altogether out of doors, and therefore the injury they do to farmers or housewives is very trifling or of no consequence whatsoever.



CROTON-BUG.



ORIENTAL COCKROACH.

COCK'S-FOOT GRASS. (See Grasses.)

COCOON. The web which covers the chrysalis of an insect.

CODLING MOTH. (See Apple Worm.)

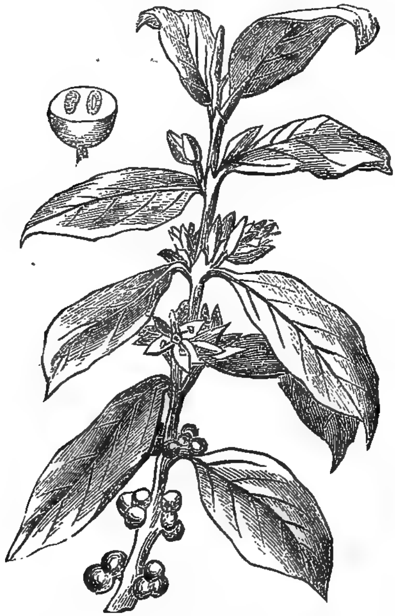
CŒLIAC. Relating to the belly or abdomen.

COFFEE. This is an important plant in the agriculture of many intertropical countries. The coffee plant has been lately introduced into the United States under the erroneous supposition that it might be acclimated, which is, of course, destined to result in failure. It is probable that the plant may survive in some portions of Southern California, and barely possible that it may not be winter killed in Southern Florida. That it can ever be profitably cultivated is out of the question. It was at one time stated that the coffee plant grew wild all over California. The ignorant persons, who started the story, supposed a plant allied to the Buck Thorn, (*Frangula Californica*) to be real coffee. The almost universal use of coffee among civilized nations has stimulated its cultivation wherever the plant could thrive. Brazil is now the largest coffee producing country in the world. Of late years much interest has been excited over Liberian coffee on account of the superior size of the berry. There are several varieties of *Coffea Arabica*, in Abyssinia and Central Africa. Liberian coffee was supposed to be one of these, but late investigations have determined it to be a distinct species, and it has been named *Coffea Liberica*. The cut shows branch, leaves, and fruit of coffee. An interesting work on coffee, published by Appleton & Co., gives, among other interesting matter, the composition of raw coffee. It is as follows:

Woody matter	34
Water	12
Fatty matter	13
Gum, sugar, and caffeic acid	18
Caffeine	2
Azotized matter, analogous to legumine	13
Saline matter, essential oils, etc	8
Total	100

Also it is stated, as among the curiosities of chemistry, that a magnificent purple dye can be prepared from the alkaloid of coffee. It is analagous to the dye which produced the famous Tyrian purple, unsurpassed for its perfection and permanence of tint. Mention is made of the facts that coffee, although a native of the Old

World, has long been one of the most important staples of the New. Meyen, in his inquiries concerning the principal plants on which the prosperity of nations is based, says that he even found some coffee trees growing wild in Brazil, not far from Rio Janeiro, in the woods of Corcorado. It is the great commercial staple of the empire of Brazil which, as before stated, is the greatest coffee producing country of the globe, Java being the next in order. The latter does not contribute one-half the quantity of the former, yet it furnishes nearly three times as much as other markets. As showing the estimation in which coffee is held in the United States, the fact is referred to that the annual consumption is greater than anywhere else in the world; to the extent of six-fold larger than in some of the states of Europe. Germany and France stand next to the United States in the rank of great coffee drinkers. It has often been expressed as a matter of surprise where the supply of Java and Mocha coffee came from, it being generally understood to be impossible that these comparatively small regions could supply a tithe of the Mocha and Java used. Of course these countries could not, even under the most intelligent system of cultivation, a system not general there. These grades really come from Brazil and other South American countries, a state of things not difficult to believe by those who inspected the many varieties shown at the Centennial Exhibition by the Brazilian government. It was extremely difficult to detect the difference in form and color of the berry, a matter, however, apparent enough when the coffee was steeped. Coffee, like tobacco, owes much of its superior quality to the climate and soil upon which it is grown. Since the introduction of Brazil coffee many of the drinkers of the old-time Java and Mocha seem to have forgotten the taste and fragrance of the real berry and, being accustomed to the taste of the counterfeit Java, seem well satisfied.



BRANCH OF COFFEE TREE.

COFFER DAM. In architecture and bridge-building, a case of piling or other material, water-tight, fixed in the bed of a river or water space for the purpose of laying the bottom dry for a space large enough to build the pier on. Under ordinary circumstances coffer dams are formed by a single enclosure or a double one, with clay rammed in between the two to prevent the water from coming through the sides. They are also made either with piles only, driven close together, and sometimes notched or dovetailed into one another; or, if the water is not very deep, by piles driven at a distance of five or six feet from each other, and grooved in the sides with boards let down between them in the grooves. In order to build, in coffer dams, a very good natural bottom of solid earth or clay is required; for though the sides be made water-tight, if the bed of the water be of a loose consistence, the water will ooze up through it in too great a quantity to permit the operations to be carried on. The sides must be very strong and well braced in the inside to resist the pressure of the water. Modern science adopts various ways of reaching the same end. In bridge-building, for instance, when it is necessary that the foundations rest upon the solid rock, immense caissons, iron tubes, are forced down, and the sand and earth pumped therefrom, subsequently to be filled with masonry. Thus the great Mississippi bridge foundations were laid, the bed rock being in places forty feet below the bed of the river.

COHESION. The force which binds together similar particles. The strain which any wood or metal bears is a measure of its cohesion. The following is a tabular view of the absolute cohesion of timber employed in building and carpentry, showing the load which would rend a prism of an inch square, and the length of prism which, if suspended, would be torn asunder by its own weight:

Name.	Pounds.	Feet.
Teak	12,915	36,049
Oak	11,880	32,900
Sycamore	9,630	35,800
Beech	12,225	38,940
Ash	14,130	42,080
Elm	9,720	39,050
Memel fir	9,540	40,500
Norway fir	12,346	55,500
Larch	12,240	42,160

The metals differ more widely from each other in their cohesive strength, than the several species of wood or vegetable fibres. According to the experiments of George Rennie, the cohesive power of a rod an inch square, of different metals, in pounds avoirdupois, with the corresponding length in feet, is as follows:

Name.	Pounds.	Feet.
Cast steel	134,256	39.455
Swedish malleable iron	72,064	19,740
English " "	55,872	19,740
Cast iron	19,096	6,110
Cast copper	19,072	5,093
Yellow brass	17,958	5,180
Cast tin	4,736	1,496
Cast lead	1,824	348

COKE. The cinder of bituminous coal after being heated for gas. This variety of coke lacks strength, since all that pertains to gas is taken from it, but it is easily kindled. In making coke, for manufacturing purposes, only the sulphur and other injurious elements of the coal are taken out. Such coke gives off a steady, intense heat and is heavy, gray in appearance and, if struck together, gives off a metallic sound.

COLCHICUM. *Colchicum officinale.* Meadow saffron, a bulbous plant, growing freely in moist, sandy loams. The bulb and seeds are of the highest value as a medicine in gout and rheumatism. In large doses it is poisonous.

COLEOPTERA. Insects, the outer wings of which are hard or horny, the inner wings being large and very delicate. Borers, lady-birds, curculios, etc., belong to this race. (See Beetles.)

COLEWORT. (See Cabbage.)

COLIC. An irritation of the stomach or intestines produced by various causes, inducing pain and griping; mild cases are readily alleviated by laudanum in the human subject. There are two forms of colic, spasmodic and flatulent. In horses, spasmodic colic sometimes runs into inflammation. Sometimes one is mistaken for the other. In colic the horse is attacked suddenly; there are intervals of rest; the pulse not much altered in the early stage of the disease; rubbing the belly gives relief; the ears and legs are of natural temperature; motion gives relief and the strength is scarcely affected. In inflammation of the bowels, symptoms come on gradually; there is constant pain; the pulse small and much quickened and scarcely to be felt many times; the belly is quite tender and sore to the touch; the ears and legs are cold; motion increases the pain and the strength rapidly fails. The treatment of colic is to relieve pain by giving one ounce of sulphuric ether, two ounces of laudanum and a pint of raw linseed oil and, if not relieved in an hour, repeat the dose. Occasionally walk the horse about to excite the bowels to action. The following is a good colic draft to have on hand: Take aromatic spirits of ammonia, one pint, sulphuric ether, one pint, sweet spirits of nitre, one and a half pints, gum opium (made fine), four ounces, camphor gum, four ounces, assafœtida, four ounces. Mix all together and shake frequently for twelve or fifteen days, then filter or strain through flannel and it will be ready for use. Dose: one tablespoonful, in a little water, repeated in thirty minutes. A larger dose may be given sometimes in very severe cases. In flatulent colic, windy colic, etc., the horse is uneasy, hangs the head, and exhibits a few of the general symptoms of spasmodic colic, before there is any enlargement of the belly, but more particularly after, for as soon as the belly swells the pawing commences, although it is not so violent as in spasmodic colic. There is but little rolling or kicking at the belly as in spasmodic colic and the horse is not inclined to move about much. After from one to four days the belly becomes much increased in size (if the disease is not checked) and the animal becomes restless. Try injections first, and if gas or wind come away with it the patient will most likely recover soon; but if no benefit is derived from the injection give the remedies as recommended for spasmodic colic. Let the horse be led around quietly until the medicine has time to take effect, so as to prevent his falling or rolling as it might cause rupture of the diaphragm.

COLLAPSE. A loss of strength. Sudden failure of the vital powers, as at the commencement and ending of disease; a falling together, used in medicine to denote fatal prostration.

COLLAR. In plants, that portion at the surface of the soil.

COLLEGE. (See Agricultural College and Industrial Education.)

COLLEY. The Scotch shepherd dog.

COLLIQUATIVE. An excessive evacuation, diminishing the strength.

COLLUM. The point where the roots diverge from the stem of plants.

COLLYRIUM. An eye-wash.

COLOCYNTH. The pulp of the *Cucumis colocynth*, a plant similar to the cucumber, bearing round fruit of great bitterness and purgative power. The cultivation is similar to that of melons.

COLON. In anatomy, the large intestine.

COLOPHONY. The dark resin remaining after the distillation of the spirit from resin.

COLT DISTEMPER. (See Distemper.)

COLTS-FOOT. (See Dock.)

COMMON GOAT. (See Goat.)

COMMON THISTLE. (See Thistle.)

COLUMBARIUM. A pigeon-house. *Columbidæ.* The pigeon family.

COLZA. A species of the (*Brassica*) cabbage family, considerably still cultivated in Europe for the oil contained in the seed, and formerly used for illuminating purposes. It is unworthy of cultivation in the United States or Canada.

COMA. A propensity to sleep, amounting to a disease (stupor). Comatose is a derivative.

COMBINATION. In chemistry, the chemical union of atoms, whereby the sensible properties of the combining parts are altered. It takes place in well defined proportions.

COMBUSTION. Burning. The chemical change of a body, attended with heat or light. For combustion, the body must be surrounded with a medium which enters, in part, into the change for instance.

COMFREY. *Symphytum officinale.* A rough perennial plant, with coarse, rough leaves and large roots. The Prickly Comfrey was introduced into the United States, under the supposition that it would be available as a forage plant. It did not answer the expectations accorded it and has pretty much gone out of cultivation, since it has to be cut and carried to stock.

COMMISSURE. In anatomy, a junction or union.

COMOSE. Ending in a tuft or brush, like the top of a tree.

COMPASS. An instrument used by mariners and surveyors to obtain the bearing of any place. The essential part is a magnetic needle, which plays over a card marked into the points of the compass. The needle if allowed free play, points constantly to the north.

COMPOSITÆ. Plants like the sunflower, dandelion, lettuce, etc., the flowers of which are grouped together on a flattish surface. They are very numerous, and form the *Syngenesia* of Linnæus. Few are cultivated. Chamomile, wormwood, and a few others yield bitter medicines. Their ashes abound in potash.

COMPOST. Any compound of manures, usually of vegetable matter for the most part. (See Peat, Lime, Vegetable Matter, etc.)

COMPRESSIBILITY. This quality depends on the natural pores of bodies, which enable the solid parts to approach nearer under great force.

CONCAVE. Having a hollowed surface. Concave surfaces in mirrors produce a magnifying effect, and condense heat and light. Convex is the reverse of concave, having a rounded surface.

CONCEPTACLES. The seed cases of ferns, lichens, etc.

CONCHOID. Like a shell. The name of a curve.

CONCRETE. In architecture and engineering, a mass composed of stone chippings or ballast cemented together through the medium of lime and sand, usually employed in making foundations where the soil is of itself too light, boggy, or otherwise insufficient for the walls. The essential quality of concrete seems to be, that the materials used should be of small dimensions, so that the cementing medium may act in every direction around them, and that the latter should on no account be more in quantity than is necessary for that purpose.

CONDENSATION. Rendering a body more dense. Commonly applied to the conversion of vapor into the fluid form.

CONDITION. In horsemanship, the health and good appearance of a horse or other animal.

CONDITION POWDERS. For a horse suspected of indigestion, the following will be useful· One ounce powdered assafœtida, two ounces powdered ginger, five drachms powdered sulphate of iron, one ounce powdered goldenseal, two ounces powdered poplar bark, one drachm powdered capsicum, one pound oatmeal. Divide the mass into sixteen doses; one to be given, in the food, every night. For hidebound, when there seems to be no particular disease, give good nutritious food, and the following: Three ounces each of powdered sassafras bark, of powdered sulphur and of salt; two ounces each of powdered bloodroot and of balmony, and one pound of oatmeal. Mix and divide into twelve parts, and give one daily in the morning's feed. Unless there is a plethoric habit, too much blood, from standing still and want of exercise, reduce the food, give proper exercise and, if the dung be hard, give two to four ounces of aloes twice a week, and also an ounce of saltpetre in the water as often. If this does not bring the animal around, give twice a week of the following: one-half ounce each of Fowler's solution of arsenic, and iodide of potash, mixed in a pint of water, and give with water or gruel. Avoid arsenic, however, on general principles, to get up a sleek coat. It is valuable when properly used, but you must know what you are using it for.

CONDUCTOR. In physics, any substance which allows the passage of heat, light, or electricity, is said to conduct it.

CONDYLE. The rounded ends of the long bones.

CONESTOGA HORSE. This once noble draft horse of the East, like the Vermont draft horse, may now be said to be practically extinct, as a variety and, unfortunately, as little is known of the history of one as of the other. Strong and able in every respect, they were a noble, honest, and quick stepping team horse, and from thirty to fifty years ago were employed in long teams of six and eight horses, in transporting goods over the Alleghanies to the markets of Philadelphia and New York. The valley of Conestoga in Pennsylvania, originally settled by Germans, is the original home of the Conestoga horse. Their height was from sixteen to seventeen hands, and their weight from 1,250 to 1,500 pounds. They had acquired a distinctive reputation before the war of 1812, and rendered efficient service to the United States Army. If such magnificent draft horses are ever to be seen again, the best way now to attain the end would seem to be to cross the Cleveland Bay upon Clydesdale or upon the largest and roomiest mares that can be found.

CONFERVA. An extensive family of small water weeds, forming the green slime on stagnant waters. They nourish innumerable insects and animalcules,

CONGELATION. The act of passing into the state of ice or other solid forms from the fluid.

CONGESTION. In veterinary and medicine, an increased accumulation of blood or other fluid in any part. It is to be relieved by bleeding, cupping, leeches or counter irritation. Congestion of the lungs is the first stage of pneumonia. Active stimulants should be given, as whisky, ammonia, spirits of nitre, ginger, etc., and the animal allowed full power to breath. Veterinary advice should always be called when practicable.

CONGLOMERATE. In geology, a compound stony mass, containing pebbles, etc., cemented together by iron, calcareous or other matter.

CONIC. Relating to a cone, smaller at one end than the other.

CONIFERS. The name of evergreen trees, the seed of which is borne in cones, as the pines, cedars, larch, etc. The word evergreen applies to all trees which continue to grow, or which hold their leaves green winter and summer, as many tropical trees and plants do, continuing their growth winter and summer. The well-known wax plant (*Hoya*), is an evergreen twiner, but not a conifer. The pine sub-family are conifers, and also evergreens, and include not only the pines, proper, but various varieties of cone-bearing trees.

CONIROSTERS. A tribe of birds with strong conical bills, as crows and finches.

CONIUM. The genus containing the poison hemlock.

CONJUNCTIVITIS. See inflammation of the eyes.

CONNIVENS. In botany, any covering or arrangement by which the parts of a plant or flower are hidden—as the flowers of the fig by the connivent receptacle.

CONSERVATORY. In horticulture, a glazed structure, in which exotic trees and shrubs are grown in a bed or floor of soil. Technically, it is distinguished from a greenhouse by the plants being planted in the free soil, and thus growing up from the floor, while in the greenhouse the plants are grown in pots placed on shelves, or on a stage or series of shelves rising one above another. They are exclusively employed for the preservation of plants which are in a growing state during the winter. There are many forms of conservatories and greenhouses, including what are called propagating houses, or pits, cheap structures used by professional florists for growing plants and flowers for sale. These are made to face the south, when built as a lean-to to another building, or they may be made as shown in the cut below, separate, and about fourteen feet wide, when the roof slants both ways, the north slope being usually not more than half the length of the south slope. The propagating-bed is of brick, single width, and nine courses high; size, three feet by ten. Common slate is laid on the top, supported by brick, laid up for the purpose from the top of the flue. A space of half an inch may be left between the slates. On the side, a few openings should be left for ventilation, so arranged as to be closed at pleasure. Make a frame the size of the top of the bed, of plank, ten inches wide by one and a quarter thick; set this on the top of the bed, and run an iron through the center to prevent the sides from spreading. In this frame, and on top of the slates, place three inches of pebbles about the size of hickory nuts; then one inch of fine gravel; then, filling the bed with fine sand, it is ready for use. Charcoal may be substituted for pebbles. The house should front south or southeast. The front glazing should be lower than the back; and may be within eighteen inches of the ground. An evaporator, or large pan of zinc or boiler-iron, should be placed upon the flue to render the air moist. Hanging shelves may be introduced if needed; they are very convenient for bringing plants near the glass. If it be heated by flues direct from the fire, they should be of brick, and run around the house, returning to the same end from which they started, or may be carried directly under the propagating bed. By such means a small house may serve a family and furnish all the plants and flowers during winter, and the females of the household will derive much pleasure in attending to it. When the house is only to be a small one, we should advise that it be a lean-to, communicating directly with the house,

CONSTIPATION. Costiveness, want of regular evacuations from the bowels.

CONSTITUTION. The general strength and liability to disease of any person or animal.

CONSTRICTOR. Any muscle which has the power of closing the openings of the body.

CONTAGIOUS DISEASES. Contagious and epizootic diseases in farm animals are Apthous Fever, Malignant Anthrax, Canine Madness, Contagious Pleuro-pneumonia, Cow-pox, Distemper or Strangles, Cholera (Hog and Asiatic), Glanders, Rinderpest, Typhoid and Bilious Fever, Scab, Mange, Itch, etc. In Malignant Anthrax, Malignant Hog Cholera (Intestinal Fever), Glanders, Canine Madness, and Contagious Pleuro-pneumonia, the diseases being well defined, it is cheaper to kill and bury deeply than to attempt a cure. Rinderpest we have never had on this continent. Contagious diseases incident to this country will be treated of under their appropriate names.

CONTRACTION OF THE HOOF. In farriery, a distorted state of the horny substance of the hoof in horses and also of cattle, producing all the mischiefs of unnatural and irregular pressure on the soft parts contained in it and, consequently, a degree of lameness which can only be cured by removing the cause. Contraction of the hoof rarely happens, however, except to those animals whose hoofs, for the convenience of labor, are shod. The best remedy is paring, thinning the contracted parts, and a summer on a soft, rather moist pasture.

CONVERTIBLE HUSBANDRY. A term implying frequent change in the same field from tillage crops to grass, and from grass back to tillage crops; an alternation of wheat, rye, etc., with fallow and grass crops. In all new countries mixed husbandry only comes to be carefully practiced as settlement increases, and markets are provided for various products. Mixed husbandry and manure are the best means of bringing exhausted land back to a state of fertility.

CONVOLVULACEÆ. A family of plants, including the bind weed, sweet potato and jalap. The stems are commonly twining, and the large roots purgative; the flowers are often beautiful, and the cultivated varieties, as the morning glory, are varied in color.

CONVULSIONS. An unnatural action of the muscular system produced by a derangement of nervous power. Staggering is a convulsion originating in an excess of blood being diverted to the head, and is relieved by bleeding; the use of hot baths to the lower extremities is also useful. Worms frequently produce convulsions. (See Apoplexy.)

COPAL. A resinous body which forms an excellent varnish when dissolved in linseed oil and mixed with turpentine.

COPING. The top course of a wall, usually of stone, and wider than the wall to save it from rain.

COPPERAS. Green vitrol, sulphate of iron.

COPPICE. A young wood. Wood cut every few years.

COPROLITE. The fossils resembling cones, which are formed in the ancient calcareous formations, and are the petrified dung of carnivorous reptiles.

CORALS. The calcareous basis of some marine animals. Corals sometimes contain two per cent. of bone earth.

CORD. A measure for wood, stone, etc., equal to four feet high and wide, and eight feet long.

CORDATE. In botany, heart-shaped. The heart on playing cards.

CORD GRASSES. Coarse, salt-marsh grasses of the genus *Spartina*.

CORDIAL. A stimulating, stomachic medicine.

COREOPSIS. A yellow, composite, garden flower, the fresh flowers of which yield a yellow dye. Named from *coris*, a bug, from their peculiar smell.

CORIANDER. *Coriandrum sativum*. An umbelliferous plant cultivated for its aromatic seeds, which are used in confectionery and medicine. The plant requires a dry soil, the seeds are sown in the middle of spring, in drills eight inches apart, and half an inch deep; the plants to remain where sown. The only cultivation required is to thin them to eight inches' distance, and to have them kept clear of weeds throughout their growth. They perfect seeds in early autumn, coming in flower in the early part of summer.

CORK. The bark of the Spanish oak. *Quercus suber*. It would flourish wherever the live oak grows, and indeed up to the latitude of Tennessee, but requires a dry granitic soil. The tree is evergreen, yields sweet acorns, and begins to supply good cork at forty years old. The cork is stripped every eight or ten years afterward. It is taken in July, a perpendicular cut being made the length of the trunk, and a circular one above and below, down to the new bark, but not into the young wood. Plantations of the cork oak have never yet proved profitable in the United States, but there is no reason why they should not.

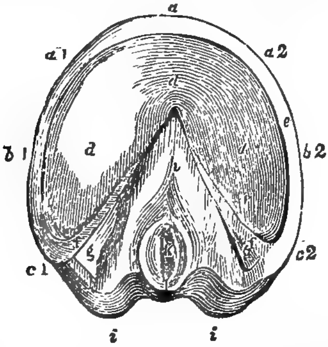
CORMUS. The solid swelling between the stem of some plants.

CORN. In Europe, wheat, or a mixture of peas, beans, and oats. In the United States the name is applied only to Indian corn, *Zea Mays.* (See article Maize.)

CORNEA. The transparent membrane in front of the eye. Any opacity injures vision; it should be carefully treated by bleeding and blisters.

CORN, MEASURING THE BULK. The following rule for this purpose is given by William Murray. It is not to be regarded as strictly accurate, but an approximation: Having previously levelled the corn in the house, so that it will be of equal depth throughout, ascertain the length, breadth, and depth of the bulk; multiply these dimensions together, and their products by four; then cut off one figure from the right of this last product. This will give so many bushels, and a decimal of a bushel of shelled corn. If it be required to find the quantity of ear corn, substitute eight for four, and cut off one figure as before. For Western corn, or Dent corn, add one-third, since three half bushels of ears make a bushel shelled.

CORNS. Small swellings or tumors on the sensitive sole in the triangular space between the bars and the wall of the heel, generally in the inside and, always on the fore feet, are called corns. They are usually the effect of bad shoeing, but sometimes occur from a bruise of the sole, when barefooted. If there is inflammation, poultice; if there is matter, open and let it out. If not, simply pare away the hoof over the tender spot, but without touching the bars or frog. Then take one half to one ounce of verdigris, two ounces of oil of turpentine, and one half pound of beeswax; melt together, at a gentle heat, and apply over the part, being careful to keep out dirt, or dress simply with tincture of myrrh. Give the animal rest in a moist pasture, until recovered. The illustration, showing the sole of the horse's hoof, will give a correct idea of the several parts and also of the location of corns, which occur between *d* and *g*: *a*, *a* 1, and *a* 2 is the toe; *b* 1, and *b* 2, the portion on each side midway between the toe and heels; *i*, *i*, the heels; *f*, *f*, the bars; *d*, *d*, *d*, the sole; the shaded surface ending above *h*, or *h*, *k*, *l*, is the frog; *k*, is the cleft of the frog. Corns are of two sorts, the true and the false corn. A competent veterinary writer, in a report to the United States Government, in 1870, says of these, that the locality of the true corn is the angle caused by the inflection of the bars, and is between the bars and wall. In this space the posterior extremities of the coffin-bone move freely in the movements of the foot. By the irritation of frequent, prolonged, and severe use, a thickening of the laminæ is produced. This hardens and ultimately becomes a semi-corneous tumor. It may remain in this condition, or it may become a smooth, dense horn, more dense than any other part of the hoof. It is a constant source of pain and consequent lameness. The more common false corn is a bruise of the sensitive sole which lies directly under the heel of the coffin-bone. This occurs most frequently in feet having a flat, level sole, deficient in the arch. It may occur in any variety of foot which is kept badly shod. A shoe with a broad web level upon its foot-surface, and seated for its whole width upon the wall and sole, will aid in the production of this form of disease. Several varieties of the false corn are described, but they are simply different stages of the same disease. The true corn is essentially incurable. For the false, in its early stages, the general principles of treatment to abate local inflammation may arrest the disease. If suppuration can be prevented, the duration of lameness will be much limited. Care should be taken that the shoe should have its bearing only on the solid border of the wall, and a very slight portion of the outer border of the sole. To this end, a shoe should be used with a narrow web, but little over half an inch in width; or the shoe with a wider web should be seated so that its bearing-surface would be narrow. Supposing the case has been neglected and suppuration has occurred, the pain and lameness will be great until the matter is evacuated. The sole must be carefully pared away until the horn is very thin, when an opening must be made through it, and the pus evacuated. If great pain is inflicted by the attempt, the foot should be soaked in a warm alkaline bath, by which the horn will be softened, and the extreme tenderness abated. If possible, the foot should be kept in a poultice for a day or two, or three, according to the previous severity of the disease. After that, the shoe may be reapplied, care being taken that the opening through the horn be so protected that no dirt or gravel can enter. A condition similar to false corn may exhibit itself in any portion of the ground surface of the foot as the result of a severe stone-bruise. If detected early, the warm foot-bath, with rest, will be sufficient treatment for it.



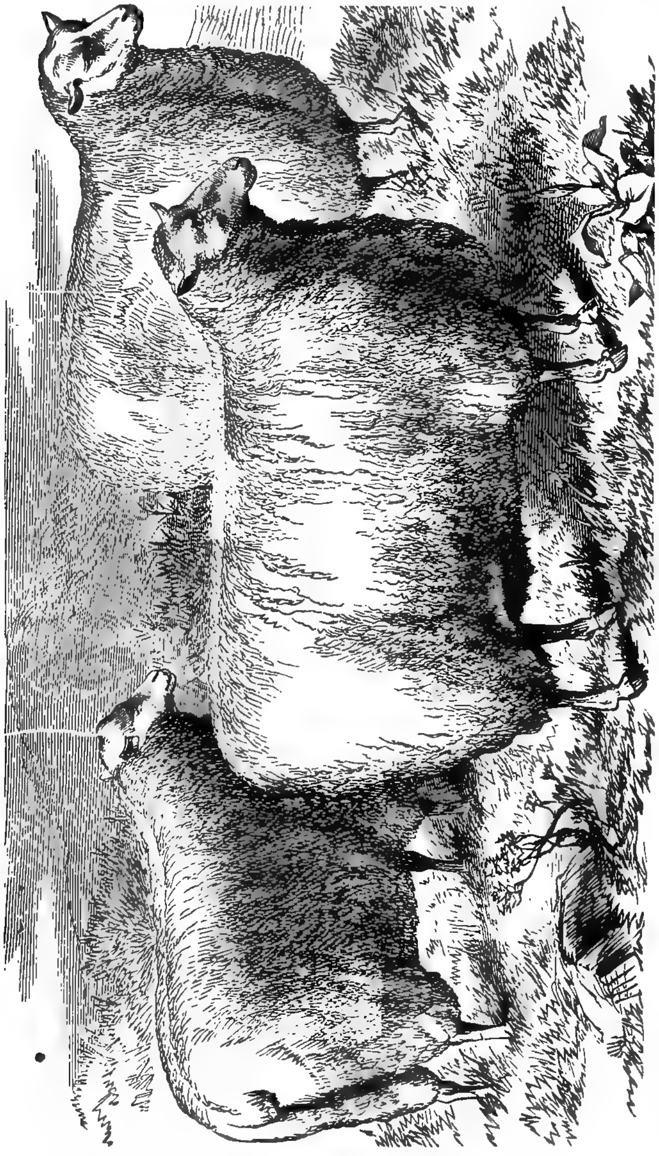
CORN SALAD. *Fedia olitoria.* Lamb lettuce. This is a mucilaginous, pleasant herb, esteemed for the early period it is found in the market. Sow the seed in drills six inches apart; weed carefully. The seeds are small and light. In England it is sown in August or September, on clean, rich land, covered with straw during cold weather, and brought out at the earliest period in spring. In the United States it is not much cultivated.

COROLLA. The colored part of flowers, usually. If there be no green calyx, the colored envelope is called a perianthium. The corolla is either in one piece, or monopetalous or, in many, polypetalous. (See Botany.)

CORONET BONE. The second of the consolidated phalanges of the horse's foot.

CORROSIVE SUBLIMATE. Bi-chloride of mercury. Deadly poison. The antidote is albumen or white of eggs. A weak solution destroys vermin and preserves wood, but so dangerous is it that it should not be used.

CORRUGATE. To wrinkle. The folds on the skin of some animals, as the sheep, are called corrugations.



GROUP OF COTSWOLD EWES.

CORTICAL. Relating to the bark.

CORUNDUM. A class of extremely hard minerals, composed of nearly pure alumina.

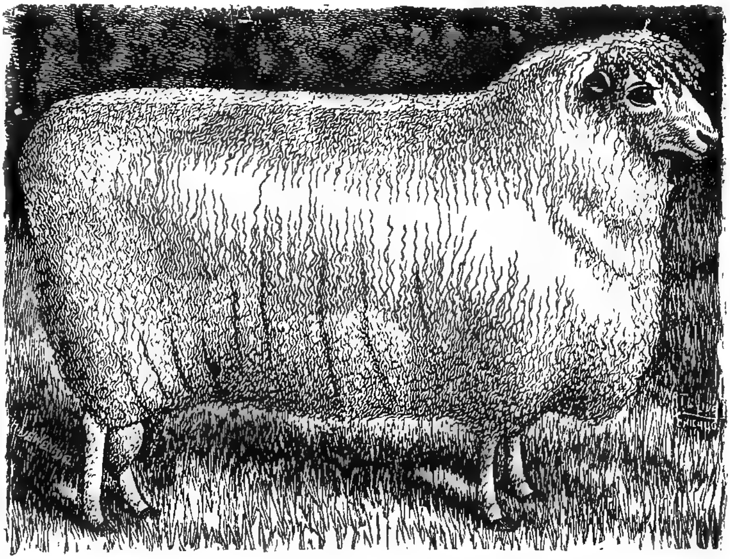
CORVUS. The generic name of the crow and raven. They are omnivorous or carnivorous. (See Crow.)

CORYZA. Catarrh, or running at the nose.

COSMOGONY. Speculation concerning the origin of the earth.

COSTATE. Ribbed. In botany, a term used to designate the bundles of woody fibre in leaves, also called nerves and veins.

COTSWOLD SHEEP. The Cotswold are an old English breed of sheep and, as improved, rank as among the very best of the long wooled breeds as they are among the largest. They began to be imported into the United States about 1832, since which time they have been generally disseminated, giving good satisfaction, everywhere, but have grown in the estimation of breeders, especially in Canada, the Western States and the more northern of the Southern States. As compared with the Leicester, Cotswold are more prolific, and have better constitutional vigor. They have been improved in form, fleece, and early maturity, so that they may be sent to the butcher at from fourteen months to two years old, giving twenty pounds of mutton, per quarter, at fourteen months, and thirty pounds, per quarter, at two years old. So their fleeces will go, in exceptional cases, up to eighteen pounds per fleece, a most wonderful weight, when we take into consideration the fact that the wool shrinks but little in washing, in comparison with the fine, gummy wooled sheep. The superior hardiness of the Cotswold, the good nursing qualities of the ewes, their good flesh, and their prolific qualities, have rendered them especial favorites in the great prairie region of the United States. If to this we add the fact that they cross kindly with the Leicester, improving their quality, and also with the Southdown, increasing the size and the wool, it seems not too much to say that they will not only hold their own but, year by year, become more and more liked. On this and the next page we give illustrations, showing a superior strain of Cotswold yearling ewes, as they appear in spring before shearing, and the improved Cotswold also carrying a full fleece. Cotswold wool shrinks but eighteen to twenty per cent., while the shrinkage in Merino wool ranges from forty to seventy per cent.; thus a pound of Cotswold wool will produce as much clean (scoured) wool as two and a half pounds of Merino wool, allowing the latter shrinks sixty-eight per cent., which the more gummy will. South of the Ohio river, the Cotswold is reported as wintering without artificial feeding, unless in exceptional years. The same is true west of the Mississippi, in a latitude below the mouth of the Missouri. This fact is true, however, of sheep generally, except some of the more tender breeds, or those not well inured to our climate. One thing should always be remembered in connection with the keeping of all long and even middle wooled sheep. They will not do well in large flocks, as is usual with the Merino. Flocks of 100 are quite large enough, and should never be exceeded. Thus the long wools, and middle wools, are especially adapted to those farms where but few sheep are kept, especially near markets where superior lambs and mutton bring extra prices.



IMPROVED COTSWOLD RAM.

COTTON. (*Gossypium herbaceum.*) This, one of the most important of agricultural plants, and cultivated in every civilized and semi-civilized country of the globe where it will mature, belongs to the mallow family. Botanists are uncertain as to the number of distinct species of this plant. De Candolle describes thirteen species, in his Prodromus, and mentions six others, but considers them all uncertain. Swartz thinks they may be all from one original species; of which many varieties have been produced by cultivation, and by the effects of different climates. The plants inhabit different parts of tropical Asia, Africa and America, and many of them are cultivated for their cotton in climates adapted to their growth. It is believed to be indigenous to Asia, as well as to America, but is cultivated largely in most of the sub-tropical countries, of both continents. It requires a certain duration of warm weather, as well as an amount of moisture, to perfect its seeds and, in the United States, can not be profitably cultivated north of the latitude of Kentucky, Tennessee and Virginia. Cotton is divided, commercially, into Sea Island—furnishing fibre of the most superior quality—and Upland. The varieties are numerous, many localities having one or more considered as peculiarly adapted to the soil and situation. Cotton cultivation has grown up in the United States almost entirely within the last hundred years, for, until the invention of Arkwright, in 1769, for the spinning of cotton, in England, and the spinning-jenny of Hargreaves, in 1770, the fibre could not be made available in a great industrial way. Comparatively little cotton had been raised in our Southern states previous to 1793, when Eli Whitney invented the cotton gin. Up to that time the difficulty of freeing the cotton from the seed had been such that one hand could clean but a pound a day, and even at the high price of twenty-five or thirty cents a pound it could not be made profitable. By Whitney's invention a hand, instead of one pound, could clean 360 pounds a day. At about the same time steam was introduced as a motive power in England, and that, with the great improvements in carding and spinning, enabled one man to do the work which it had previously required 2,200 men to do, in the same time, by the old methods. Machinery had introduced an entirely new condition of things. The effect of it was to produce a vital change in the state of affairs at the South, and cotton growing very rapidly grew up to immense importance, constituting about a third part of the whole exports of the country. Each decade showed an increase of about 100 per cent in production, till, in 1840, it had reached 744,000,000 pounds, six times the product of 1820. The quantity of cotton exported in 1792 was only 138,328 pounds. The quantity exported in 1860 was 1,765,115,735 pounds, or 4,412,789 bales of 400 pounds each, but the quantity produced in 1860 was 2,079,230,800 pounds, or 5,198,077 bales. This production had fallen off somewhat in 1870, when the quantity produced was reported as 3,011,996 bales, or 1,204,798,400 pounds. The statistician of the United States Department of Agriculture, in 1876, compiled exhaustively on cotton, from which we quote: In 1858 and 1860 the receipts from America constituted four-fifths of the British imports. In 1863 they amounted to a fraction of one per cent.; in 1864, one and a half per cent., and in 1862 but two and a half per cent. Starting at thirty-seven per cent. in 1866, in 1876 the proportion reached sixty-two per cent., and the proportion of India cotton had fallen to eighteen and a half per cent. The price, as an index of quality, tells the story of India's inability to compete with the United States far more eloquently than all special pleadings, since climate and climatic conditions "speak by the card." The average value per pound, in pence, of British imports, is thus given:

Country.	1872.	1873.	1874.	1875.	1876.
Cotton of the United States	9.9	9.1	8.	7.7	6.4
Cotton of India..........	7.	6.4	6.	5.7	5.1

American seed and American planters have in vain been introduced into India; the fibre inevitably deteriorates, becomes short, dry, harsh, and brittle, with a low rate of fibre product. The details of production, during the two periods named, are thus given, the pounds per bale being the average net weight of Liverpool receipts, which include a large portion of each crop:

Years.	Bales.	Weight per bale.	Pounds.
1850	2,355,257	416	979,786,912
1851	3,015,029	428	1,290,432,412
1852	3,262,882	428	1,396,513,496
1853	2,930,027	430	1,259,911,610
1854	2,847,339	434	1,235,745,126
1855	3,527,845	420	2,481,694,900
1856	2,939,519	444	1,305,146,436
1857	3,113,962	442	1,376,371,204
1858	3,851,481	447	2,721,612,007
1859	4,669,770	445	2,078,047,650
1860	3,656,006	477	1,734,914,862
	36.169,117		15,869,176.615
1865	2,193,987	441	967,548,267
1866	2,019,774	444	896,779,656
1867	2,593,993	443	1,149,138,899
1868	2,439,039	437	1 065,860,043
1869	3,154,946	434	1,369,246,564
1870	4,352,317	438	1,906,314,846
1871	2,974,351	439	1,305,740,089
1872	3,930,508	440	1,729,423,520
1873	4,170,388	439	1,830,800,332
1874	3,832,991	439	1,682,683,049
1875	4,669,288	436	2.0 5.809.568
	36,331,582		15,939,344,833

Few are aware of the rapidity in cotton production since the prostration of the war period. It is not generally known that the aggregate product since 1865 exceeds that of a similiar period prior to 1861. If we include the crop of 1876, the excess of its production in the period of twelve years, from 1865 to 1876 inclusive, is about 2,000,000 bales more than from 1849 to 1860, inclusive. Leaving out the large crop of 1876, similar periods of eleven years make a comparison also favoring the production of the later. The aggregate of the crop movement of the former is 36,169,117 bales, or 15,869,176,615 pounds, averaging 3,288,101 bales per annum, or 1,442,652,419 pounds. A similar statement for 1865 to 1875, inclusive, reads, 36,331,582 bales, or 15,939,344,833 pounds, averaging 3,302,871 bales per annum, or 1,449,031,348 pounds. An average increase of nearly 15,000 per annum. The great crop of 1859 was but two per cent. larger than that of 1875. Three crops since the war are each larger than any prior to it, with the above single exception; these are in order of size, 1875, 1870, 1873. The crop of 1872 was larger than that of 1858, and every crop preceding the latter is surpassed by every crop of the seven past years, with one exception, 1871. This is a remarkable result, which is a surprise to planters themselves, and an indication of what can be accomplished in the future when the cotton area shall be an essential part of a rotation, and fertilizers shall be not the least important product of the plantation, and two bales are made to grow where one grew before, as can easily be accomplished on many acres of present slovenly cultivation. In relation to the cotton crops of 1877, 1878, 1879 and 1880, we find that in the first named year was estimated at 4,500,000 bales; in 1878 it was 5,200,000 bales; in 1879, it was 5.073,530 bales; and in 1880, 5,761,252 bales. As to cost of production and price, in 1876, we find the State averages as follows, in cents and fractions, per pound, of Upland cotton:

State.	Cost.	Price.
North Carolina	$0 09.3	$0 09.8
South Carolina	9.4	9.7
Georgia	9.3	9.8
Florida	8.7	9.2
Alabama	9.9	10.1
Mississippi	9.8	10.2
Louisiana	9.7	10.2
Texas	8.	9.1
Arkansas	9.	9.9
Tennessee	9.	9.8

This gives to Texas the largest proportion of profit, or eleven mills per pound; Arkansas, nine; Tennessee, eight; the others two to five; the average slightly exceeding half a cent, being $2.60 per average bale; making the net profit to the cultivators $11,500,000 in round numbers, in an aggregate of about 205,000,000. This is within a fraction of six per cent. of the gross receipts and, if assumed to be substantially correct, is too small a margin for a good season. It illustrates the necessity of increased returns. How shall they be obtained? By increasing the yield and diminishing the cost of supplies. Both ends are reached by a single operation: the adoption of a restorative rotation, which involves animal production and green manuring, a cheapening of fertilizers and supplies for man and beast, a partial protection of the soil from washing and waste, a large yield at a minimum cost, and increase of fertility instead of exhaustion. The seed of cotton yields a valuable oil and is now largely expressed for this purpose. The cake or residue, after pressing, is valuable as a manure. For a long time, in the South, the seed was used whole as manure Of late years, however, cotton seed oil has come to be a merchantable article, and large quantities are now yearly exported to the North for the oil it contains. Large quantities of oil are also beginning to be made in the South. With improved systems of cultivation and careful rotation there is no reason why this crop should be an exhausting one, and the experience of the last few years shows it not to be so, where an intelligent system of cropping is practiced. The greatest drawback to the profitable cultivation of cotton is really the insects injurious to the plant. Of these the boll worm is one of the most destructive. Another is the necessity of diversified farming, and manure. Upon this question one of the reports of the Commissioner of Agriculture says· Every farmer should rely mainly upon his stock for manures; hogs should be fattened upon field-pease; and horses should be penned at night in deeply-littered yards. Accretions to the manure pile may be made from a great variety of sources, including all decaying vegetable and animal matter, waste and wash from the kitchen, muck from the swamps, and pine straw or leaves from the forest. There are many special fertilizers in the South ample for a perpetual supply of all possible drain upon the resources of the soil. The coast-line from Virginia to Texas, including all the sounds, inlets, bays, and estuaries, has an aggregate extent of thousands of miles, and every mile can furnish abundant stores of fish and seaweed for manuring adjacent fields. Oyster-shell lime is also plenty and cheap in the tidewater regions. No mineral manure is more abundant than marl, which is found in the whole tidewater section of the Atlantic coast, in the Mississippi Valley and in Texas. It underlies wide belts at various depths, often very near the surface; it is, in many localities, easily obtained in large quantities; and its value, though variable, is undoubted for application for soils needing lime. Gypsum can be obtained from native beds at no great distance from any locality in the South. Lime is abundant in the mountain valleys from Virginia to northern Alabama; and the rotten-limestone formations of Alabama and Mississippi are unsurpassed for fertility. All these home resources should be used in bringing up the average cotton yield from one hundred and ninety to five hundred pounds per acre, and obtaining from half of the present acreage all of the fibre needed, leaving free a sufficient area to produce the bread, the fruits, the vegetables, the beef and mutton, necessary for the home population, and a surplus of the lighter products for exportation.

COTTON SEED. The seeds abound in a mild oil, and are very nutritious. A bushel weighs thirty pounds, and yields two and one-third quarts of oil, and twelve and a half pounds of meal. They are used as food in some oriental countries. The oil is readily obtained by pressure; the cake can afterwards be used for fattening stock and as a manure for crops. To some extent, the whole seed is used for cows and fattening in the South, and is said to afford well-flavored milk.

COTTONWOOD. In the Western States the name Cottonwood is applied to the *Populus monilifera*, a tree of the largest size, found growing generally along river bottoms, and other moist, alluvial soils. Far west, along the Platte bottoms and up to the base of the Rocky mountains, two other species of poplar are found growing with it, *P. augustifolia* and the balsam poplar, *P. balsamifera*. The balsam poplar is also found, but quite rarely, over the West. The class are all large trees, and of late years have been used extensively in the settlement of the vast open region west of the Mississippi, for forming belts and groves, both from the certainty with which it may be grown from cuttings and its sure and fast growth. The wood is not lasting, except when kept perfectly dry, but is useful for poles and for fuel, burning freely when seasoned. All the poplars are diœcious—that is, bear male and female flowers on separate trees. The female, or seed-bearing trees, fill the air with cottony down during the season of ripening—hence the common name. This renders the tree particularly objectionable for planting near dwellings, or for street planting. This, however, may be avoided by selecting cuttings only from staminate (male) trees.

COTYLEDON. The seed-lobes. Jussieu divides the vegetable kingdom according to the number of parts or cotyledons in any seed. Thus *dicotyledons*, or plants with two seed-lobes, are the ordinary inhabitants of the temperate zone. *Monocotyledons* are the palms, grasses, etc., which are most luxuriant in tropical regions, and possess but one seed-lobe. *Acotyledons* are the same with cryptogamic plants, and contain no apparent cotyledons.

COUGH GRASS. Several varieties of repent grasses, with perennial stems, as *Triticum repens*, *Agrostis repens*, etc. Hoed crops, thorough plowing with harrowing, to collect the fragments, and heavy liming or salting, is the only way to destroy them.

COULTER. The knife of a plow. And also used to designate a one-pronged cultivator in the South.

COUNTER. The breast of a horse.

COVER. Any sheltered place in which game can lie hidden.

COVEY. A small flock of partridges, quail, etc.

COW. The female of the genus *bos* or ox tribe, which, within the last two hundred years, by selection, careful breeding and scientific crossing, has been broken up into many valuable sub-families. Of these, the Short-horn and the Hereford are accepted as most superior beef-making cattle; the Devons for working qualities, combined with superior flesh, and the Alderney, the Ayrshire, and the Holstein, as superior dairy cows.

COWAGE. *Dolichos pruriens*, the pods of which are set with small bristles, which produce great irritation on the skin, sometimes called cow-itch.

COW-BANE. (See Wild Parsnip.)

COW-BIRD. Cow black bird. Cow bunting *Molothrus pecoris*. This bird is common in spring and summer in the North, both East and West, arriving early in the spring, and remaining well into the fall. They do not mate, as other birds do, and rear their young, but remain in small flocks during the season, laying their eggs, one only in a place, in the nests of various small birds, chiefly in those of the warblers and sparrows. This bird subsists on various seeds and fruits, and also consumes great numbers of insects and their larvæ.

COW PEA. The Southern bean, one of the most valuable forage and fallow crops of the South.

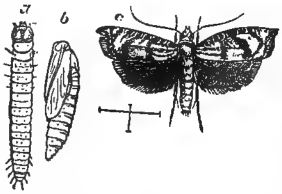
COWPOX. In farriery, a disease affecting the teats of cows. This disease appears in the form of small bluish vesicles surrounded by inflammation, elevated at the edge and depressed in the centre, and containing lymph. By the use of the virus of this disease has originated the present system of vaccination, as a prevention of the dreaded small pox.

CRAB-APPLE. *Pyrus*. The cultivated apple is supposed to be descended from the wild crab of Europe, the *Pyrus malus*. The Siberian crab is *P. baccata*. The native crab of the United States is *P. coronaria*. Nuttall found, in the maritime portions of Oregon, in rich alluvial forests—the natural soil for the whole family of apples—another species *P. rivularis*. The following is the list of the finer sorts of cultivated crabs, as recommended at the last session of the American Pomological Society: Byer's Beauty, Cherry, Glover's Early, Haas, Hyslop, Lady Elgin, Marengo, Montreal Beauty, Red Siberian, Spitzenberg, Sylvan Sweet, Transcendent and Yellow Siberian. Among the most beautiful and fine of western crabs, if indeed it be a crab, is Whitney's No. 20, which, so far as we have learned, succeeds well generally and is, from its great beauty and excellence, steadily gaining favor. Hewes' Virginia (crab) has long been famous for cider. Among the new crab seedlings of 1879, are Margaret and Sarnia crab, both highly commended for hardiness and pleasant flavor. (See article Apple.)

CRANBERRY. The Cranberry (*Vaccinium*) is a native of bogs in various parts of the United States, North. In the Northwest, there are vast tracts covered with the vines, principally in northern Indiana, Michigan, Wisconsin and Minnesota. The species is highly valued for its grateful acid fruits, for preserves and tarts, and large quantities are yearly sent East, and also exported to Europe. The principal wild varieties are *Vaccinium macrocarpum*, or the large fruited Cranberry; *V. oxycoccus*, rather rare, with smaller fruit, spotted when young. In cultivation, the Cranberry will succeed in situations much dryer than when found in the wild state. The cultivation of the Cranberry, of late years, has become an important industry in various States, where the climate and soil are adapted to its growth, and large sums of money have been invested in the preparation and cultivation of the marshes, a situation where the beds may be flooded, or not, at will, being essential as a precaution against frost and the attacks of insects peculiar to the plant. The chief difficulties in Cranberry culture are late spring frosts and insects. Among the more destructive of these are the tip worm, the vine or fire worm, and the fruit worm. Mr. C. S. Whittier, of Wisconsin, has furnished, to a late volume of the Wisconsin Horticultural Society, a condensed paper on the Cranberry, from which the reader can get definite information as to the management of the crop, and from which we extract as follows: The Cranberry demands a light, porous soil, that water can easily pass through; that will not bake and hold the water until it becomes stagnant. Hence peat, gravel and sand are each good soil for cranberries. Sand and gravel have the advantage of holding heat and will therefore sometimes protect a crop from frost. On the other hand, peat will retain moisture the longest, which is a great advantage when there is not an adequate supply of water. Too rich soils should be avoided, as the plant then goes all to vine. On too poor soil it does not grow at all. J. J. White, in his Cranberry Culture, says: The best soil is an equal mixture of sand and muck; but I should rather have the sand on the top, to catch the heat of the sun, and the muck underneath, to retain moisture and furnish sustenance. In the spring of the year, when the blossoms are out and the new wood is very tender, there may occur a late frost that will not only destroy the blossoms but also cut off the new wood, and therefore prevent the formation of the fruit bud for the following year's growth. Such a frost will therefore destroy two years' crop at once. The remedy for this is to have the vines entirely covered with water and therefore kept from starting until the heaviest frosts are over; then take the water off sufficiently to let the vines start, but still keep some water standing, among the vines, so that when the temperature goes down to freezing the exposed water will protect the blossoms and the vine. The theory of this protection is, that when the plant has frozen, the water in the cells of the plant expands in freezing, and in thawing contracts, and this expansion and contraction breaks up and destroys the structure of the cells, and causes the death of the plant. If, in the immediate vicinity of the plant, there is exposed water, it will congeal first and throw off latent heat or, in other words, will absorb the cold in the atmosphere around the plant, and it escapes, in the same manner as water in a cellar will protect vegetables from frost. Early fall frosts will also destroy cranberries, but the riper they are the less injury they will sustain. The way to guard against these fall frosts is to get the vine started as early in the spring as possible, keeping water among the vines all the time when there is danger of frosts, and harvest as early as possible. The Vine or Fire Worm (*Anchylopera vacciniana*—Fig. 1) is an insect that makes its appearance generally in June, and spends its short existence feeding on the pulpy part of the leaf of the vine. There are two generations of this insect each year. The last, being much more numerous, does the greater part of the damage. They will feed upon a leaf until there is nothing left of it but the frame work, or skeleton and, when they are numerous, will soon so thoroughly destroy a marsh that it will look red, as though a fire had spread over it, and hence the name, fire worm. The history of this insect is, that the moth deposits its eggs early in the spring, upon the vines, and they hatch out the first generation of worms, and these, if not destroyed, feed a short time, enter the chrysalis state, and soon appear as a moth, which soon lays the second brood of eggs, and does the main damage to the vines. The remedy for this pest is to have the vines all covered with water during early spring (it will not do to trust to early spring rains). In my experience of ten years I have never known of a case of destruction by this pest where the vines were absolutely all covered with water early in the season. If covering with water, after the eggs are deposited, would destroy them, then when the dam has been broken in spring and repaired, there should be no trouble; but we have known a number of instances where the furious ravages of this pest followed such breakages when reflooded. The Fruit Worm seems to hatch out inside of the berry itself and, after eating there until it has destroyed the berry, eating its way out, it enters another, and so on until it has destroyed a large number of berries. Some believe that a fly punctures the skin of the young berry and deposits an egg inside; others hold that the eggs are deposited in the blossoms and, as the fruit sets and develops, they are enclosed. Whichever may be the fact, we know that water will check its destructive powers. A heavy rain will sometimes almost entirely rid a marsh of them and, acting on this suggestion, we should flood the marsh suddenly, when the worm is at work, and then draw the water off quickly before it has had time to injure the vines or fruit. There is another class of enemies, however, that water will not control; plants that flourish under the same treatment with the Cranberry, as the feather leaf and the rush. This class of pests must be fought on our marshes as thistles, pursley and other weeds are upon high lands, with the hoe, the spade, the knife, the scythe and the hand; that is, in any way you can reach them. The great requisites, in the culture of cranberries, are a suitable soil, and an abundant supply of water under absolute control. It is comparatively easy to find the suitable soil, but to find it properly located, with reference to an ample supply of water, and get that absolute control is the great trick of the trade. The man going into the cranberry business should first study his location thoroughly. He should go over it, around it, through it and across it, until every feature is familiar to him, and even then, though it looks all right to him, he should get some expert to examine it. If no serious defect is found, a reliable engineer should be employed to ascertain the comparative height of the marsh and the source of water. It will not be sufficient to calculate the fall, from the highest point at which the water stands at its source to the lowest point in the marsh, but the estimates should be made from the lowest point to which it will be necessary to draw the water, at its source, to the highest point that you want to cover on the marsh. This is to show whether or not, when the marsh is nearly full of water, and the water is drawn low at the source, there is still a fall on to the marsh. When one is sure that he has an ample supply of water, with an absolute fall on to the marsh, and another fall from the marsh, so that he can drain it in time of flood, and flood it when necessary, he may then turn his attention to laying out his improvements on it. No two marshes are alike, neither are any two sets of improvements the same, any more than any two mill ponds or mill dams are alike. Every man must keep in view the objects to be attained by the use of water, and shape his improvements to that end. He should first locate one or more main dams; the number, location, length, height, manner of building, etc., to be determined by the size, shape and inclination of the marsh, and the materials at hand to be used in building. These dams being used for winter flooding, their height should be sufficient to cover all parts that are to be flooded at all to a depth of one foot or upwards. Their strength should be in exact proportion to the depth of the water to be held, regardless of the size of the pond; but it will be well to bear in mind that the wash of the waves will be in proportion to the size of the pond. The next thing is to lay out what may be termed sub-dams; that is, small dams between the large ones, and so near together that the fall will not be more than from four to eight inches from one to the other. These dams should be built upon ground of nearly the same level from one end to the other, even though it should make them very crooked. In each dam there should be a waste gate, and the sluice-boards, in these gates in the small dams, should be very narrow. There should be a main ditch running entirely through all the marshes, passing through each dam at the waste gate; also a ditch parallel to each dam and just above it, and I think (this, however, I have not tried) there should be a ditch from just below each main dam, starting at the main ditch and running each way to the side of the marsh, and thence down on the outside to the next main dam below. There should be a waste gate on the upper side of the marsh, so arranged as to let the water on or shut it off at will; an ample ditch or canal to bring the water on to the marsh, and another to conduct it off. When these improvements are made, the cultivator of a native marsh is ready to begin to handle the water; and now, a few words as to how to handle it. In the fall of the year, when the vines begin to turn red, go to your upper sub-dam and close the waste gate; let the pond fill until the water runs over the waste gate (not over the dam), and then you can see whether the dam is strong enough. If not, now is the time to fix it. In this way proceed down the marsh, testing each dam before you fill the pond below. Next go to your upper main dam, close and watch and strengthen it, if necessary; and then to the main dams below, just as you did with the sub-dams. The strain on a dam is greatest when there is no water standing against it in the pond below, and if it will hold when the pond below is empty, it is strong enough. The waste gates should be high and wide enough to carry all the water off in a time of freshet, and not let the water run over the dam. When the spaces between the main dams are covered with water, sub dams and all, your work for the season is done. In the spring, when the heaviest frosts are over, open the main dams and let the water off down to the sub-dams. The sun will soon have an effect on the water and the vines, and those at or near the surface will start, and the water covering the vines will protect them from injury from frost. Gradually lower the water by taking out the narrow sluice-boards in the sub-dams, and the vines, which are very tender and easily frozen when first uncovered, will gradually harden; and more and more of them will start as the water recedes, and your marsh will soon be under way. If at this season there should be sudden changes of weather, and there is danger of frost, raise the water again, but lower it as soon as possible. When managed in this way, there will be no trouble from the Vine Worm, for the vines were all covered in early spring. If the Fruit Worm appears, close the waste gate at the head of the marsh, and collect, as soon as possible, sufficient water to fill the upper pond, then open the waste gates and let the flood into the pond below, filling it full, and so on until each part has been entirely covered with water. The next great danger, that water will prevent, is drought. If you have an ample supply of it, in a dry time, you can close the main ditch, just below each main dam, force the water out to the sides of the marsh, and then let it soak or trickle through the soil, back to the main ditch again, to be forced out at the next dam, and so on, keeping the marsh constantly moist. In the fall you should be weather-wise, if ever, for while the fruit is ripening, too much water checks its progress and, if there comes a frost, it is necessary to have a plenty of water to protect the fruit. When there is a change in the weather, and there is danger of frost, you should hold the water to save the fruit, and draw it off as soon as possible when the danger is over.

CRANBERRY INSECTS. The study of insects injurious to the Cranberry, has not been prosecuted to so great an extent by entomologists, as have insects injurious to other crops. This probably from the fact, that until within a few years, the Cranberry has not been extensively cultivated, the principal dependence having been upon wild vines. In looking over the various data in relation to insects destructive to the Cranberry, we find, in the Transactions of the Wisconsin Horticultural Society, in which State the Cranberry is receiving much attention, a series of illustrations, showing the more important insects, which we have reproduced. The descriptions are from the observations of Prof. A. L. Packard, Jr., of the United States Entomological Commission, who also prepared the cuts.

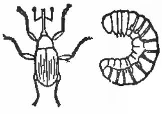
Fig. 1.



CRANBERRY VINE WORM.

The Cranberry Vine and Fire Worm, (*Anchylopera vacciniana*, Fig. 1,) hatch out from eggs that have remained on the leaves of the plants all winter. They commence to feed on the tender shoots of the vine, drawing the leaves together, with their web, for a shelter. If very numerous, they soon destroy the leaves and tender shoots, and give the bog a dark, red appearance, as though a fire had run over it; hence the name Fire Worm. Having reached maturity, they spin up among the leaves on the vine, or on the ground. After remaining ten or thirteen days, in the pupa state, the moths hatch out and deposit their eggs on the leaves. This second brood hatches out in five or six days; it is this brood that is most destructive. They reach maturity for the most part, and go into the chrysalis state, before the twentieth of July, but may be found on the vines until September. The second brood of moths appears in July and August, and lay the eggs which hatch the following spring. The only sure way to destroy them is to cover the bog with water for twenty-four hours. The moth is of a dark, ash color, with small yellowish-brown bands on the fore wings, alternating with white, narrow bands. The apex of the wing is dark brown. The cut shows *a*, larva; *b*, pupa; *c*, moth; hair line natural size.

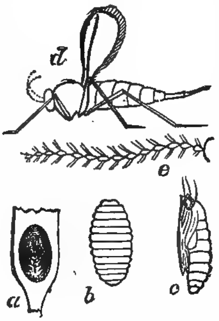
Fig. 2.



CRANBERRY BUD WEEVIL.

The Cranberry Bud Weevil (*Anthonomus suturalis*, Fig. 2,) is a very small, reddish-brown beetle, with a snout which is half as long as its body. The elbowed antennæ are inserted just beyond the middle; the head is darker than the body, being brownish-black. The pro-thorax is a little darker than the wing covers, and covered sparsely with short, whitish hairs. The scutellum, at the base of the wing covers, is white. It is a line in length including beak. This weevil lays its eggs in the buds of the Cranberry; it selects a bud not quite ready to open, works its snout deep into the centre, and then deposits the egg in the hole made; going back to the stem, it cuts it off just below the bud, which falls to the ground and decays; a dull, whitish worm hatches out and feeds on the bud. Having attained its growth, it changes to the pupa state, and the perfect beetle eats its way out from the bud. This brood of beetles may be found on the vines soon after the blossoms have disappeared. As they are never seen on marshes flooded in the winter, it is thought that water will hold them in check. It is proper, however, here to state that, in using water on a marsh to destroy insects, care must be taken not to injure the vines, for when in a state of growth, they will not bear flooding for any considerable length of time. In the case of the insect in question, it is probable that winter flooding will be effectual, and then water is beneficial in preserving the vines. It must be remembered, however, that the Cranberry is not an aquatic plant. It will not grow in permanent water. It is not even partly aquatic, since its natural location is on the edges of low ridges and marshes, just between dry and wet. Its roots require constant moisture, but the plant will grow in any soil where moisture is present near the surface. To return to the subject of flooding, to kill insects, the water must be used with the greatest care during the period of growth, and not at all during the period of inflorescence. It is probable that thirty-six hours is the maximum, and twenty-four or thirty hours would be better.

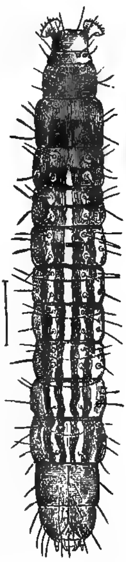
Fig. 3.



CRANBERRY GALL FLY.

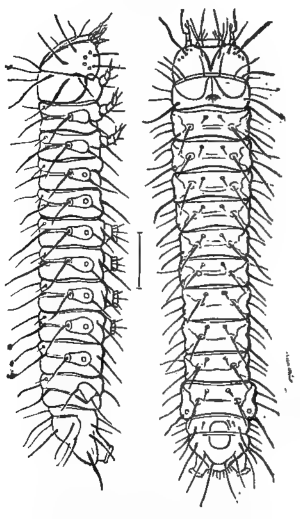
The Two-winged Cranberry Gall Fly (Fig. 3) lays its eggs on the vines, from which are hatched out pink-colored maggots, which raise tumors on the leaves. Its habits are yet unknown. The cut shows at *a*, egg on vine; *b*, maggot; *c*, pupa; *d*, fly; *e*, antennæ enlarged. The Red-striped Cranberry Worm (Fig. 4) is seen on the vines at the East about the last of September. It draws the leaves together by a few threads, and eats off the parenchyma from the upper side; sometimes it spins a tube of silk between two leaves. The worms are less than

Fig. 4.



RED-STRIPED CRANBERRY WORM.

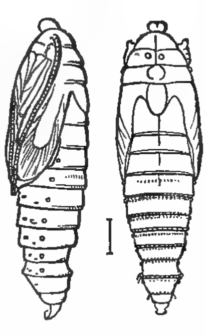
Fig. 5-*a*.



YELLOW CRANBERRY WORM.

half an inch in length, long and slender, pale green, with six longitudinal, pale, reddish, broken, irregular lines. The parent is as yet unknown. The Yellow Cranberry Worm, (*Tortrix vacciniivorana*, Fig. 5,) is very destructive to the vines in New Jersey. It is of a pale, honey-yellow color, and the moth has yellow wings, mottled with deep ocherous spots. It expands half an inch. Fig. 5-*a*, shows the larva enlarged; hair line natural size. Fig 5-*b*, shows chrysalides of Yellow Cranberry Worm enlarged, side and front view; hair line natural size. The great injury the various cranberry insects accomplish, renders it necessary that every possible means be used in their destruction.

Fig. 5-*b*.



YELLOW CRANBERRY WORM.

CREAM. The lighter, fatty portions of milk containing some caseine. (See Creamery.)

CREAMERY. A factory where butter and also cheese is made under systematic management. These creameries are worked as a distinct branch of dairying, on large estates, or by the associated system; the milk being furnished twice daily from adjoining farms, or in some cases, the cream alone being supplied, this latter plan, being now feasible, by means of late improvements in the raising of cream, in apparatus occupying a small space, and by the use of very cold water or ice. (See article Butter, and also Dairying.)

CREOSOTE. A colorless, acrid and oily liquid obtained from wood tar. It is singularly antiseptic, imparting that property to smoke, wood tar, etc.

CREMOCARPIUM. A two to five celled inferior fruit, cells one-seeded, indehiscent, dry. When dry, separating from a common axis, as in the *Umbelliferæ*. (See Botany.)

CRENATE. The edges of leaves, which are divided into curved notches. (See Botany.)

CRESS. Peppergrass. *Lepidium sativum.* A hardy annual, a native of Persia. The leaves of cress are eaten, when young, as a salad, either separately or mixed with lettuce or other salad plants, thus imparting their warm pungent taste. To cultivate Cress the soil should be made very firm, and the seed sown—as soon as the soil may be worked—rather thickly, in drills eight inches apart, covering but slightly. Sow at intervals of a fortnight until the middle of May, for succession, since the plants become acrid when they get old. About 14,000 seeds are contained in an ounce and this amount is usually sown in 100 feet of drill. There are a number of varieties Broad-leaved, Curled-leaved, Golden cress, etc. Water cress (*Nasturtium officinale*) is a hardy, aquatic perennial, found, growing naturally, along spring brooks, ponds and wet ditches. In cultivation it succeeds best, when grown in running water, in gravelly soil. The roots are planted in spring in water from four to eight inches deep. There are three described varieties. The small, Brown-leaved, the hardiest; the Green-leaved considered to be the easiest of cultivation, and the large, Brown-leaved; the last the best, and the only one that can be grown in water not quite shallow. Indian Cress (*Tropæolum majus*) common nasturtium, is a brilliant, yellow-flowered, climbing plant, the fruit of which resembles capers. Sow late in spring in good, strong soil and open situation; put out in rows, allowing six inches between plants; set sticks for them to climb. They flower in June and July. The fruit is excellent for pickling, when full-sized but green. They are put in vinegar or a suitable pickle as soon as gathered. There are many varieties, both running and dwarf, much used by florists for their elegant bloom.

CRETACEOUS. Of the nature of chalk.

CRIB. A feeding-stall; used in the United States as the name for the place of storage for Indian corn in the ear.

CRIB BITING. A habit in horses proceeding from derangement of the stomach usually. It is a vice, but does not constitute unsoundness unless severe.

CRICK. A common term signifying inability to move the muscles of the part, as the neck, back, etc.

CRICKET. *Achetadæ.* Crickets belong to the jumpers, which include crickets, grasshoppers and locusts. They are by far the most prolific and most destructive of orthopterous insects. There are a number of varieties, of which the common black cricket (*Acheta abbreviata*) is the most abundant. Like the locust, scarcely anything in the way of herbage, seems to come amiss. They are also destructive to many dry substances, as woolen or cotton clothes, left in the open air during the season of their feeding, especially in the fall. One of the most curious of the genus is the Mole cricket (*Gryllotalpa*). Its short fore legs are admirably adapted to burrowing, and hence they are seldom seen. Crickets may be poisoned by laying, in their way, grated carrots or potatoes mixed with a small quantity of arsenic; but it is not feasible, since when scarce they do comparatively little harm, and when they swarm in countless numbers this means is not practical. Hogs are fond of them, and hunt them assidiously. Crickets eat such insects as they can master. They lay numerous eggs, which they deposit in the ground by means of their ovipositor. At the approach of cold weather the greater part of them die, but a few hybernate, sheltering themselves beneath stones, or other places secure from water and the inclemency of the winter. The American crickets, unlike the European species, do not make their homes in houses. Those found in living rooms are chance individuals which have wandered there. The large wingless crickets, or grasshoppers (*Anabrus simplex*, etc.) generally live on the ground, or on low growing plants; some are found in caves or under stones, while others are found on wild grasses and herbage. Some species are found in immense numbers on the western plains, where they feed upon weeds or any green plant that may occur in their vicinity. In the Eastern States many species inhabit woods or dark, damp places and, if disturbed, hide under stones or rubbish; they are, however, at present not known to destroy the crops to any considerable extent; and if they do, the same remedies may be applied as above. The field-crickets of Europe form burrows in the ground in which they live, and are said to be very voracious, and even cannibal in their propensities, killing and devouring their own species whenever they can overcome them. The crickets in this country injure grass, melons, squashes, potatoes, and other roots and fruits. The eggs of field-crickets are deposited in the autumn in the earth, and hatch the following season, some of the old insects surviving throughout the winter under stones, dead fallen trunks of trees, etc. To destroy house-crickets, vials half filled with beer, milk, or any liquid will attract and drown them. A deep, glazed earthenware jar, having a little food, such as boiled potato or sliced cucumber in it, will serve as a trap for crickets, for when once in, they are unable to jump out again. Pills made of arsenic or Paris green and flour, or these poisons mixed with grated carrots or mashed potatoes, will poison them; but if such deadly poisons are ever used, great care should be taken that the dead insects do not fall into any of the domestic kitchen utensils, nor should they be swept where domestic fowls can find and eat them. If field-crickets are very numerous and annoying, many of the same remedies, recommended for grasshoppers, such as plowing up the earth and exposing it to the winter's frost or rains, or rolling the ground very early in the morning, will be of utility; but fowls, turkeys, and insectivorous birds are of inestimable value in destroying such insects as are found around gardens and houses, if they can only be kept out of the gardens themselves. Toads should never be killed in gardens, as they feed entirely on insects, and are entirely harmless to man, however the prejudice to the contrary.

CRISTATE. Having the appearance of a horn, or crest.

CROP-OUT. More properly out-crop. In geology, the exposure of rocks above the surface. Sometimes used in breeding, but incorrectly, when the peculiarity of some ancestor is shown in the progeny. (See Heredity.)

CROPS, ROTATION OF. A system of farming where certain crops follow each other in regular succession.

CROSS-BRED. (See Cross Breeding.)

CROSS BREEDING. In plants this consists in fertilizing the female organs with the pollen of the male organs, both being of the same species. The resulting seed will produce a variety or varieties. In animals it is the crossing of two animals of the same species, but of different breeds, as for instance, the Devon or the Alderney, Short-horn, etc., or vice versa. In plants crossing is extensively used, in the formation of new varieties, and in animal husbandry it is sometimes resorted to for the purpose of giving stamina, yet, in the latter case, it is often of doubtful utility. (See article on Hybridizing, Heredity, Grades and Breeding.)

CROSS FURROW. A water-furrow running across the ridges or lands. Sometimes deepened with a spade or opened with a double-mouldboard plow.

CROTALUS. A genus of snakes, including the *C. horridus*, or rattle-snake. They are all furnished with a rattle, and their wounds are extremely dangerous. Sucking the wound, cupping, and the use of stimulants are remedies.

CROTON OIL. An extremely active purge, obtained from the seeds of the *Croton tiglium.*

CROUP. An acute inflammation of the throat and windpipe, attended with a shrill wheezing and suffocation, occurring in children. It runs its course rapidly, and must be treated with decision. Hogs are subject to this disease; and if attacked, blood should be drawn freely from the neck, and active fomentation practiced.

CROW. Of all American birds few have so bad a reputation among farmers, or are more disliked than the Crow; and arising solely from the fact that, in planting time, they will pull a little corn. This, however, may be avoided by the same means used with blackbirds; give them plenty of cheap soaked corn with which to vary their diet of insects. There are few of our wild birds more persistent in hunting verminous animals and insects than crows. They also eat such substances as would otherwise putrefy and taint the air. Consequently they are always worthy of preservation, and should be harbored rather than be hunted to death. So persistent has ignorance followed them up that they have become the most wary of birds and, as cunning as a crow, has passed into a proverb. The crow is easily domesticated, and easily instructed to do many tricks, and even to speak. When domesticated they become much attached to those who pet them, and will soon learn to follow them about the fields. It must be confessed, however, that they are very mischievous, and are inclined to carry off and hide any small article they may find.

CROWN OF A LAND. The central part of the ridge.

CROWSFOOT. Several species of *ranunculus*, which are acrid and poisonous.

CRUCIBLE. A chemical vessel used to expose bodies to a strong heat. For common purposes the Hessian crucible, made of sand and clay, is used. Porcelain crucibles are necessary for finer work, and where the platinum will not answer, but are destroyed by fixed alkalies. The platinum crucible is the finest, from the ease with which it may be cleaned and managed, but is unfit for the treatment of lead, arsenic, mercury and a few other metals which alloy with platinum. A black-lead crucible is used for coarse work, and resists a stronger heat than the Hessian. In delicate operations, the platinum crucible is placed within another of coarse porcelain, or in a muffle. They are not used in agriculture, except in calcining earths in analysis.

CRUCIFEROUS PLANTS. Plants which have a flower consisting of four petals, arranged as a Maltese cross, as the cabbage, cress, turnip, mustard, radish, etc, They require rich land, abound in pungent oil, and when grown for seed are extremely exhausting. They are essentially sulphur and potash, or soda, plants.

CRUOR. The clot of blood.

CRUPPER. The horse's rump; the harness strap which passes under the tail is the crupper strap.

CRURAL. Belonging to the thigh or leg.

CRUSTACEANS. A tribe of animals, as crabs, lobsters, etc., with a crust, and destitute of vertebræ.

CRYPTOGAMIA. An immense tribe of plants which have no flowers or apparent sexual organs, but produce sporules or minute seeds, in cases, on their sides, backs, or on stalks. Ferns, mosses, fungi, sea-weeds, lichens, and the minute parasites which infest plants and dead wood, as rust, mildew, rubigo, etc., are of this tribe. The sporules of some of them are so minute that they appear as dust under a strong microscope.

CRYSTAL. Any transparent solid with a natural and regular geometrical figure.

CRYSTALLINE LENS. The lens of the eye, which refracts light, so as to produce clear vision. It is situated behind the aqueous humor.

CUCUMBER. *Cucumis sativus.* This plant, although possessing but little nutriment, is universally cultivated, where it will mature in the open air, and is largely raised, wholly under glass, where it will not mature. In all northern countries it is forced in advance of the natural season by gardeners. It is a tender annual plant, a native of the tropics, and supposed, originally, to have been brought from the East Indies. The varieties are all creeping, or running vines, holding themselves secure by means of tendrils. The seeds should not be planted in the open air until the ground becomes permanently warm, or about the time that corn is raising the soil. The plants require a distance of five to six feet each way, not more than three plants being allowed to remain permanently in each hill. From ten to twenty seeds should be scattered in each broad hill, and the plants thinned when all danger from cut worms, striped beetles, and other insects have passed. For pickling cucumbers, the seeds are planted from June fifteenth to July first in the North. The vines will come into full bearing about the middle of August, and continue until frost. In the cultivation of cucumbers, we have always had the best success by opening furrows six feet apart, filling with half rotted manure, and then plowing the soil back in regular ridges. With a two-horse plow we then strike furrows across the ridges, six feet apart, and at the crown of the ridge, in the cross furrow, throw a shovelful of compost manure. Over this a slight hill is formed and the seed planted, covering them about two inches. The subsequent cultivation can be principally done with the plow, except weeding the hills and thinning. The varieties used generally for slicing fresh, are Long Green, and White Spine. There are a number of long fancy varieties. When fresh they are easily digested, but otherwise are an unwholesome article of diet. The English people prize these sorts. Some of them are two feet long. In the United States the long, fancy varieties are not cultivated except as a curiosity. The principal varieties used for pickling, are Early Frame and Short Prickly. Near cities the raising of cucumbers, for pickling, is an important industry, fields of twenty to forty acres being not uncommon.

CUCUMBER BEETLE. (*Diabrotica vittata.*) This insect is very destructive to young cucumber, melon, and squash vines, and even to the blossoms of the pear, cherry, and apple trees. The Cucumber Beetle, in May and June, eats the bark of cucumber and other plants, and the larvæ perforate and hollow out the lower part of the stem which is beneath the surface of the ground, and the upper part of the root. Occasionally when the supply below fails, they are found in the vine just above the ground. The larva arrives at maturity in about a month or more after the egg is laid, and is found boring into the squash and cucumber vines as late as October. The pupa is formed in a smooth earthen cavity in the ground. There are two or three generations each year, according to latitude and length of winter. The perfect insect does great damage by eating holes in the seed, leaves, and young foliage. This is one of the most destructive of the insect tribe to gardeners, among vines, coming as they often do suddenly and in countless numbers. Both the larva and the perfect beetle are destructive. The beetle however is not especially destructive after vines, cucumbers, melons, etc., acquire their rough leaves. The cut (Fig. 1) shows the beetle, and Fig. 2 and 3, the larvæ; the short lines showing the natural size. Their depredations may be avoided by covering the plants with glazed boxes or with boxes covered with gauze. Gardeners, however, depend upon killing them by hand when wet with dew. When the weather is hot and dry, they may be rendered incapable of flying by being slightly drenched with cold water from a watering pot. The plants are also protected by being dusted with London purple, in the proportion of one pound to ten of flour.

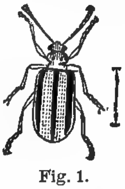


Fig. 1.

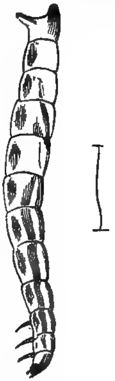


Fig. 2.

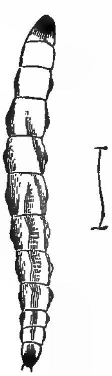


Fig. 3.

CUCUMIS. The generic name of the cucumber family.

CUCURBITACEÆ. A family of plants, mostly vines, monœcious, with inferior fruit, inhabiting warm countries. The melon, pumpkin, cucumber, gourd, squash, colocynth, and bryony are examples.

CUD. The pellets formed in the first stomach of ruminants, which are afterwards raised and rechewed, passing then into the third stomach to be fully digested in the fourth stomach.

CUD, LOSS OF. This difficulty is simply ceasing to ruminate, from some disorder in the system as indigestion, impaction of the rumen, or other disability. The real difficulty must be discovered and treated, when, the organs being restored, the animal will again resume rumination, as chewing the cud is called.

CULEX. A genus of insects including the gnat (*C. Pipiens*). It is a type of the *Culicidæ.*

CULINARY VEGETABLES. Plants cultivated in gardens, and sometimes in fields, for culinary purposes. They may be classed as leaf plants, such as the cabbage tribe, spinaceous plants, salads, pot and sweet herbs; stalk plants, as asparagus, rhubarb, sea kale, etc.; roots, as the turnip, carrot, potato, etc.; seeds, as the pea and bean; fruit, such as the cucumber, pumpkins, squashes, tomato, etc ; and the entire plants, such as onion, leek, mushroom, etc. They may be otherwise arranged, as the cabbage family, the leguminous family, esculent roots, spinaceous plants, alliaceous plants, asparaginous plants, acetarious plants, pot herbs, sweet herbs, plants used in tarts, confectionery and for seasoning and condiments, and edible fungi.

CULM. Stems which, like the straw of grain, sustain the flowers at a distance from the leaves. It is also used as a synonym for anthracite in England.

CULMIFEROUS PLANTS. Cereals and grasses.

CULTIVATION. Cultivation is that branch of agriculture which relates to causing increased growth, by means of implements for loosening the soil, thereby enabling the dew and rain to penetrate easily; and also in the destruction of weeds. This cultivation gives the soil proper aeration, and enables the roots to easily penetrate the soil and readily assimilate proper nutriment. In cultivation the operator must understand the nature and necessities of various plants, in order to know whether deep or shallow cultivation is proper; also those varieties of plants which require earthing up to assist growth; whether the hills should be made previous to planting, as in the sweet potato, or during the season of growth, as in the common potato, and also at what stage of growth the hilling should be performed. The planter must also distinguish between such plants as require level cultivation, as cereal grains and garden crops generally, and also those plants which, at some seasons of growth, are benefited by slight removal of the earth next the plants, as the onion; and again those requiring slight earthing, as size is attained, as with the beet and Indian corn. Still the cultivator must understand those classes of plants where the principal cultivation must be performed before the seed is sown, as in cereals sown broadcast, and also those classes of plants—melons, cucumbers, the tomato, etc.—where benefit and ease of cultivation is secured by slightly ridging before planting. (See articles on the various plants.)

CULTIVATOR. Implements for stirring the earth by horse power; extensively used in the United States for running between the rows of Indian corn and other crops planted in drills or rows. Their operation is somewhat between that of the plow and the harrow and, as they do not penetrate very deep, they leave, below, the manure and vegetable matter turned under by the plow, and at the same time do no injury to the roots of the plants under culture, unless these are too far advanced in their growth. The cultivator should generally be run through a crop twice at a dressing, and if the soil be stiff or grassy, it may be passed oftener or renewed at short intervals. The implements most preferred in the United States bear a strong resemblance to the horse-hoes of Europe. The invention of the straddle-row cultivator, by which a row is cultivated in going once through, has cheapened the cost of the corn crop one half, doing away, as it does entirely, with the hand hoe.

CULVERT. An arched channel of masonry built for the purpose of conducting water under a road or canal. If the water to be conveyed has nearly the same level as the canal, the culvert is built in the form of an inverted siphon, and acts on the principle of a water pipe. The word also signifies any arched channel for water under ground.

CUMIN. *Cuminum cyminum.* A plant cultivated in Sicily for its bitter aromatic seeds; used in confections, and to flavor cheese.

CUNEATE, CUNEIFORM. Any surface, angular, with the length considerably exceeding the width.

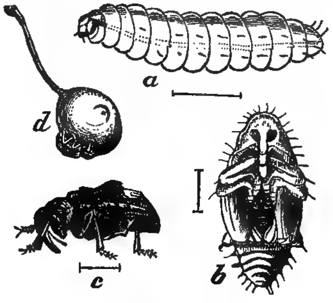
CUPEL. A shallow earthen vessel, somewhat of a cup shape, generally made of bone earth. It is used in the assays of the precious metals, which are fused upon a cupel with lead. Cupellation means the refining of gold or silver upon a cupel.

CUPULIFERÆ. A natural order of arborescent or shrubby exogenous plants, inhabiting all temperate and some hot climates. They are distinguished, by their amentaceous flowers and peculiarly veined leaves, from all European trees; and from other plants by their apetalous calyx, fruit enclosed in a husk or cup; and by their nuts, which contain but one cell and one or two seeds. This order comprehends the oak, hazel, beech, chestnut and hornbeam

CURB. This is a strain of one of the ligaments of the foot, and presents itself sometimes as a small hard swelling, on the lower part of the rear portion of the hock. The animal must have perfect rest. If the foot is hot, bandage, and keep constantly wet with cold water and saltpetre. When the heat is removed, if the swelling remain, cut off the hair of the swelling and rub, with considerable friction, once a day, with an ointment composed of one drachm biniodide of mercury rubbed up with one ounce of lard. Continue the application until a free watery discharge is produced. Then foment with hot water to promote the flow. If this does not reduce the swelling repeat with the ointment as before directed.

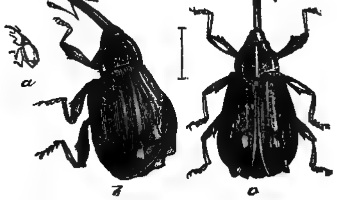
CURCULIO. This is a name given by the ancient Romans to the Corn Weevil. The weevils belonging to the family *Curculionidæ*, are short, thick beetles, the antennæ bent or elbowed near the middle, the first joint being longer than the rest. Feelers not perceptible. They vary in the form, length and direction of their snouts. Those most destructive to fruit are the Plum Curculio and the Plum Gouger, both of which attack various fruits, even the apple, though preferring the plum. Although there is a distinct Curculio

Fig. 1.



PLUM CURCULIO.

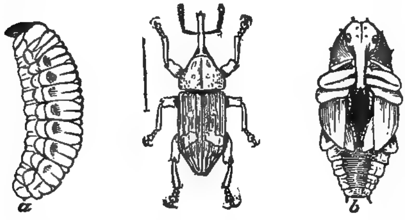
Fig. 2.



APPLE CURCULIO.

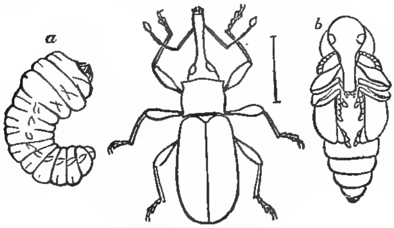
attacking the apple, as there are also weevils attacking grain, peas, beans, and various other fruits and farm products. In the accompanying illustrations (which are given herewith) Fig. 1 shows the destructive Plum Curculio (*Conotrachelus nenuphar*) magnified; *a*, being the larva, *b*, the pupa, *c*, the chrysalis, and *d* shows a young plum, with the peculiar crescent-shaped mark, and the dot in which the egg is laid—also the perfect insect on other side, natural size; the hair lines also show the natural size of the insect in its various transformations. Fig. 2 is the Apple Curculio (*Anthonomus quadrigibbus*), *a*, natural size, *b*, side view, and *c*, back view.

Fig. 3.



PINE WEEVIL.

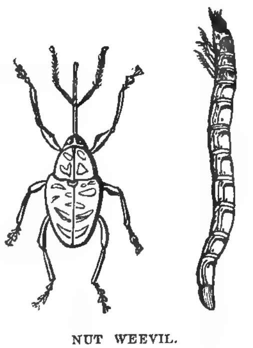
Fig. 4.



ELM TREE WEEVIL.

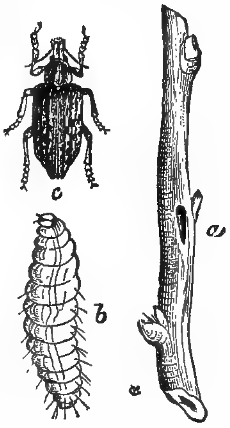
Fig. 3 is the Pine Weevil (*Pissodes strobi*), *a*, larva; *b*, pupa, and *c*, the perfect insect; hair line, natural size. Fig. 4 is the Elm Tree Weevil (*Magdalis armicollis*), *a*, larva, *b*, pupa; the central figure, the perfect insect; the hair line showing natural size. Fig. 5 shows the Long Snouted Nut Weevil (*Balaninus nasicus*), the figure to the right showing the larva, and that to the left the perfect insect. Fig. 6 shows the New York Weevil (*Ithycerus noveboracensis*), *a*, the work of the female where she lays her egg under the bark; *b*, the larva or grub; *c*, the perfect beetle. In presenting these and the following cuts, which embrace some of the more important of the Curculio or Weevil family, we have selected those working in fruit, nuts and wood. For some other of the more destructive species, as the Pea Weevil, the reader is referred to articles under the distinctive titles or names. The figures will give a good general idea of several of the most destructive species, for, it must be remembered, that the curculios, which embrace the weevils are numerous and especially noxious, from the fact that the first destroy the fruit, and the latter the ripe grain and seeds, both ultimate products. The late and lamented Dr. Le Baron, of Illinois, describes the *Curculionidæ*, or Snout Beetles, as follows: Their bodies are always of an oval form, never being very much elongated or depressed. The snout varies extremely, being sometimes short and broad, and sometimes as long as the body and almost as slender as a hair. Their most important organic character is the negative one of the absence of the labrum and the rudimental condition of the palpi. Like all the plant-eating Tetramera their tarsi are clothed with a dense brush of short stiff hair on the under side, and the last joint but one is strongly bilobed. Another very distinctive character is the bent or elbowed form of the antennæ, which is caused by the first joint being much longer than the others, and forming an angle with them. The antennæ are almost always knobbed at the end. The larvæ are soft and white, slightly narrowed at each extremity, and usually lying in a curved position. They are always destitute of feet, but in their place we often find little elevations or papillæ which are sometimes surmounted by a coronet of fine bristles. They always occupy the substance of plants, and therefore require but little locomotion. Though they are emphatically the occupants of fruits and fruit-like galls, yet there is no part of a plant which is not inhabited by the larvæ of some one or other of their numerous species. The snout-beetles consequently furnish a greater number of species which are injurious to the agriculturist than any other family of beetles. In depositing their eggs the females first puncture a hole with their snouts, then drop an egg at the aperture and lastly, with the aid of the proboscis, push the egg to the bottom of the cavity. In harmony with this mode of egg-deposit is the organic character observed in many species, of the female having a proboscis considerably longer than that of the male; of which our Apple Curculio (*Anthonomus quadrigibbus*) furnishes an example. The classification of the Curculionidæ, on account of their great numbers and the small size of the great majority of them, taken in connection with the rudimental state of some of the organs, namely, the labrum and the palpi, which, in other insects, often furnish valuable generic characters, presents a difficult study which will tax both the patience and the ingenuity of the student. They are divided primarily into two large sections, according to the length of the rostrum or snout, and the point of insertion of the antennæ, and designated as the Brevirostres or short-snouted Cur-

Fig. 5.



NUT WEEVIL.

Fig. 6.



NEW YORK WEEVIL.

culios, and the Longirostres or long-snouted Curculios. These sections not being sharply separated from each other in nature, Lacordaire has adopted, as the basis of the primary division of the Curculionidæ, the relative position of certain parts of the mouth; but these parts are often so minute and obscure that the characters derived from them are very difficult of application. We have therefore followed the more popular classification of Latreille and Schœnherr, so far as respects this primary division. These are: Section 1—*Brevirostres.* Rostrum short and broad, never much longer than the head; scrobes extending to the end of the rostrum, and the antennæ inserted at or near their extremities. Anterior coxæ contiguous. Elytra covering the whole of the abdomen. Section 2—*Longirostres.* Rostrum usually much longer than the head, narrow and cylindrical; scrobes very rarely reaching the end of the rostrum, and the antennæ usually inserted at a greater or less distance from its extremity, generally near the middle, and sometimes at its base. Coxæ and elytra various. The Longirostres, which are much the most numerous, are divided by Lacordaire into two sub-sections, accordingly as the anterior coxæ touch each other, or stand more or less apart. The former he names *Synmerides*, meaning thighs contiguous, and the latter *Apostasimerides*, (which we have contracted to *Apomerides*) meaning thighs separate. The word scrobe, used in describing the Curculionidæ, is the name given to the channel on each side of the rostrum for the reception of the antennæ. The term occular lobes refers to the form of the anterior and lateral margins of the thorax, which, in this case, curve forwards so as to touch or partly cover the eyes. Scape is the same as pedicel, and is the name of the elongated first joint of the antennæ. The rostral canal is the name of the groove in the prosternum of some species for the reception of the rostrum when it is bent under the breast in repose. It is necessary to bear in mind that as the Curculionidæ are, for the most part, small insects when compared with the Coleoptera in general, the terms large and small, when applied to particular groups or species, have a modified significance. A curculio half an inch or upwards in length, is comparatively large; one a quarter of an inch is medium; and one an eighth of an inch or less is small or very small.

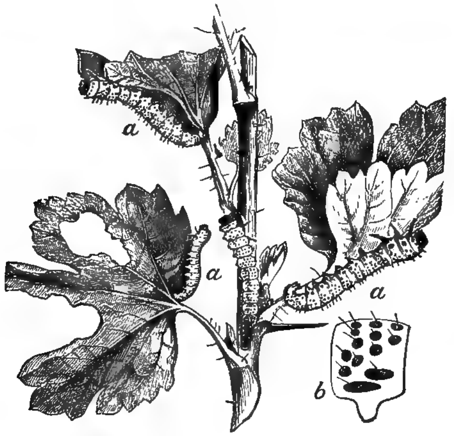
CURD. The coagulum of milk. (See Cheese.)

CURING MEATS. The curing of meats, by means of salt, has been known from quite remote antiquity. The simple use of salt as a preservative was not specially improved on until within the present century. Since that time, the use of saltpetre has come into general use, and later, sugar and pepper, also in the curing of all lean meats. The art of curing meats by drying in the sun, aided by artificial heat and smoke, is undoubtedly the first effort made by savages in its preservation since it was not only practiced by the Indians of the Atlantic coast, but also by the Digger Indians, of the region between the Rocky and the Sierra Nevada mountains, than which no more degraded savages can be found. The preservation of food by canning, in the fresh state, has now been brought to a great state of perfection through the aid of scientific appliances and machinery; with this we have but little to do. In the canning of fruits, it is simply a question of expelling the air, by immersion of the cans in hot water, and quickly sealing. This is more promptly accomplished by wax sold by every grocer, the cans or glass jars being self-locking. To return then to meat, the preservation is first by salt. In the case of fat meats, as side pork, it should have all it will take, a full half bushel to the barrel of 200 pounds. Hams and shoulders of swine, mutton hams, beef tongues, that are to be smoked or dried, are to be preserved in sweet pickle. The same rule will also apply to bacon. Here again a modification may be used, that is, the meat may be dry salted in proper proportions of salt, sugar and saltpetre. In the operation of salting, whether it be dry salting or pickling, the first operation is to free the meat of blood. This is important, and is accomplished by rubbing thoroughly with salt, as hot as the hand can bear, and placing it in layers to drain for thirty-six hours. It is then ready for the final process of salting. Prepare a table with a grated bottom so the juices can run away, and rub with salt, in the proportion of one quarter pound of saltpetre to each eight pounds of salt, heated as hot as the hand can bear. Repeat this three or four times at intervals of three or four days. To this brown sugar may be added at discretion up to four pounds of sugar to each eight pounds of salt. This applies to beef and mutton. Hams, shoulders and bacon are better rubbed cold. The meat may then be either dried or smoked as the taste indicates. If the meat is to be pickled, that is immersed in brine, prepare enough to cover it as follows: To each four pounds of coarse salt used, add two pounds of brown sugar and four ounces of saltpetre. This to be dissolved in two gallons of water, and scalded and skimmed clear. When cold pour over the meat, using brine enough to cover. It may remain in the brine from four to six weeks if cold, and then dried or smoked. This is a good recipe for corned beef, but the meat will not keep longer than about May. If required to be kept during hot weather the brine must be scalded, further strengthened with salt, and again poured over the meat. Use brine enough to fully cover the meat and keep it under by means of weights. An ordinary pickle for beef or hams is made by saturating water with salt until it will bear out an egg the size of a quarter dollar. Then for every fifteen pounds of meat, add an ounce of saltpetre and one pound of brown sugar. Scald, skim and pour over the meat as heretofore directed. In the spring pour off the brine, add more salt, scald, skim and again pour over the meat. It may be hot for beef and cold for hams.

CURRANT. *Ribes.* The general character of all the varieties of the Currant is, they are low growing shrubs; smooth stemmed; leaves more or less lobed; flowers yellow, crimson, or white; fruit red, black, and white. The species from which our cultivated varieties have been produced, are credited with being natives of Northern Europe and, until within the last one hundred years, have not attracted much attention. The old Greek and Roman writers do not mention this fruit and, indeed, Turner in his list of fruits (1557), does not name the Currant. Gerarde, more than forty years later, only notices it as a smooth stemmed gooseberry. The principal wild species of the United States are the Fetid Currant, (*Ribes prostratum*) Missouri Currant, (*R. aureum*) Red Flowering Currant, (*R. sanguineum*) and Wild Black Currant, (*R. floridum*). The varieties cultivated are the red, the white, and the black currant, all originally natives of Europe. The cultivation of the currant is exceedingly simple. They readily strike from cuttings, taken in the fall, when kept in moist sand through the winter and planted in the spring, six inches apart. Thus by autumn they will be well rooted and may be planted four feet apart each way, in rich soil. Keep the ground free of weeds; cut out the old wood from year to year; destroy insects, especially the borer, if it appears; give an annual top dressing of compost and you will be rewarded by full annual crops. The Long Bunched Red; the White Grape, and the Black Naples are among the best varieties of their several classes.

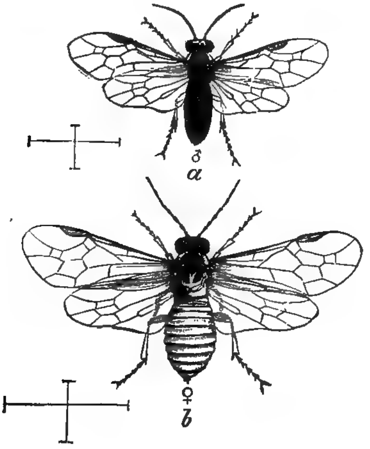
CURRANT WORM. The two principal pests of the currant, are the European Saw Fly, (*Nematus ventricosus*) imported, and the native Saw Fly,(*Pristiphora grossulariæ*). The European species first began to attract attention, in the Eastern States, about 1857, since which time it has spread over the United States. The cuts show, Fig. 1, *a, a, a,* larvæ; *b*, a magnified joint of body, showing black tubercles; Fig. 2, shows the perfect insect; *a*, male; *b*, female, the cross lines showing the natural size. The native species is not unlike the European one, the cut, Fig. 3, being sufficient to distinguish it; *a*, shows the larva or worm feeding on a leaf; *b*, the perfect insect The native species is only about two-thirds the size of the European one, in all its states, and both infest the gooseberry. as well as the currant. Fig. 4 shows a leaf infested, 1 showing eggs along the ribs of the leaf; 2 and 3 show the holes made by the minute young insect in feeding. The remedy most effectual is dusting white hellebore on the leaves, when wet with dew, or else sprinkling the leaves in the proportion of one pound of the fresh powder to twenty or twenty-five gallons of water.

Fig. 1.



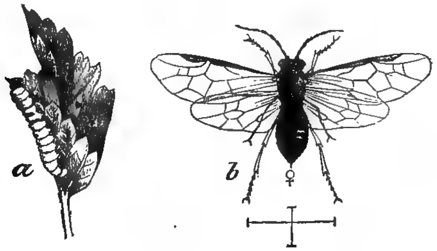
IMPORTED GOOSEBERRY SAW FLY.

Fig. 2.



EUROPEAN CURRANT SAW FLY.

Fig. 3.



NATIVE CURRANT SAW FLY.

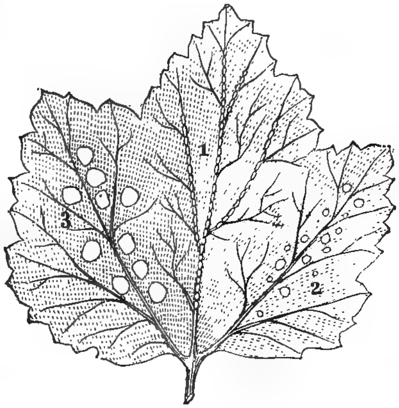


Fig. 4.

CURRYING. The preparation of leather by which it is polished and rendered soft.

CUSCUTA. The generic name of the dodders.

CUTANEOUS. Relating to the skin.

CUTICLE. The external delicate membrane of the true skin; the epidermis of plants.

CUTTING ICE. (See Ice Harvesting.)

CUT WORMS. (*Agrotididæ.*) The larvæ of the May-beetle, the White Grub Worm, and the larvæ of the Click Beetles (Wire Worms) are, in connection with the true Cut Worms, very often incorrectly called Cut Worms in many parts of the United States. The true Cut Worms are smooth caterpillars, the larvæ of moths. There are many species, all of them destructive, some species which eat the plant, severing it deep-below the ground; others climbing fruit trees to feed on the tender buds; still others eat the plant just at, or above, where it enters the ground. The natural history of the most of the Cut Worms is given by Dr. Riley, in his First Missouri Report, from which we extract: The parent moth attaches her eggs to some substance near the ground, or deposits them on plants, mostly during the latter part of summer, though occasionally in the spring of the year. Those which are deposited during late summer, hatch early in the fall and the young worms, crawling into the ground, feed upon the tender roots and shoots of herbaceous plants. At this time of the year, the worms being small and their food plentiful, the damage they do is seldom noticed. On the approach of winter they are usually about two-thirds grown, when they descend deeper into the ground and, curling themselves up, remain in a torpid state till the following spring. When spring returns, they are quite ravenous, and their cutting propensities having fully developed, they ascend to the surface and attack the first green succulent vegetation that comes in their way. When once full grown they descend deeper into the earth, and form for themselves oval chambers, in which they change to chrysalides. In this state they remain from two to four weeks, and finally come forth as moths, during the months of June, July and August, [in the North, Editor,] the chrysalis skin, being in most cases so thin, that it is impossible to preserve it. These moths in time lay eggs, and their progeny go through the same cycle of changes. Some species, however, are most likely two-brooded, while others pass through the winter in the chrysalis state. The only practical remedy against their depredations is hunting for the caterpillars just at daylight in the morning. They will then be found feeding, or at rest, just beneath the surface, and may be easily found by the cast or mark they leave at the surface of the ground. The group of cuts illustrating Cut Worms, shows, in Fig. 1, the moth of the Western Striped Cut Worm (*Agrotis subgothica*); Fig. 2 shows the Climbing or Dark-sided Cut Worm. (*Agrotis Cochranii*) larva and moth; Fig. 3 shows the small, white, Bristly Cut Worm, (*Celæna renigera*) larva and moth. There are various other Cut Worms, one of which attacks corn, (*Agrotis nigricans*, variety *maizi*); also the Wheat Cut Worm, and others. The illustrations given will suffice to give a fair comprehension of these destructive species.

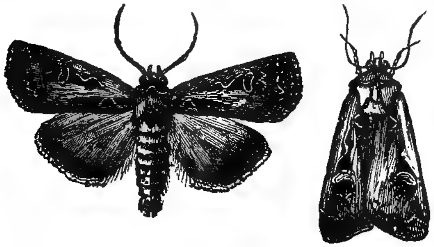


Fig. 1.
MOTHS OF STRIPED CUT WORM.

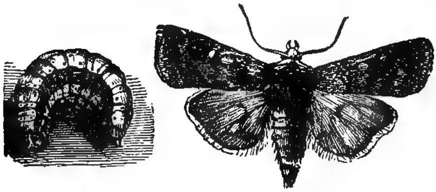


Fig. 2.
CLIMBING CUT WORM, LARVA AND MOTH.

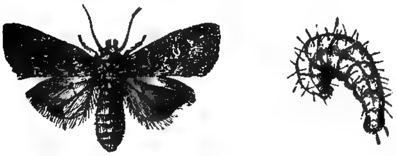


Fig. 3.
BRISTLY CUT WORM, LARVA AND MOTH.

CYANITE. A massive and crystallized mineral, of a pearly lustre, translucent, and of various shades of blue; it is a silicate of alumina, with a trace of oxide of iron. Found in primitive rocks.

CYANOGEN. A gas which burns with a blue flame, the bicarburet of nitrogen; it is a compound radical, forming acids with oxygen (*cyanic*) and hydrogen (*hydrocyanic* or *prussic*). The gas is poisonous: it combines directly with many metals, forming cyanides.

CYANURIC ACID. A product of the action of heat on urea.

CYCADEÆ. A small family of dwarf palms which are gymnospermous. The sago palm is (*Cycas circinnalis*).

CYCLOSIS. A circulation of the elaborated sap in the higher plants in delicate anastomosing vessels. The latex circulation.

CYDONIA. The generic name of the quince tree.

CYLINDER. A solid, the height of which exceeds the diameter, which is constant; it offers a circular section at every part when made at right angles to the axis. Round stacks are nearly cylindrical. Thus their contents may be found by the formula for a cylinder (one-half of the top should be measured). The solid contents are equal to the height multiplied into the area of the base or section.

CYME. An inflorescence; the flower stems spring from one part, but are afterward variously subdivided.

CYNARACEÆ. Plants like the artichoke, thistle, etc., with the flowers included in a scaly *capitulum*.

CYNIPS. A genus of hymenopterous insects without stings. They insert their eggs in parts of living trees, causing tumors, of which the gall nut is a specimen.

CYNOSURUS. A genus of grasses.

CYPERACEÆ. From *Cyperus*, a genus. The tribe of plants consisting of rushes, sedges and other marsh grasses without nodes or joints. They are of trifling value; the *Cyperus esculentus* of Italy furnishes a sweet nut or tuber, known as Chufa or Earth Almond.

CYPRESS. *Taxodium.* Of the varieties of the Taxodium, natives of the United States and Mexico, it will only be necessary to mention the Deciduous Cypress, or Bald Cypress of the Southern States, which occasionally is found growing as far as 39° North. It assumes, like the elm, many distinct forms and is known by a variety of names, the lighter colored wood being locally known as White Cypress, and the darker wooded as Black Cypress. The varieties are mostly sports, some of which, however, perpetuate themselves from seed. The timber of the Bald Cypress (*Taxodium distichum*) is one of the most valuable of the timber trees in the Southern States, comprising vast districts of swamp, from Maryland to Florida, Louisiana and along the rivers to Missouri and Illinois, growing in rich, alluvial lands South, often to a height of 120 feet, supported upon an immense truncated base, which has, after the tree reaches a height of thirty or forty feet, curious appendages known as cypress knees, and used by the natives as bee hives. The wood is soft, fine grained, elastic, strong, and exceedingly durable; this last quality equaled by few trees, making it valuable for timber, lumber, and especially for shingles. The following graphic account is given of this noble southern tree in the North American Sylva: In the swamps of the Southern States and the Floridas, on whose deep, miry soil a new layer of vegetable mould is deposited every year by the floods, the Cypress attains its utmost development. The largest stocks are 120 feet in height, and from twenty-five to forty feet in circumference above the conical base, which, at the surface of the earth, is always three or four times as large as the continued diameter of the trunk. The roots of the largest stocks, particularly of such as are most exposed to inundation, are charged with conical protuberances, commonly from eighteen to twenty-four inches, and sometimes four or five feet in thickness; these are always hollow, smooth on the surface, and covered with a reddish bark, like the roots, which they resemble also in the softness of their wood, and they exhibit no sign of vegetation. The foliage is open, light, and of a fresh, agreeable tint; each leaf is four or five inches long, and consists of two parallel rows of leaflets, upon a common stem. The leaflets are small, fine, and somewhat arching, with the convex side outwards. In the autumn they change from a light green to a dull red, and are shed quite soon after. The Cypress blooms in Carolina about the first of February. The male and female flowers are borne separately, by the same tree; the first in flexible, pendulous aments, and the second in bunches, scarcely apparent. The cones are about as large as the thumb, hard, round, of an uneven surface, and stored with small, irregular, ligneous seeds, containing a cylindrical kernel; they are ripe in October, and retain their productive virtue for two years. Among the ornamental varieties of Cypress, Lawson's Cypress, (*Cupressus Lawsoniana*) is one of the most beautiful, but, unfortunately, is not hardy north of the Middle States, except in favored localities near the sea coast. It is a native of California, attains the height of 100 feet, and is delicately beautiful, as the illustration we give will show. It should be planted wherever it will endure the rigors of winter.

LAWSON'S CYPRESS.

CYSTIC. Appertaining to the bladder. *Cystic oxide*, a rare ingredient in urinary calculi.

D

DACTYLIS. A genus of grasses, of which *D. glomerata*, orchard or cocks-foot, is one of the most important species.

DAIRY. (See Dairying.)

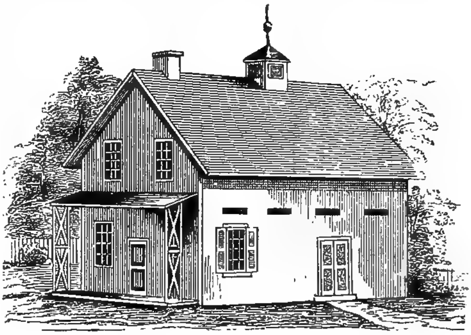
DAIRYING. The importance of the dairy interest of the United States, and the magnitude it has assumed within the last ten years, the constant multiplication of factories for the manufacture of butter and cheese, especially in the West, and the constant interest in new processes for cheapening production, is one of the many astonishing developments in American industries. Under the old system of making cheese, scarcely two were alike in texture, quality, or flavor. Now, in well ordered factories, the cheeses are not only uniform, but may be produced of any flavor and ripeness demanded. This is entirely due to the perfect system adopted, not only in the feed.

ing and management of the cows, but especially in the precise management and manipulation of the milk and curd, the pressing and curing of the cheese, and packing it for sale. (See article Cheese) In the manufacture of butter the same precise care is given. The milk must be kept scrupulously from all suspicion of taint, from bad odors. It must be kept at a low and equable temperature, until the cream is raised. The cream must be properly ripened, churned at a proper temperature, carefully worked and salted and packed in suitable packages, according to the season and also the particular market for which it is intended and, until sold, kept at a low temperature, and from contact with air; care also must be taken that the cream is properly churned. (See article Churning.) In this way the intelligent dairyman makes a uniform article of butter, no matter what the season, and an article which commands the highest price in any market in which it is sold. (See article Butter.) To accomplish all this, a suitable dairy building must be provided, containing all modern conveniences, including ice and pure water. (See article Dairy Buildings.) Cold springs are not now so much sought by the dairyman as formerly. Springs are especially scarce in the West; but nature has given every other requisite, cheap fuel, cheap grain, and flush pasturage Ice supplies have superseded the need of very cold springs, and that cheaply. (See article Ice House.) In all we have said, and equally important, the dairy cow will be found of the first importance. In this progressive age no man can succeed in dairying with a lot of cows picked up at random and of mixed breeds, or of no particular breed. There are cows especially adapted to the dairy, just as there are cattle adapted to the production of beef or for labor. (See article Dairy Cows.) Again the question of grasses comes in. This also is one among the very important questions to be considered. Without grasses, sweet, succulent, and that shall follow the season in succession, the dairyman can not hope to compete with his more practical, if not more intelligent, neighbor, who has paid due attention to this keystone of dairying, grass. With a succession of sweet, succulent grasses from spring to fall, supplemented with proper forage plants during the months of late July and August, plenty of good clover, timothy, orchard grass, and red top for winter feeding, and an abundance of ground grain, to be used both during the drought of summer, and during the winter, and proper implements, utensils and buildings, we have the foundation laid for making money, in one of the best paying branches of agriculture. (See articles Hay and Forage Plants) The United States is producing annually 750,000 tons of butter, of which we exported 11,000 tons during the year 1879; and 100,000 tons of cheese, of which we exported 61,000 tons during the year 1879. In 1880 the export of butter was about 20,000 tons, and of cheese, nearly 72,000 tons. Even in the matter of salt, with which to season the butter and cheese, this is of such magnitude that great firms of salt dealers, both English and American, eagerly compete for the dairy demand in salt. Relating to the competition of the West, in dairy products, an intelligent dairyman of New York lately expressed himself as follows: A few years ago, when New York State furnished nearly the entire trade with butter and cheese, this old-fashioned custom of holding was necessary; but of late years a mighty enemy has risen up in the West, outstripping and surprising us all. Butter and cheese of fine quality is now laid down in our market, from Illinois, Iowa, Wisconsin, Missouri, Nebraska, and the entire Northwest, in better order than from New York State by express. The western wide awake men meet our market by forwarding their butter while it is fresh; and this by a creamery system of manufacturing fine butter all winter long, having their cows come in during the fall and winter for that purpose. The magnitude of the butter and cheese trade may be one cause of the trouble, but if the larger proportion of it was properly manufactured and marketed, the greater trouble would be avoided, for we are developing an almost unlimited market for American fine butter and cheese. Although we have increased the annual production of butter from 600,000,000 pounds to 1,500,000,000 pounds, and of cheese from 150,000,000 pounds to 350,000,000 pounds, in the last eighteen years, we find ourselves only at the threshold of our responsibilities and opportunities, for the vast population of this country must be mainly cared for by the development of its agricultural resources. This branch of agriculture shows, within the last twenty years, an export of cheese alone of 1,163,000,000 pounds, and a total value of exported butter and cheese of $185,000,000. During the last ten years 885,000,000 pounds of cheese have been shipped abroad. Thus it will be seen that the dairying interest is one of vast and increasing magnitude. Its rapid growth in the East will be equaled and surpassed in many Western States adapted to dairy products. In 1840, in the great dairying State of New York, the entire dairy product, including milk, butter, and cheese, in value amounted to a little less than ten and a half million dollars, and in all the States to about thirty-four millions; but in 1869, according to the census of 1870, the milk and butter produce in New York alone reached the value of fifty-seven millions, and, including milk, one hundred millions. But in the city of New York, in 1876, the total value of milk, butter, and cheese received, according to the daily reports of the Board of Trade, was over fifty-five and a half millions. Coming westward, we find that, in the single dairy product of cheese, the State of Illinois advanced her yield seven-fold between 1870 and 1874. In 1869 Commissioner D. A. Wells estimated the value of the dairies of the United States at $400,000,000. In a paper read before the National Agricultural Congress at Philadelphia, in 1876, Prof. X. A. Willard thought it much within the truth to state the value of the products of the farm dairies for that year at $600,000,000, illustrating these figures by the comparison that in 1860 the total products arising from agriculture in the United States was estimated at $1,800,000,000; so that the dairy farms of the United States in 1876 produced a sum equal to one third the value of the entire productions of agriculture, in all its branches, in 1860. The butter product of the United States at this time may safely be put at 1,000,000,000 pounds, and that of cheese at 300,000,000. The exports of dairy products in 1876 were: butter, 10,593,968 pounds, value, $2,230,469; cheese, 104,041,108 pounds, value, $14,069,391; condensed milk, $118,590, as against the following in 1870; butter, 2,019,288 pounds, value, $592,229; cheese, 57,296,227 pounds, value, $8,881,934; condensed milk, none. In relation to the factory season, New York statistics contain the most ample and full reports of 127 butter and cheese factories which show the average length of the New York factory season of 1874 to be 6.24 months, if estimated from the whole number of cows, and 6.44 months, if only the average number is taken into account. Average number of cows for the season per factory, 311; lowest number reported by any one factory, 55; highest number, 800. Average yield of milk per cow for the factory season, 3,241 pounds, or 377 gallons. Excepting a few factories, which made considerable amounts of butter as well as cheese, 112 reports show an average of 331 pounds of cheese per cow, and 9.82 pounds of milk required for one pound of cured cheese. Fifty seven factory reports give, each, statistics of the best and of the poorest dairy for the season. These reports show an average season of 6.5 months. Average net receipts by patrons per 100 pounds of milk, $1.229, or about 2.63 cents per quart; receipts per cow, $40.33, showing 382 gallons of milk per cow. Best dairies, average net receipt per cow by patrons, $52.99, showing 501 gallons of milk per cow. Poorest dairies, average net receipt per cow, $30.63, showing 290 gallons per cow. Excess of yield per cow of the best dairies over that of the poorest dairies, 211 gallons, or about seventy-three per cent. The following tabulated statement will show the exports of dairy products from the United States, from 1790 to, and including 1878, and the value thereof:

Year.	Butter. Pounds.	Value.	Cheese. Pounds.	Value.
1790.....	....	$ 48,587	144,734	....
1820.....	1,068,024	....	766,431	$ 190,287
1830.....	899,393	...	688,241	142,370
1840.....	1,177,639	....	723,217	210,749
1850.....	3,886,175	....	13,020,817	1,215,463
1858.....	3,082,117	541,863	8,098,527	731,910
1859.....	4,572,065	750,911	7,103,312	649,302
1860.....	7,640,914	1,144,321	15,515,799	1,565,630
1861.....	15,553,381	2,355,985	32,361,428	3,321,631
1862.....	26,691,247	4,164,314	34,052,687	2,715,892
1863. .	35,172,415	6,733,743	42,045,054	4,216,804
1864.....	20,895,435	6,140,031	47,757,329	5,638,007
1865.....	21,388,185	7,234,173	53,089,468	11,684,927
1866.....	3,806,835	1,267,855	36,411,985	6,036 828
1867.....	4,912,355	1,184,367	52,352,127	7,898,535
1868.....	2,071,873	582,745	51,097,003	7,010,424
1869.....	1,324,332	484,094	39,960,367	6,437.866
1870. ...	2,019,288	592,229	57,296,327	8,881,934
1871.....	3,965,043	853,096	63,698,867	8,752,990
1872.	7,746,261	1,498,812	66,004,025	7,752,918
1873.....	4,518,844	952,919	80,366,540	10,498,010
1874.....	4,367 98	1,092,381	90,611,077	11,898,995
1875.....	6,360,827	1,506,996	101,010,873	13,659,603
1876.....	4,644,894	1,109,496	97,676,264	12,270,083
1877. ..	21,527,242	4,424,616	107,364,666	12,700,627
1878.....	21,837,11.	3,931,822	123,783,736	14,103,529

Mr. J. M. Smith, of Wisconsin, at the session of the Northwestern Dairymen's Association in 1878, held the following in relation to cooling milk, and the manufacture of butter and cheese: 'The practical cheese maker who succeeds in making a cheese that is at once firm, soft, mild, and entirely sweet, rich and meaty—one that has these properties in such excellence that it can be spread on another cheese under the hand like unmelted butter—knows, if he has taken note of the facts, that that kind of a cheese was made when the coldness of the weather, or the carefulness of his patrons, gave him a vat of milk that was sound and cool, and free from any manifest approach to acidity. Whatever science or recklessness may assert can be achieved in making such a kind of cheese from milk not kept so cold, or from that perceptibly acid to the ordinary senses of smell and taste, I know that a cheese maker of even limited experience can make a good cheese every time from the former-named kind of milk; while I have yet to learn and be convinced that a philosopher, a chemist, a scholar and experienced cheese maker combined can make such a cheese from milk that has deteriorated to perceptible acidity. If like causes produce like effects in the cheese vat as well as elsewhere, (and they do) then I argue that if the maximum of excellence is attained by the proper manipulation of good cooled milk, and defeat, manifest and disgraceful, accompanies the manufacture of sour milk, then approximate success or failure will show the per cent. of each, to good judges, just in proportion as the milk has progressed in acidity before coagulation is effected. The per cent. of variation is not so plainly discernible, as the condition of the mercury is on the scale of the thermometer, and it has been made, not by the cheese maker alone, but by the atmosphere and the acts of the patron. The practical, educated butter maker knows that as soon as milk sours the raising of cream is at once checked and, we may safely say, substantially stopped. If left to acidify by not being cooled when first drawn from the cow, the acid will devour the cream, and a per cent. of loss of butter is the certain consequence. By experiment, made in warm weather, I learned that mixed night's and morning's milk plunged in water at 60° made about one pound of butter per 100 pounds of milk less than that plunged in iced water at 40°, and that the milk of the former was sour next morning, and unfit for making skimmed-milk cheese—while the latter was to smell and taste yet sweet. By another experiment, made also in warm weather, it was shown that the night's milk delivered next morning, taken care of in the night in the usual way, though plunged in an ice-bath as soon as received, would sour by 3 p. m. of the day of delivery, while the morning's milk of the same day, put in the same ice-bath, would be sweet forty-eight hours after delivery. From this I saw that to keep milk sweet long enough to get the butter all out of it, it is necessary to rapidly cool it immediately after being drawn. Now, if the causes that produce acidity have the effect to so change the weight of butter that can be made from a given weight of milk, then the same cause, (absence of cream) if the milk is used to make cheese, will modify the character of your cheese and make it approximately fancy, or decidedly of the white oak variety, according as the boss skimmer of the age—acid—has been permitted to ravage the milk, either by the act of the patron or the tardy manipulations of the cheese maker. These facts and experiences lead direct to conclusions essential to be observed in the care of milk by the patron, and the manufacture of it after delivery in the vat. The patron is most vitally interested, and therefore he ought to have his ears wide open to a proclamation of the fact—which fact is, that cents per hundred pounds for his milk is intimately dependent upon the rapid cooling of his night's milk during the warm weather. This is true, whether he does it himself or has it done for him by the maker at the factory. To cool on the farm is the prevailing custom, at least in the West, and so I address myself to urging that it be done there more thoroughly. To give some known reasons of failure, and what would more surely secure the end sought—One of the chief reasons of failure is the ignorance or carelessness of patrons, or a combination of both. Sometimes the ignorance is so dense that precept upon precept will not penetrate the cranium. The loss of a can of milk, occasionally, will aid materially in the development of such. When that is the case, the cheese maker is fortunate. It is not that kind of milk that harms him, for he does not use it. It is the partially acid milk that gets into the vat that takes the gilt edge off his cheese. Whatever the magnitude of the dairy interests, as has been shown in this article, and the extracts given, there is still room for expansion. In fact there would seem to be little fear that for some time the production of really fine butter and cheese will hold high prices, at least for years to come. Nevertheless, what is known as grease butter, and skim cheese, can not expect even to hold its own. People will eat sweet lard in preference to rancid butter, and will go without cheese rather than attempt the toughness of white oak cheese.

DAIRY BUILDINGS. The adaptation of buildings to the special wants of the farm is one of the departures that has gradually grown up, and which, within the last fifteen or twenty years, has been so improved that, now, barns and dairy houses for the special manufacture of butter and cheese, or both; improved sheds for the feeding of calves, and convenient buildings for feeding swine are found in all dairy districts; even dwellings adapted to the use of the family, with a dairy room attached, are often found in the East, where comparatively few cows are kept in single dairies, but which in the aggregate count most largely. This plan, however, is not to be commended even on the score of economy, and certainly not, where the highest grade of manufacture is to be accomplished; the difficulty, in so isolating the room from outside temperature and especially in holding the requisite coolness in summer, would render the cost, when from twenty to thirty cows are kept, more than that of a proper dairy building. (See Ice Houses.) Ice is of the first importance, in the manufacture of prime butter, and in preserving it intact; and the cheese maker, who finds it economical to make butter at some seasons, will fully understand its importance. Where a stream of very cold water is supplied by a spring or where the water can be raised from a deep well, ice may be very well dispensed with, if a deep, dry, cool, well ventilated cellar may be provided. (See Sub-earth Ventilation.) To return to the subject of ice for dairy purposes, as in any case, the ice house should be a building by itself. It should also be on ground higher than the dairy and provided with a pipe to carry the cold water of the melting ice to the dairy room. The dairy house need not be an expensive building; it must however be built with special reference to the required use. A room simply intended for raising cream and making butter, under the present improved processes, need occupy but little space for ten to fifteen cows. For making butter simply for home use, a sweet, cool cellar answers well. When the butter and cheese is for market, the building should be of brick, with double walls, and if partly sunk in the ground, or built in a bank, so much the better. The foundation walls should, if possible, be of stone, the floor of cement, with ample drains both for water and the waste liquids of the milk, etc. These drains should have ample fall, those for skimmed milk, whey, etc., leading directly to the calf and pig pens, and emptying into vats that may be easily cleaned. These drains must be water tight, except the drains for surface water, which may be of tile. The drains for the wastage of the factory—the pipes leading to and from the dairy house—should be laid before the floor is: The floor to be of flags or brick laid in cement, or a floor of cement, this to be laid on a surface of pounded glass or tin shavings, six inches thick, as a protection against rats. The top and side walls of the house should be finished with plaster. Thus cleanliness, economy, perfect ventilation and an equal temperature are secured. We give below an illustration of a small factory, which is simple in construction and which, with the explanations, will be easily understood. If built as we have suggested, and with sub-earth ventilation, (see article on this subject) with the use of ice, it may be used for both butter and cheese.



FARM DAIRY-HOUSE.

The building, say thirty by twenty-four feet may be arranged as follows. The ground floor is extended to a piazza, shown in the elevation, leading into a milk room twelve by fourteen feet, provided with a heater and vat, a cheese press, an elevator, and stairs to second story. To the left a door leads to a store room ten by twelve feet lighted by two windows. Another door leads to a ware room with windows, and also folding doors, as shown, wide enough to admit a team, also with stairs leading to the upper floor. The upper floor is all in one room with tables on three sides, and passage ways, openings on two sides, provided with ventilators as shown in the elevation, with windows at each end. This is the curing room and should be provided with the most modern improvements. If an extra story be desired, for additional store room, stairs, and an elevator, must be provided with easy entrance. The barns, piggery, and calf stables need not vary from those used for other purposes, except that the dairy barn should have storage room for roots in winter, if possible. (See article Barns, and Hog House.) The American associated system of dairying and the multiplication

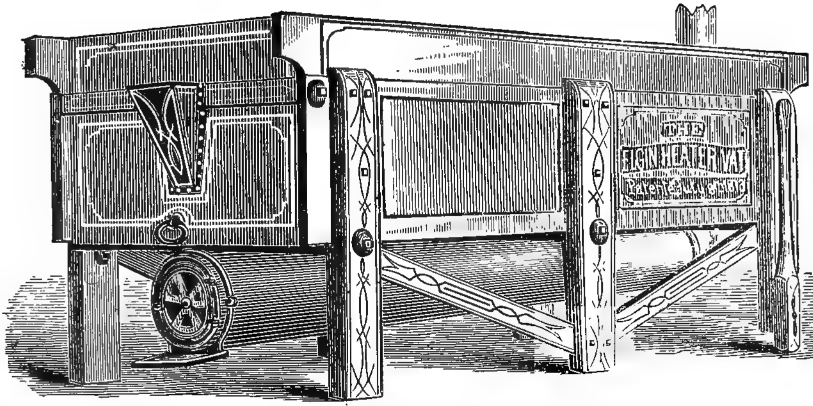


Fig. 1.

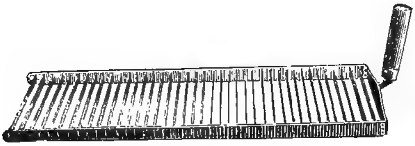


Fig. 2.

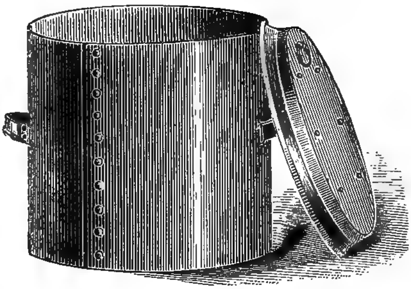


Fig. 4.

Fig. 3.

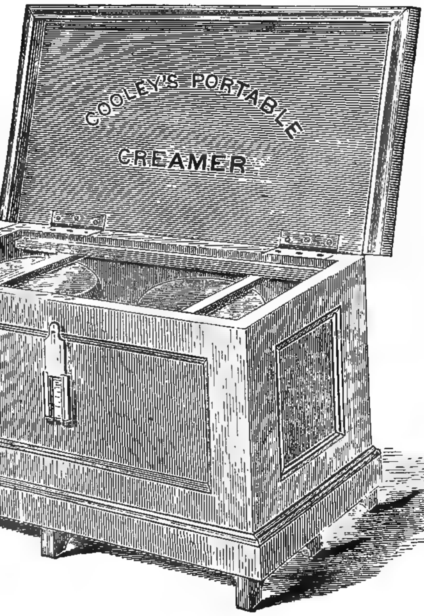


Fig. 5.

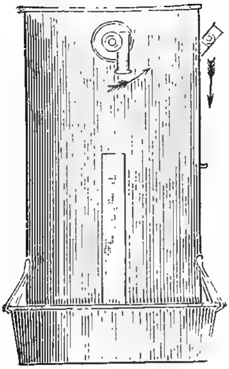
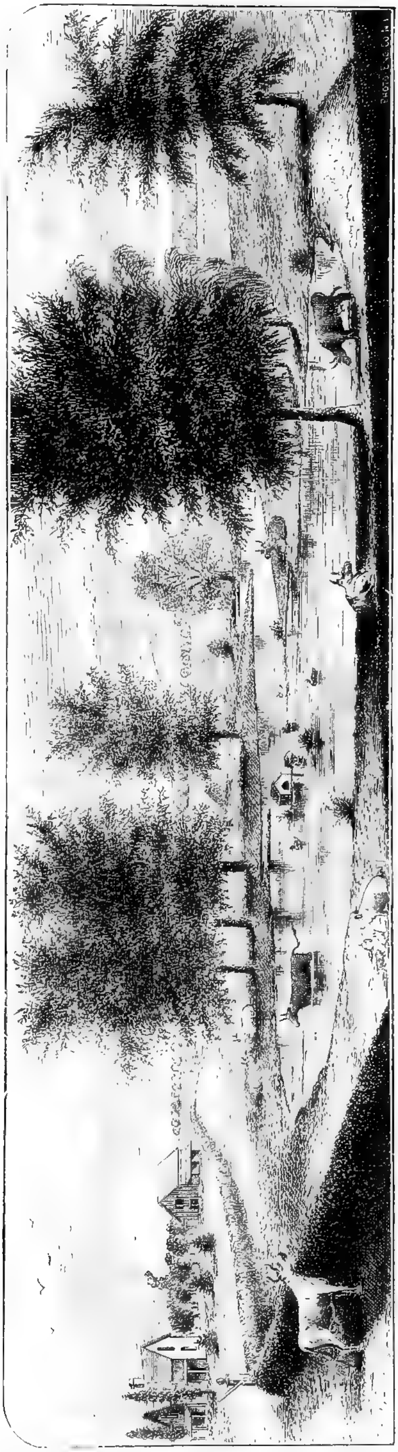


Fig. 6.

DAIRY FIXTURES



EMBANKMENT AND WATERING POND.

of butter and cheese factories here, has so cheapened and improved our products, that in self defense, especially in England, the adoption has become imperative. The plan has worked as well there, as in the United States, although in England, buildings especially designed for dairying, have long been common.

DAIRY COWS. (See articles Alderney, Ayrshire, Holstein, and Short-horn Cattle, also article Cattle.)

DAIRY FIXTURES. The principal apparatus for large dairies should be, a steam engine, or other means for heating and power, cheese presses, cheese vats, curd cutters, dippers, pans, or other utensils for setting milk and raising cream; also churns, butter table and worker, pails, and cans for milk, and packages for shipping the merchantable commodities. (See Butter, Cheese, etc.) These of course will be of the latest and most improved forms. In the article of cloths, to be used in bandaging cheese, it is now manufactured especially for the purpose; so also, are the boxes for packing, and the dairyman can now order just such fixture for one, or of any required size for the other. Annotto is now prepared with special relation to the wants of the dairyman, and so are all of the other materials needed. Hoops for holding the cheese while being pressed, are now made of various materials, the best probably, being those of galvanized iron, turned over stout wire at the top and bottom. Bent hoops of elm or hickory, and those made of wooden staves, banded with iron, are also in use, but are decidedly inferior, since they are much more difficult to keep clean. (See article Cheese.) On page 261 we have shown some of the most approved forms of dairy fixtures: Fig. 1, heater; Fig. 2, perpendicular gang curd knife; Fig. 3, horizontal curd knife; Fig. 4, cheese hoop; Fig. 5, a modern cream-raising apparatus; and Fig. 6, one of its cans.

DAM. The use of dams and embankments, to form reservoirs of water, is important in dry localities and countries, as a means of securing a supply in times of drought, when the supply is not easily reached near the surface. As a means of securing power for mechanical purposes the use is limited in agriculture; nevertheless, there are many situations where two purposes may be subserved in this way, that of forming a never failing pond of water for stock, during the dry season, and of supplying power for running various farm machinery, during the spring, late autumn and much of the time in winter. No specific directions can be given for the formation of dams or embankments. When the head is not more than four or five feet, a simple embankment of earth to be protected from the burrowing of musk-rats and other water animals, by means of planks, set upright, edge to edge, closely, and at least two feet below the bottom of the pond, with a waste way in the most convenient place, to allow the surplus water to pass off freely; this will be all that will be necessary when the head is of a height sufficient to endanger the bank by the overflow of water. We give an illustration showing how an embankment may be built in a depression, showing pond of water and trees ten years planted. The earth excavated to deepen the pond may form the embankment. This may be cheaply done by any of the modern scrapers which dump without stopping the team, and at the same time the operator may spread the earth, so but little levelling will be needed. Dams may sometimes be made to serve the purpose of furnishing a supply of water to the house and out-buildings, when the elevation of the locality containing water is sufficiently above the buildings to form a sufficient head when conducted in underground pipes. Thus the water of a higher level, by means of a suitable dam, may be made to operate a fountain and supply ornamental and other ponds and streams near the dwelling. So, again, water is sometimes conducted in underground pipes, where the level of the pond is not much below the level of the barn, and the water is pumped, by wind or other power, thence into a tank, placed at a sufficient height, for distribution. The pipes for conducting the water must be quite tight, and of sufficient strength to resist the strain, according to the height of the water head. Thus, the pipes may be conducted over inequalities in the land, care being taken that at no place they rise higher than the pond or pool from which the water is taken.

DAMSON. A small, useful, black plum, brought originally from Damascus, whence the name. Also called Damasene plum.

DANDELION. *Taraxacum dens-leonis.* This common weed is a native of Europe, but has become thoroughly naturalized in nearly every portion of the United States. Although not specially obnoxious, it is difficult to extirpate, since its seeds are borne long distances (on the wind) by means of the pappus or down. On lawns it is most obnoxious, but may be extirpated by thrusting a thin, chisel-shaped tool diagonally into the ground, so as to cut the root about two inches below the surface. The plant may then be easily pulled up. The leaves are used as greens, boiled, by those who like bitter herbs, and the plant has some reputation as a remedy in cases of diseases of the liver. The young leaves are sometimes tied up and blanched like endive, but it is a poor substitute for this plant. The plant blossoms early in spring and again during the latter part of summer. Fall Dandelion (*Leontodon autumnale*) is a plant with many-flowered heads; a low, stemless, perennial herb, with toothed or pinnatifid root leaves, the scapes bearing one or more yellow heads. The pappus is tawny and composed of a single row of equal bristles. It is not very common in the West, but is so east of the Alleghanies, and especially in New England. It flowers late in the spring, or early in summer, and continues until frost.

DANDRUFF. Scales of skin, epidermis which are brushed off readily.

DAPPLE. Marked with various colors.

DARNEL. *Bromus secalinus.* Smooth rye brome-grass. *Bromus mollis.* Soft brome-grass. Both these grasses pass in England under the common name of darnel. Professor Martyn supposes the annual bearded rye-grass (*Lolium temulentum*) to be the darnel of the Romans. Mr. Holdich observes that he never found this grass among small grain crops. Sinclair says: I have found the *Bromus mollis* and *Alopecurus agrostis*, with the *Bromus secalinus* to be the most prevalent weeds (of the annual grass kind) in corn fields; these, therefore, may be considered the darnel of the British farmer. What we in the United States know as darnel is *Lolium perenne*, ray or rye-grass. *L. temulentum* is bearded darnel.

DARTARS. In farriery, a sort of scab or ulceration taking place on the skin, to which lambs are subject.

DATE. The fruit of a palm (*Phœnix dactylifera*) remarkable for its nutritiousness, and as affording food to entire populations.

DATURA. The generic name of the thorn apple or Jamestown weed, a poisonous plant.

DAUCUS. The generic name of the carrot.

DEAL. Originally the small sections into which a piece of timber of any sort were cut up; but in England the term is now restricted in its signification to the wood of the fir, (Norway Spruce) and also what is known as cork pine in Canada, and cut up into thicknesses in the countries whence deals are imported. It is, in fact, now used in the sense, as we apply to boards, cut to a required thickness and width.

DEBRIS. In geology, any worn materials, such as fragments of rocks, ruins, or rubbish. Sometimes applying, but incorrectly, to rubbish or waste, as the remains of a fire.

DECAGON. Any solid having ten sides and angles.

DECANDRIA. The class of plants having ten stamens.

DECAPODS. Crabs with ten feet. Animals like the cuttle-fish, with ten tentacles, wherewith they walk.

DECAY. The destruction of organized bodies by natural causes. The products of decay depend on the presence or deficiency of air. In the first case, the process is called Ercuracausis; in the second, Fermentation, which see.

DECOCTION. Any mixture which has been boiled. Coffee is a decoction when prepared by boiling. Tea is an infusion when made without boiling.

DECOMPOSITION. In chemistry, the separation of the parts of any compound, whether mineral or organic. Electricity and heat are the principal forces used by chemists for this purpose, and they are capable of disturbing most combinations. Chemical affinity, or the attraction which one form of matter has for another, is also an agent of decomposition. Thus, oil of vitriol (sulphuric acid) has a powerful attraction for water; if it be dropped on the skin a blister is instantly produced, and the part blackens. This decomposition is owing to the greater affinity of the acid for water than the flesh of the hand. In the same way some minerals act on each other, producing change of composition, or decomposing them. Decomposition may be expected if one of the ingredients is of a volatile or gaseous nature, or if the agent added forms with one of the original components, a product which is insoluble in water. Thus sulphuric and oxalic acid decompose every solution of lime, because they form insoluble salts with lime. Carbonic acid, in its salts, is decomposed by every fixed acid, because it is gaseous. Lime, potash and soda decompose most salts of ammonia, because the latter is volatile. Decomposition of light is the separation of a ray of light by means of a prism of glass, into the seven colors, red, orange, yellow, green, blue, indigo, violet, which were called the primary colors, light being the result of their mixture. The true primitive colors, however, are red, yellow and blue, from the combination of which all other colors are obtained.

DECORTICATION. Removing the bark. Scraping the bark, and even partially removing it during the active growth, has been found to invigorate trees. Sometimes resorted to in bark-bound trees which bear little fruit. Care must be taken not to wound the sap wood, or expose the inner bark. Manure and high cultivation should always be resorted to in connection with the scraping of the bark of moss or bark-bound trees.

DECREPITATION. A chemical term signifying crackling, and used to describe the sound made by nitre, salt, sulphate of potash, and other salts, when thrown into the fire. Crepitate is the word used by physicians and veterinarians for the peculiar sound emitted from the lungs, and other viscera, in certain diseases and ailments. There is crepitation—crackling—of the bones in fractures.

DECUMBENT. In botany, inclined downward.

DECURRENT. In botany, a leaf, a part of the lamina of which is attached to the stalk of the plant.

DECUSSATE. To cross and intermingle, in anatomy.

DEFLAGRATION. A chemical term, meaning very rapid combustion, as when nitre is thrown on a surface highly heated.

DEFLECTION. A term in optics. When a thin, opaque body is placed in the course of a ray of light, the ray is bent out of its straight direction. The phenomenon is also called diffraction.

DEGLUTITION. The act of swallowing.

DEHISCENT. A botanical term signifying the bursting open, when dry, of seed vessels.

DELIQUESCENT. Saline substances which absorb so much moisture from the air as to become fluid, are called deliquescent.

DELPHINIC ACID. An oily acid, obtained from whale oil, and having a rancid smell.

DENTATE. Toothed.

DENTIROSTERS. Birds having a tooth-like notch on each side of the upper mandible. Dentirostrate, having a toothed bill, as the shrikes, etc.

DEOBSTRUENT. A medicine given to remove any obstacle in the bowels, etc.

DEODORIZE. The substances used to destroy noxious smells, are various, and each year, through the investigation of chemists, gives us new ones. The object sought in deodorizing is to fix the volatile particles which would otherwise escape, often in the form of noxious gases, and to render the substance without unpleasant smell. In the spreading of rank manure in a liquid state, heavy dilution with water, is all that is necessary, since the soil has a strong affinity for nitrogen. Sawdust, sand or dry earth, especially dry clay, will have the same effect, when incorporated in the heap, as in the case of the refuse of the house, and other offensive substances to be converted into compost. Another means is used, especially near cities, particularly in the case of night soil. The soil is thrown into trenches, a part of the earth thrown out being mixed with the mass. The trench being nearly full, the whole is covered with a bank or thick layer of earth sufficient to take up the gases, when upon becoming homogeneous throughout, it is carted on the land as manure. The more usual course, however, is to treat the privy vaults with a solution of green copperas, (sulphate of iron). This from its cheapness, and its quick and strong power of fixing ammonia, should be kept in every farmhouse and village homestead, for deodorizing privies, sinks, drains, cesspools and other offensive places. Thus the ammonia, one of the most volatile of substances, and the sulphuretted compounds, among the most horrible in their effluvia, but of the first value as manure, may be retained until it can be carried to the land. Lime is also a deodorizer, but it should never be used about manure containing nitrogen in any form, since it sets the ammonia free to be dissipated in the air. Gypsum will seize and hold nitrogen, but its action is too slow, except that it may be used in the horse and cattle stables, under foot, both as a deodorizer and as an absorbent. There are many deodorizers applied to particular uses, many of them most expensive. Those we have mentioned, will meet the general requirements of the farm. (See Disinfection.)

DESPUMATION. The act of skimming the scum from any heated fluid.

DESTRUCTIVE DISTILLATION. The heating of bones, wood, coal, etc., in iron vessels, at a high temperature to produce peculiar substances. From green wood, vinegar (pyroligneous acid) and wood tar; from bones, superphosphate (impure ammonia); from coal, gas, coal tar, etc.

DETERGENTS. Medicines which remove impurities and cleanse sores.

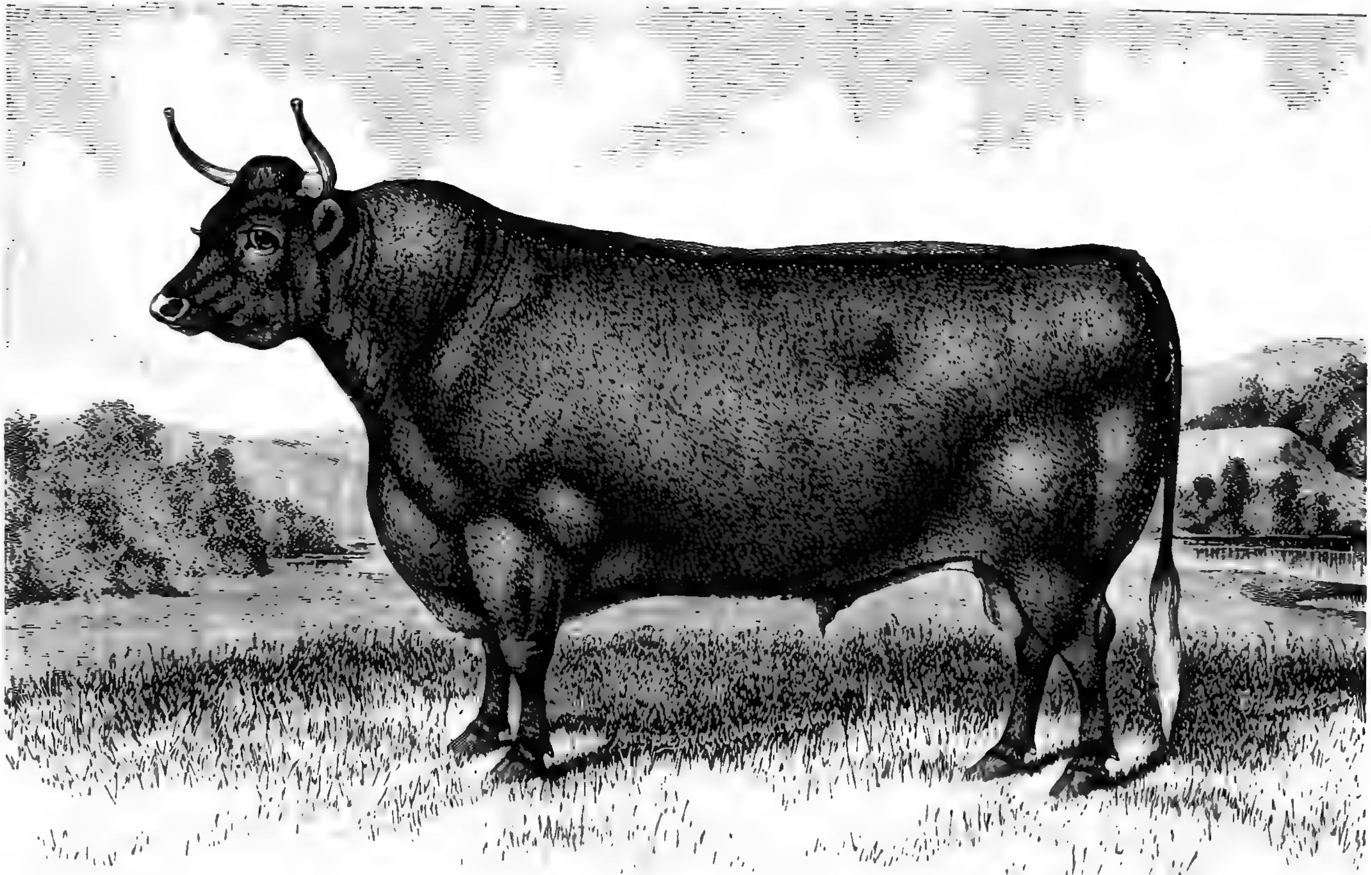
DETERIORATION. This term as applied in agriculture means degeneration of animals and plants through want of proper care and attention in breeding in the one case, and in plants, degeneration (running out) from various causes, principle among which are the crowding of vegetation on unmanured land, want of proper cultivation, the disuse of rotation in crops, and the saving of inferior seed. To prevent deterioration in animals, they must be well sheltered and fed; none but mature animals should be bred from, and care should be exercised in selecting and putting together males and females, of the form best adapted to improvement; and especially should we have in view physical conformation, and qualities which will blend happily each with the other. (See articles Breeding and Selection of Seed.)

DETONATION. In chemistry slight explosions. Any slight explosion, as of percussion caps.

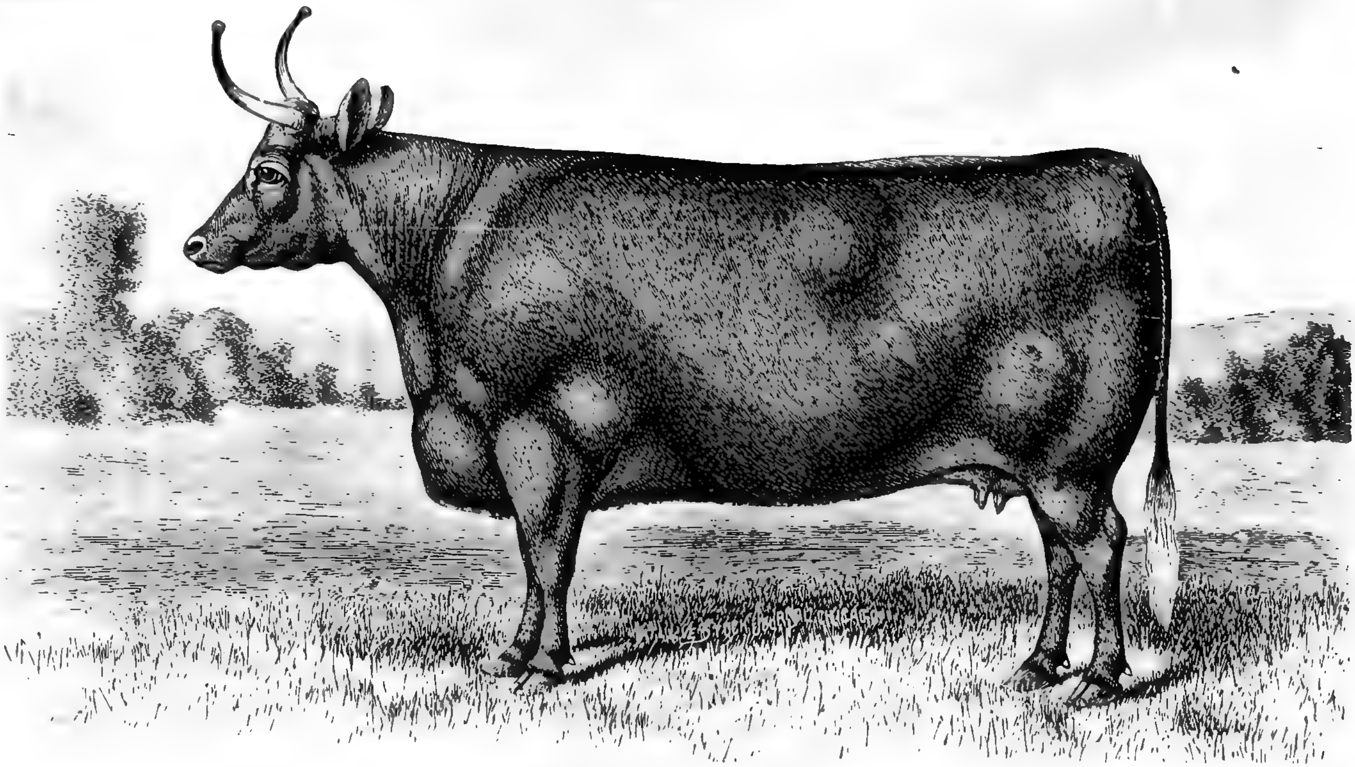
DETRITUS. The broken and pounded remains of rocks.

DEVON CATTLE. The Devons are among the very oldest of the distinctive breeds of cattle in Great Britain, as they are still the best adapted to hilly countries and scant pasturage wherever beef, labor at the yoke, and milk are to be taken into consideration. As grazing cattle they are unequaled in the quality of their flesh, among cattle in America, and only excelled in Great Britain by the Highland (Scottish) breeds. The cows, while not great milkers, give good messes of rich milk and, in exceptional cases, as with all breeds, individuals give large yields of milk. The oxen are unequaled at the yoke, especially in the ability to work continuously at a quick pace. They are long lived, hardy, good feeders, tractable, high spirited and sagacious. The great objection to the breed is their small size. While this is true of the bulls and cows, the oxen attain good weights, from 1,100 to 1,300 pounds, and upwards, live weight, when ripe, being not unusual. It has been objected that the Devon bull, when fully mature, is apt to be be dangerous.

This, however, is only true in a sense; they are high spirited, and courageous to a degree, and if abused will resent the abuse. Firm, gentle handling will correct all this, as we can testify from having bred them many years, in early life. The same rule will apply to the cows and oxen. If treated kindly and, at the same time, with a firm will, there are no cattle more amenable to the hand of their master. In the article Cattle we have illustrated the breed as they were known one hundred years ago. The illustrations, on adjoining pages, of a bull and cow of to-day will serve to show the perfection to which Devons are now brought through careful breeding and feeding. Youatt, in reference to the history of this breed, written in the early part of the century, says. The north of Devon has been long celebrated for a breed of cattle beautiful in the highest degree, and in activity at work and aptitude to fatten unrivaled. The native country of the Devons, and where they are found in a state of the greatest purity, extends from the river Taw westward, skirting along the Bristol Channel; the breed becoming more mixed, and at length comparatively lost before we arrive at the Parrett. Inland it extends by Barnstaple, South Molton, and Chumleigh, as far as Tiverton, and thence to Wellington, where again the breed becomes unfrequent, or it is mixed before we reach Taunton. More eastward the Somersets and the Welsh mingle with it, or supersede it. To the south there prevails a larger variety, a cross probably of the Devon with the Somerset; and on the west the Cornish cattle are found, or contaminate the breed. The Devonshire man confines them within a narrow district, and will scarcely allow them to be found with purity beyond his native county. From Portlock to Biddeford, and a little to the north and the south, is, in his mind, the peculiar and only residence of the true Devon. From the earliest records the breed has here remained the same; or if not quite as perfect as at the present moment, yet altered in no essential point until within the last thirty years. This is not a little surprising when it is remembered that a considerable part of this district is not a breeding country, and that even a proportion, and that not a small one, of Devonshire cattle, are bred out of the county. On the borders of Somerset and Dorset, and partly in both, extending southward from Crewkern, the country assumes the form of an extensive valley, and principally supplies the Exeter market with calves. Those that are dropped in February and March, are kept until May, and then sold to the drovers, who convey them to Exeter. They are there purchased by the Devonshire farmers, who keep them for two or three years, when they are sold to the Somersetshire graziers, who fatten them for the London market; so that a portion of the Devons, and of the very finest of the breed, come from Somerset and Dorset. The Devonshire farmers were, until the last century, not conscious that they possessed anything superior to other breeds; but, like agriculturists everywhere else, they bought and bred without care or selection. It is only within the last one hundred and fifty or sixty years that any systematic efforts have been made to improve the breeds of cattle of the kingdom; and we must acknowledge, that the Devonshire men, with all their advantages, and with such good ground to work upon, were not the first to stir, and for a time, were not the most zealous when they were roused to exertion. They are indebted to the nature of their soil and climate for the beautiful specimens which they possess of the native breed of our island, and they have retained this breed almost in spite of themselves. A spirit of emulation was at length kindled, and even the Devons have been materially improved, and brought to such a degree of perfection that, take them all in all, they would suffer from intermixture with any other breed. Whatever be the breed, there are certain conformations which are indispensable to the thriving and valuable ox or cow. When we have a clear idea of these, we shall be able more easily to form an accurate judgment of the different breeds. If there is one part of the frame, the form of which, more than of any other, renders the animal valuable, it is the chest. There must be room enough for the heart to beat, and the lungs to play, or sufficient blood for the purposes of nutriment and of strength will not be circulated; nor will it thoroughly undergo that vital change which is essential to the proper discharge of every function. We look, therefore, first of all to the wide and deep girth about the heart and lungs. We must have both: the proportion in which the one or the other may preponderate, will depend on the service we require from the animal; we can excuse a slight degree of flatness on the sides, for he will be lighter in the forehead, and more active; but the grazier must have width as well as depth. Not only about the heart and lungs, but over the whole of the ribs, must we have both length and roundness; the hooped, as well as the deep barrel is essential; there must be room for the capacious paunch, room for the materials from which the blood is to be provided. There should be little space between the ribs and the hips. This seems to be indispensable in the ox, as it regards a good healthy constitution, and a propensity to fatten; but a largeness and drooping of the belly is excusable in the cow, or rather, though it diminishes the beauty of the animal, it leaves room for the udder; and if it is also accompanied by swelling milk veins, it indicates her value in the dairy. Speaking of the steers, Youatt says, they are usually taken into work at about two years old, and are worked until they are four, or five, or six; they are then grazed, or kept on hay, and in ten or twelve months, and without any further trouble, are fit for the market. If the grass land is good, no corn, or cake, or turnips, are required for the first winter; but, of course, for a second winter these must be added. The grazier likes this breed best at five years old, and they will usually, when taken from the plow, fetch as much money as at six. After having been worked lightly on the hills for two years, they are bought at four years old by the tillage-farmer of the vales, and taken into hard work from four to six; and, what deserves consideration, an ox must be thus worked in order for him to attain his fullest size. If he is kept idle until he is five or six, he will invariably be stinted in his growth. At six he reaches his full stature, unless he is naturally disposed to be of more than ordinary size, and then he continues to grow for another half year. The Devon oxen are rarely shod, and very rarely lame. Their next quality is their disposition to fatten, and very few rival them here. Some very satisfactory experiments have been made on this point. They do not,



DEVON BULL OF TO-DAY.



DEVON COW OF TO-DAY.

indeed, attain the great weight of some breeds; but, in a given time, they acquire more flesh, and with less consumption of food, and their flesh is beautiful in its kind. It is mottled, or marbled, so pleasing to the eye and to the taste. For the dairy, the Devons must be acknowledged to be inferior to several other breeds. The milk is good, and yields more than an average proportion of cream and butter; but generally it is deficient in quantity. There are those, however, and no mean judges, who deny this, and select the Devons even for the dairy. Such is not, however, the common opinion. They are kept principally for their other good qualities, in order to preserve the breed; and because, as nurses, they are, indeed, excellent, and the calves thrive from their small quantity of milk more rapidly than could possibly be expected. This aboriginal breed of British cattle is a very valuable one, and seems to have arrived at the highest point of perfection. It is heavier than it was thirty years ago, yet fully as active. Its aptitude to fatten is increased, and its property as a milker might be improved, without detriment to its grazing qualities. Those points in which the Devons were deficient thirty years ago, are now fully supplied, and all that is now wanting, is a judicious selection of the most perfect of the present breed, in order to preserve it in its state of greatest purity. Many of the breeders are as careless as ever they were; but the spirit of emulation is excited in others. Mr. Youatt adds: The Devon cattle are more than usually free from disease. The greater part of the maladies of cattle, and all those of the respiratory system, are owing to injudicious exposure to cold and wet; the height and thickness of the Devonshire fences, as affording a comfortable shelter to the cattle, may have much to do with this exemption. Since Mr. Youatt's time great improvement has been made, while their eminent fineness and style has been preserved. They now mature earlier, and their size has been increased. The characteristic points of the Devon, as it existed fifty years ago, may be summed up as follows: The North Devon bull has a bold countenance, indented forehead, clear, full and prominent eyes, surrounded by an orange-colored ring; his head is square, with a light, cream-colored muzzle, or nose; his horns are moderately strong, a little turned up at their tips, and of a wavy color; his back is straight from the hip-bone to the insertion of the tail; his hind quarter is full and round quite down to the hough, with the thigh full of muscles, and a deep, rich flank; his shoulder is also deep and strong from the withers to the chest, and thick through the breast behind the elbow; his fore-arm and knee are thick and strong, with the bone small and short under the knee; his flank is well down the body, which is rather straight underneath. The cow has a neat, sharp head, with graceful, upturned horns, a very full, clear eye, encircled with an orange-colored ring, and she is of the same color within the ears; the muzzle, or nose, is narrow, and of pale cream color; her frame is long and straight, symmetrical in shape, with good, prominent hips and full springing ribs; her hind-quarter is long and full; her shoulder round, slanting and full, and she is deep from the top of the plate-bone to the breast-point; her fore-arm thick down to the knee-bone, and thin and short below the knee, her abdomen is straight along the under side; her flank is low down near the hough; she is usually small when compared with the bull. The North Devon working ox has a large, long, straight and symmetrical frame, with a clean, sharp-looking head, clear, prominent eye, encircled by an orange-colored ring, a cream-colored nose, and long, waxy, upturned horns, which are fine at the points; his shoulder is slanting and well placed; his neck is lean and thin at the breast-point; his ribs are rounded, and spring out; his hip is high and long from the hip-bone to the insertion of the tail, and nearly as high as the line of the back; hind-quarter round and full, quite to the hough, with great substance and bone; fore-arm, thick and large above, but small below the knee, with a good, expansive solid hoof that seldom fails. While these characteristics remain, measurably, to-day, they have been modified and refined by breeding, so that while retaining their high muscular development, rounded form and intelligent sagacity, they are at the same time more fully rounded out, and finer in every way; and in the show rings, both for fat and breeding animals, in England and America, they do not compare unfavorably with other improved breeds —except in localities where flush pastures and abundant winter feed enables the larger breeds to supersede them. In high northern latitudes, and in hilly countries, they will always be favorite cattle. In relation to the uniform red color of the Devons—breeders of the improved Devons adhere scrupulously to the deep red color, and reject individuals who have a tendency to produce white, and in this way the color of the Devons has been established and perpetuated. It is now found that the deep red color of the pure-bred Devon is implanted so strongly that there is no race in which a mixture of foreign blood is so easily traced; nor is there a race that has remained so free from foreign intermixture. Their color is generally stamped on the progeny, in a cross with any other breed—so much so that when the Devon bull is crossed on the native and grade cows, of whatever color, the progeny are almost invariably like the sire in color. The systematic improvement of the Devons, commenced in England, over 150 years ago. They were transferred to the New England States and into Maryland. They are said to have been imported into the Plymouth Colony in 1623, but the first importation of improved Devons into the United States was in 1817, when Mr. Coke, afterwards Earl of Leicester, presented to Mr. Robert Patterson, of Baltimore, Md., six heifers and one bull, Taurus. The dam of Taurus, in 1820, made thirteen pounds of butter per week. Three of these heifers Mr. Patterson gave to his father-in-law, Mr. Richard Caton; the other three he gave to his father, Mr. William Patterson; they were all bred to Taurus. In 1835, Mr. George Patterson came in possession of the herd of his father, Mr. William Patterson, and, in 1836, imported the bull Anchises (140), for a cross, from one of the best dairies in Devonshire. He afterwards imported Eclipse (191); in 1846, Herod (214); and in 1852, Norfolk (266). As showing the estimation in which Devons were held in England and America, from the time of their introduction here, up to 1860, we find in one of the volumes of the Agriculture of Massachusetts, the following: Mr. Bloomfield, the manager of the late Earl of Leicester's estate, at

Holkham Hall, Norfolk, England, has, by careful attention, greatly improved the size and quality of the Devons, and increased their milking properties, so that he obtained a prize for having produced an average annual yield of 200 pounds of butter per cow, in a dairy of twenty cows, or equal to four pounds per week, the year round; and he offered to milk forty pure Devons from his own herd, against an equal number of cows in any one herd, of any breed found in England, without finding a competitor. At the Smithfield show of fat cattle, held at the London market-place, in 1858, the gold medal for the best ox or steer of any breed in the show-yard, was awarded to a Devon, bred and owned by the Earl of Leicester. They are highly esteemed in the Smithfield market, not only for the excellence of the meat, but because its size is more agreeable, on most tables, than the huge joints of some other breeds. In weight, they are much exceled, but the opinion of the Devon breeder is, that more meat can be made from them, with a given amount of food, than from any other breed. The quality of the Devon beef is unsurpassed, even rivaling the little black West Highland ox, in the estimation of the London west-end butcher, whose fastidious customers oblige him to kill none but beef of the finest quality and flavor In the New York market, the red oxen of Connecticut most generally bring the highest price, they being Devon grades. The Devons have the preference of all other breeds for the yoke, being strong, active, and of great endurance; and are remarkable for docility and good temper. It is evident they have not lost caste, as our cattle rings (breeding and fat cattle) will amply show. In 1852 the editor of this article commenced breeding Devons in Illinois. The largest herd in the West at that time was that of Col. Capron, of Illinois. Since that time they have been disseminated pretty generally, and now there are no finer nor better bred Devons in the world than may be found in Canada and the United States. Maryland, Connecticut and Massachusetts take the lead in the Atlantic States, and Michigan, Illinois, Wisconsin and Iowa, in the West. In the hill region of the South this breed is highly estimated, and in Canada there are to be found many fine cattle of this breed.

DEW. The phenomena connected with the formation of dew, and its influence upon vegetation and the soil has always been an interesting one in meteorology and, practically, the subject is an important one in agriculture, in all its branches. The subject has been elaborately studied by many eminent scientists and we give, from various sources, the important facts determined by patient investigation. The phenomenon of dew depends upon the cooling of the air by radiation by which it immediately parts with a portion of the moisture mechanically held. The point of saturation of the air depends upon its temperature. Thus, given the per cent. of water which a stratum of air is capable of holding, at a given temperature, if the temperature be raised by 27°, it will hold double the previous quantity; if lowered by 27° it parts with half the water held if, previously, it was saturated. Hence we have one of the principal reasons for the phenomena of dew, fog, mist and rain. The condensation of atmospheric moisture upon bodies, cooled by nightly radiation, causing the deposit of dew, is a phenomenon, says a report on agricultural meteorology for the United States Government, as worthy of study from a physical point of view as on account of its utility in vegetation. At all times dew has impressed the minds of the most casual observers, and all have regarded it as destined to furnish plants, by absorption, the means of repairing the losses caused during the day by transpiration. The celebrated Hales, and all succeeding physiologists and agriculturists, have thought that the dew, which wets the leaves, was absorbed by them, and that this water was added to the mass of nourishing liquids in the plant. By delicate experiments, Duchartre has, on the contrary, proved that dew does not penetrate into the tissues of leaves. There do not appear to have existed, before Duchartre's researches, any continued experiments which could demonstrate that the leaves of living plants absorbed the dew formed upon their surface, save two incidental passages of Hales in his observations on the transpiration of plants. But as these first experiments were defective, his assertions are valueless. Bonnet, having laid upon water detached leaves which retained their freshness for a time, thought that they had absorbed the water in contact with them. Many physiologists have refused to admit this explanation, and Moldenhawer and De Candolle, among others, have advanced the opinion that the position of the stomatum upon the water prevents the evaporation of the juices contained in the leaf and preserves its freshness. Meyen and Treviranus affirm in the most formal terms that the suppression of transpiration was the sole cause of the facts observed by Bonnet. Duchartre, on the contrary, has established with the aid of the balance that the explanation given by Bonnet was exact, and that detached leaves placed upon water absorb by either of their faces, more rarely by both, a very appreciable quantity of water simply by local imbibition. However, having plunged entirely into the water the foliate capitulum of a *Veronica Lindleyana*, living and planted in a pot enveloping an exactly tight apparatus, he saw the plant remain there for forty-eight hours in succession without augmenting in weight, while during the day it transpired sensibly. Thus it is now satisfactorily proved that while detached leaves of plants can absorb by imbibition a certain quantity of water, the same leaves of living plants do not absorb the least particle of the liquid which bathes them. Are we, therefore, to be surprised at seeing leaves in full bloom remain covered with dew during a whole night without absorbing a quantity appreciable by delicate balances? The following physiological considerations will dispel what, at the first glance, seems extraordinary in this fact. In order to understand why dew is not absorbed by the leaves, and why, in the same way, it does not exactly wet them, we must consider the mode in which it is formed upon plants, the nature of the epidermis of leaves, the coating which it presents, and, in fine, the nature of its organs. This has been stated as follows: Air bathes in some way the bodies surrounded by it and it adheres rather strongly to their surface. When we observe the epidermis of leaves under the microscope we recognize this adhesion of the air. Now, dew being condensed on the surface of the leaves can not displace this stratum of adherent air. The dew as it is deposited forms a great number of small globular drops, distinct and separate, which do not exactly wet the leaves. These little drops augment in volume with the increase of vapor condensation, and coming soon in contact with each other, they at length form a continuous layer. Under this liquid coating we perceive a lamina of air more or less complete, which is interposed between the deposit of dew and the epidermis in such a way that contact is not direct. The epidermis is usually found in a state which renders it more or less difficult to wet. This state is a consequence of the evaporation taking place every day at its surface, or in other words its transpiration. The water alone, says Schleiden, is evaporated at its surface, and is deposited as a thicker or thinner layer of substances which were in solution in the cellular juice, covering the external surface of the epidermic cells. At the same time these substances under the action of atmospheric oxygen undergo a chemical modification, and are changed in a manner which renders it still more difficult for the passage of liquid. It is thus that wax and resin appear finally on this surface. Transpiration, adds Duchartre, being in direct proportion to the intensity of solar light and heat, it follows that the production of the layer of wax, which coats the epidermic cuticle, takes place in the most energetic manner possible on a fine day, and it is then, too, that dew is ordinarily formed in greatest abundance. This circumstance can not certainly favor the absorption of water as it is deposited. If greasy matter, observes Garreau, is already an obstacle to the absorption of water among plants whose leaves are buried in part in the ground, it becomes henceforth almost certain that those whose leaves float constantly in the air, and exhale, under the influence of summer heat, a large proportion of fatty substance, ought not to be more endosmotic than the preceding. The existence of this greasy coating on the surface of the epidermis enables us, moreover, to comprehend why the leaves do not absorb the dew deposited upon both their faces. The air found in a more or less considerable quantity between the cells of their parenchyma is a new obstacle to the penetration of water from the exterior to the interior of the organs of leaves, according to their anatomical structure. On the whole, and for the three reasons indicated above, Dutrochet thinks that the non-absorption of dew by the organs which it wets, is a fact of easy explanation. It is not without importance in this place to destroy a popular belief, which has even passed into some scientific works, on the subject of faded plants recovering their turgescence by the direct action of the dew. Seeing that plants wilted by the heat of day, says Duchartre, recover the turgescence of their tissues and their freshness in the night during which they are covered with dew, it is thought that this circumstance points to the absorption of the water which covered their surface. In this connection scientists, as well as others, have united. Senebier, in common with all physiologists, speaking of dew-drops, said: Plants wilted by the heat of a parching sun, recover their freshness during the night when they are covered by these drops. Now, in this conclusion, says Dutrochet, there has been attributed altogether to local and direct absorption what was due to the simple moistening of the ground by the condensation of the aqueous vapor of the atmosphere Duchartre has been able to elucidate the subject by two modes of observation, which seem to put this confusion into full relief, and according to which it follows that leaves, even in their greatest thirst for water, do not directly introduce into their tissues the dew deposited upon their surface during the night. It is by the moist earth that the absorption of dew is effected. To sum up, after the very numerous and delicate observations made by Duchartre during five years, his conclusions relative to the action of dew on vegetation are the following: Plants do not absorb the dew condensed on their surface, and hence ideas of this kind which have prevailed up to our own day are deprived of foundation. Dew does not, therefore, exert any immediate and direct influence upon vegetation. Its action upon vegetables is no less important in a great number of cases, but it takes place and is explained differently from what we had always thought. The first effect produced by dew upon vegetables is to suppress their transpiration almost entirely, which is already much enfeebled by the obscurity and descent of the temperature at night, but which will continue in some measure without the deposit of dew. Dew, therefore, causes the plants to pass from a period of activity during the day to a period of repose during the night. Thanks to this suppression of aqueous waste, however little humidity the roots find in the ground, they obtain enough to repair the losses which the diurnal transpiration of the leaves caused. Occasionally, even in the absence of all absorption by the roots, the apparent state of the plant may be notably modified by reason of a single displacement of the nourishing liquids, which, from the stem and root, proceed into the wilted leaves, and restore to them the fullness of their tissues. But it is chiefly through the medium of the ground that dew acts upon vegetation. Its action is exerted in two modes: The dew deposited upon the leaves remains there only in an inconsiderable quantity, for above a certain measure variable with different plants, it commences to fall upon the ground by its own weight, in a sort of local shower. The earth, as a porous and hygroscopic body, then receives the moisture, which is at once sucked up by the plant's roots, in the same way as the moisture in the air. The dew also trickles along the stems, branches, and trunks to the ground. Upon mountains the soil formed of permeable earth is continually humid. Otto Sendtner, who has made observations in Bavaria, asserts that upon these high mountains dew is more abundant than rain. In the forests of warm countries dew-drops continually fall from the trees in the form of a plentiful shower. For the rest the total quantity of dew deposited upon leaves has been much exaggerated. Duchartre has made the following experiments, which prove how trifling this deposit is: A Hortensia bore fourteen large leaves, whose extent was on each face at least a square decimeter, and twenty-eight square decimeters for the whole surface of the limb. The dew which covered this Hortensia was in such abundance that it was gathered into pools wherever it found a small cavity. Nevertheless, all this liquid stratum weighed only 7.2 grams in two nights of observations, and seven grams on the third; it had, therefore, only seven cubic centimeters in volume. We see thence that each leaf had for its part one-half cubic centimeter of water spread out upon two square decimeters of surface. This small quantity of liquid, adds Duchartre, which is sufficient to cover entirely both sides of a leaf, so as even to form the deepest layer it can hold, explains very well the shower of dew which the ground receives every time that the condensation of atmospheric humidity is effected energetically. Mists must be dense enough and humid enough to deposit a film of water upon plants. The action of mists upon vegetation has been studied by Duchartre after the same method adopted in the case of dew, and in the condensation of vapor upon vegetation he reached the same conclusions. Mist condensing on the surface of plants, even like a heavy dew, has never increased their weight by any appreciable quantity. The leaves and different parts of the plant act under mist just as under the deposit of dew. Where the mist has not wet the plants, the transpiration of the leaves has been only weakened, not suppressed, particularly during the day. But the suppression of transpiration was complete, or at least nearly so, when the deposit of mist had clothed these organs with an entire coat of moisture. These facts establish conclusively, as Duchartre believes, that mists exert upon vegetation only a secondary influence, since they supply plants with nothing, and only diminish, or at most momentarily suppress their waste. Their function becomes much more important in certain localities, particularly in the zone of mean altitude upon inter-tropical mountains, where the epiphyte plants abound, and where prevails, chiefly through this cause, an excessive humidity. In every case it is from the trickling of water to the ground that the action of heavy mists is as advantageous to vegetation as that of dew. For the action of mists upon vegetation, as for that of dew, we are forced to confine ourselves to the experiments and conclusions of Duchartre; because all that has been said on this subject has either no scientific value or presents no fact of importance. On the other side, after the hygroscopic action just pointed out, mists appear to have no other influence than that of certain electric mists still doubtful and unknown, or those called dry mists because of the atmospheric dryness which universally accompanies them. The late Prof. Henry, some years ago, in a report to the government on Meteorology in relation to dew and hoar frost, gave these instructions for meteorological observations, published by the Smithsonian Institution: When a mass of moist air is brought in contact with a cold body, its vapor is condensed into water, and deposited in minute globules on the cooled surface, which constitute dew. If the temperature of the surface is below the freezing point, the globules of water will be frozen into minute crystals of ice, which constitute hoar frost. For a long time the nature of these phenomena was entirely misconceived; the effect was put for the cause, the dew being regarded as producing the chill which accompanies its formation, instead of the reverse. Dr. Wells, of London, born in South Carolina, was the first who gave the subject a scientific investigation, and, by a series of ingenious, accurate and conclusive experiments, furnished a definite explanation of all the phenomena. They are simply due to the cold produced in different bodies by radiation. The earth is constantly radiating heat into celestial space, and is constantly receiving it from the sun during the continuance of that body above the horizon. As long as the heat from the sun exceeds that radiated into space, the temperature of the surface of the earth, and that of the air, in contact with it continues to increase; but when the two are equal, the temperature remains stationary for a short time, and then begins to decline as the heat of the sun, on account of the obliquity of the rays, becomes less than the radiation into space. The maximum of heat generally takes place between two and three o'clock in the afternoon, and the cooling from this point goes on until near sunrise of the next morning. As soon as the sun descends below the horizon, the cooling of the surface of the earth takes place more rapidly if the sky be clear; the air in contact with grass and other substances which are cooled by this radiation, will deposit its moisture in a manner analogous to that of the deposition of water on a surface of a metallic vessel containing a cold liquid. Although the atmosphere may contain the same amount of vapor, yet the quantity of dew deposited during different nights, in different places, and on different substances, is very different. It is evident that, all things being equal, it must depend upon the quantity of moisture, since if the air were dry no deposition could take place. It must also depend upon the clearness of the sky; for if the heavens be covered with a cloud, the radiant heat from the earth will not pass off into space, but will be partly absorbed by the cloud and radiated back to the earth. This has been proved by direct experiment. The experiment is detailed, but will not be necessary here, but in relation to cloudiness and haziness of the atmosphere, obstructing the deposition of dew, Prof. Henry says, it is probable that the lower surface of the cloud is really a little warmer than the air in which it is floating from the radiation of heat by the earth, while the upper surface is probably colder on account of the uncompensated radiation into space. But be this as it may, the counter radiation of the clouds prevents the cooling down of the bodies at the surface of the earth sufficient for the deposition of dew, or at least to allow of the formation of a copious quantity. A haziness of the atmosphere, and it is probable a large amount of invisible vapor, will retard the radiation, and hence a still, cloudless night, without a deposition of dew, is considered a sign of rain. The amount of deposition of dew will also depend upon the stillness of the atmosphere; for if a brisk wind be blowing at the time, the different strata of air will be mingled together, and that which rests upon the surface of the ground will be so quickly displaced as not to have time to cool down sufficiently to produce the deposition. Again, the deposition will be more copious on bodies the surfaces of which are most cooled by the radiation. It is well known that different substances have different radiating powers. The following table from Becquerel exhibits the proportional tendency of different substances to promote the deposition of dew. The figures do not represent the relative emissive power, but the combined effects of emission and conduction:

1. Lamp black	100
2. Grasses	103
3. Silicious sand	103
4. Leaves of the elm and the poplar	101
5. Poplar sawdust	99
6. Varnish	97
7. Glass	93
8. Vegetable earth	92

Polished metals are, of all substances, the worst radiators; they reflect the rays of heat as they do those of light, and it would appear that by internal reflection the escape of heat is prevented from the capacity of the metal. In order that the surface of a body should cool down to the lowest degree, it is necessary that it should be a good radiator and a bad conductor, particularly if it be in a large mass and uninsulated. Thus a surface of a mass of metal coated with lamp black, though it radiates heat freely, will not be as much cooled under a clear sky as a surface of glass, since the heat lost at the surface is almost immediately supplied by conduction from within. If, however, a very small quantity of metal, such as gold leaf, be suspended by fine threads, the dew will be deposited, because the heat which is radiated is not supplied by conduction from any other source, and hence the temperature will sink to a low degree. M. Melloni, repeating the experiment of Wells, established the correctness of his conclusions, and added some particulars of interest. He found that the apparent temperature of the grass, which in some cases was 8° or 10° lower than that of the air at the height of three or four feet, was not entirely due to the actual cooling of the air to that degree, but to the radiation and cooling of the thermometer itself, the glass bulb of which is a powerful radiator. To obviate this source of error in estimating the temperature he placed the bulbs of his thermometer in a small conical envelope of polished metal of about the size of an ordinary sewing thimble. This prevented a radiation, and, by contact with the air, indicated its true temperature. He found, with thermometers thus guarded, that the solid body was in no case cooled down more than 2° below the temperature of the surrounding air, and that the amount of radiation was nearly the same at all temperatures. The explanation, therefore, of the great cold of the air between the blades of grass is as follows: By the radiation of the heat, the grass is at first cooled two degrees lower than the air at the surface of the earth, and next the thin stratum of air which immediately surrounds the grass is cooled by contact to the same degree. It then sinks down and another portion of air comes in contact with the blade of grass and is, in its turn, cooled to the same extent, and so on until all the air between the blades is 2° lower than that of the air farther up. The radiation, however, continues, and a stratum of air from the mass already cooled is cooled 2° more, which sinks down as before, and so on until the air between the blades is cooled to 4° below its normal condition; and in this way the process may be continued until the temperature descends to 8° or 10° below that of the stratum of air a few feet above. In this way we can readily explain the small amount of dew deposited on the tops of trees, since the air as soon as it is cooled sinks down toward the ground, and its place is continuously supplied by new portions of the atmosphere. To the same cause, we may attribute copious deposition of dew on wool and other fibrous materials which, though they do not radiate heat more freely into space, they entangle and retain the air between their fibres, and thus allow the cooling process we have described to go on. It would appear that spider-webs radiate heat freely into space, since they are generally covered with a large amount of dew; their insulated position prevents them from renewing their heat, but, according to the above principle, a much larger amount of deposition ought to be produced by the same material, were it loosely gathered up into a fibrous mass. The fact of the screening influence of the clouds teaches us that a thin cloth or even a slight gauze supported horizontally over tender plants is sufficient to neutralize the radiation, and to prevent injury from frost during the clear nights of spring or autumn. The same effect is produced by artificial clouds of smoke. Radiation from the surface of the earth is most intense on clear nights, when the moon is visible, so many effects which are due to this cause have been referred to lunar influence; for example, a piece of fresh meat exposed to the moonlight, is said to become tainted in a few hours; this may arise from the deposition of moisture on the surface of the meat due to the cooling from radiation. The moon itself, however, acts as a cloud, and radiates back to the earth a portion of the heat which it received from the earth, as well as a portion of that which it received from the sun; and hence Sir John Herschel has referred to this cause, with apparent probablity, the origin of an assertion of the sailors, that the moon eats up the clouds. He supposes that they may be dissipated by the radiant heat from that body, which, being of low intensity and but feebly penetrating the lower stratum of the atmosphere, may serve to dissipate the clouds. Though a wrong explanation is generally given by the popular observer of natural phenomena, and though effects and causes are frequently made to change places in his explanations, yet it is true, as Biot has properly said, that the scientist who devotes himself assiduously to investigate the subject of popular errors, will find in them a sufficient amount of truth to fully repay him for his labor. The difference between a fog and a cloud relates principally to the conditions under which they are severally formed. A fog has been aptly called a cloud resting on the earth, and a cloud, a fog suspended in the atmosphere. The circumstances under which a fog is usually produced are the following: Either the surface of the earth or water is warmer than the air, or it is cooler. If the temperature of a river or of a damp portion of ground is higher than that of the atmosphere which rests upon it, the warmer surface will give off vapor of an elastic force due to its temperature. Should the superincumbent air be extremely dry, the vapor will diffuse itself up through it in an invisible form, without condensation, and no fog will be formed, until, by the continuation of the process, the air becomes completely saturated; and then if an excess of heat remain in the evaporating surface, the fog will be produced, and will increase in density and height so long as a difference of temperature continues. If, however, a wind be blowing at the time, so that successive portions of unsaturated air are brought over the place, no fog will be produced. A still atmosphere, therefore, is a necessary condition to the accumulation of fog. The foregoing is the usual method in which fog is produced, for it is well known that in cold weather the surfaces of lakes and rivers are much warmer than the strata of air which rest upon them. It is, however, frequently observed that fogs are formed during still nights, in low places, when the surface of the ground is colder than the stratum of the atmosphere which rests upon it, and, indeed, we have shown that the temperature of the surface of the earth on a still and clear night, is always lower than that of the air which is immediately in contact with it; and it is not easy, without further explanation, to see the reason why fogs should not always be produced in this case as well as dew. When the atmosphere is still, the condensation of the vapor by the coldness of the surface is so gradual that the air is not disturbed, and the strata immediately above the grass has relatively less moisture in it than that a few yards higher; hence, no fog ought to be produced in this case, since all the precipitation produced is that which has settled directly upon the grass in the form of dew. In this case, we may define the dew to be a fog entirely condensed into drops of water. The question still arises, how, under these conditions, can a fog really be produced. The answer is, that another condition is required, namely, that the surface, cooled by radiation, should slope to a lower level, as in the side of a hill or the concave surface of the sides of a hollow. In this case, the superincumbent stratum of air of which the temperature has been lowered by contact with the cold earth, flows down the declivity, by its greater weight, into the valley below, and there, mingling with the damp air which generally exists in such places, precipitates a part of its transparent vapor into visible fog. In the way we have described, large hollows are sometimes seen in the morning, filled with a mass of fog, exhibiting a definite and level surface, presenting the appearance of a lake of which the shores are bounded by the surrounding eminences; and if a depression of sufficient depth occurs in any part of the circumference of the basin, through this the fog is seen to flow like a river from the outlet of a lake. The explanation we have here given of the formation of fog in low places, is also applicable to the phenomenon, frequently observed, of early frost in the same localities. As rapidly as the air is cooled on the sides of sloping ground, it sinks into the valley below, and its place is supplied by the warmer air above, which has not been subjected to the cooling influence. Thus, hollows are sometimes found several degrees colder than the more elevated parts of the surrounding surface. Fogs are produced on the ocean when a gentle wind, charged with moisture, mingles with another of a lower temperature. The wind from the Gulf Stream, mixing with the cold air which rests upon the water from the arctic regions, which flows along close to the eastern shores of our continent, gives rise to the prevalence of fog over the Banks of Newfoundland and along the Atlantic Coast. From the extracts given, the reader will form a good idea of some of the principal phenomena connected with the formation and action of dew, fog and mist. Rain is produced in a great degree from the same causes. In relation to some of these phenomena, they may be summed up as follows. As much as twenty grains of dew may be deposited on a surface of four square inches in one night. The electrical conditions of a body has no influence on its capability of receiving dew. Objects a few inches above ground collect more dew than those lying directly on the ground. The leaves of plants receive more dew than the earth, and for the reason that they cool more quickly. Fog differs from dew in the fact that it moistens all bodies indifferently, while dew attaches itself more freely to some bodies than others. Dew is more abundant near water, as the shores of oceans and lakes, and the banks of streams, ponds, etc.; and as a rule, the first clear night succeeding a continued rain will cause a more copious deposit of dew, and generally it increases with the humidity of the air. (See also article Dew Point.)

DEWBERRY. Running brier. *Rubus Canadensis.* This plant is found in various localities, in fence rows, along embankments, in ill-kept meadows and pastures, in rocky and sterile soils from Canada throughout the South. In the West, the Dewberry is comparatively rare. The fruit is sweeter than the upright variety, and earlier. The Dewberry of England is a different species, *R. cæsius.* (See Blackberry.)

DEWLAP. The fold of skin below the neck of cattle.

DEW POINT. In the article on Dew, we showed the manner in which dew is deposited, and some of the phenomena connected therewith. It will only be necessary here to say that the temperature at which dew begins to form is called the Dew Point. This is a temperature at which the air begins to part with its vapors, and this again is a varying one. For instance, knowing the temperature of the air, if the bulb of a thermometer be placed on grass which quickly loses heat, the difference between the first degree of heat shown by the thermometer, and that shown when dew begins to form, is the Dew Point. Now, if at the time of placing the thermometer in the grass another be suspended from two to four feet above, the difference shown will sometimes be as much as 10° to 15°, if the bulb is protected from radiation by having some non radiating substance placed above it, as tin foil or paper. Again, in the deposition of dew, bright substances do not acquire moisture so quick as others; the reason is, they do not part with heat so readily as some others. Thus the heaviest dew will, of course, form most quickly on those substances that part with their heat easily. The simple means for testing the Dew Point we have shown is by no means accurate. There are a number of hygrometers in use, some of them costly and intricate. The degree of cold necessary to be acquired by objects, before they can have dew deposited on them, can always be known as follows: Take a thin tumbler of glass, having polished sides; fill this about half full of ice-water. Plunge into it the bulb of a thermometer, and the moment a film of dew or mist is seen to form on the polished outside surface, read the degree at which the thermometer stands, and this will be the dew point. The temperature at which atmospheric vapor condenses to form dew is generally several degrees below the temperature of the atmosphere. But this is only the case during clear weather, since, when there is a fog, or a rain, the dew point will be found to correspond with the temperature of the air; showing that any cause which contributes to bring down the atmospheric temperature to the dew point, will directly promote the condensation of its vapor or moisture into mist, cloud, rain, snow, or hail. The many relations which the dew point, or degree at which vapor condenses, holds with atmospheric phenomena, may be understood from this; and it must be borne in mind that the dew point is almost continually rising or falling; like the temperature of the atmosphere, being usually, in clear weather, some four, six, eight, or ten degrees lower than common air, as indicated by the thermometer.

DEXTRINE. Soluble starch, resembling gum, but having the property of turning the plane of polarization to the right; hence its name. The descending sap and cambium of plants contain much dextrine.

DIADELPHIA, DIADELPHOUS. A Linnæan class, in which the stamens are bound together into two parcels.

DIAGNOSIS. The determination, by symptoms, of one disease from another.

DIAMETER. The measure across a circle or other regular figure.

DIAMOND. The hardest body in nature; a rare gem, of organic origin, consisting of pure carbon, and crystallized in octohedrons, dodecahedrons, and other derivative forms.

DIANDRIA, DIANDROUS. Plants with two stamens.

DIAPHANOUS. Translucent; not quite clear like glass.

DIAPHORESIS. Sweating, or perspiration; hence *diaphoretics*, medicines which produce sweating.

DIAPHRAGM. Any substance which divides a cavity. Thus, the muscle which lies between the chest and abdomen is a diaphragm; the matter dividing the cells of shells; the disks which are inserted into microscopes. *Septum* is synonymous.

DIARRHŒA. Simple Diarrhœa is occasioned by a variety of causes, indigestible food, or that which is irritating, disorded liver, worms, etc., or it may be constitutional. It is often an effort of nature to relieve the system of disease or injurious matter in the bowels. Early in the effort, a light dose of castor oil, say a half pint, will materially aid. Later it should be given, if at all, under the advice of a veterinary surgeon. For sour and fetid discharges, give one ounce each of powdered chalk and bisulphate of soda. If there is griping, add one drachm of opium. If this does not lesson the discharges give half ounce doses of laudanum, beaten up with three eggs, and mixed with nearly a pint of warm water. As a help to these, when necessary, give an injection of two to four drachms of tannic acid in a pint of warm starch water. If the diarrhœa be the result of violent purges, give two ounces each of powdered chalk and laudanum, mixed in a quart of thin gruel of flour, repeated every three hours as occasion may seem to require. These doses are for horses, but those containing laudanum are also good for cattle, but should be allowed to trickle slowly down their throats.

DIASTASE. A condition in the decay of fibrin and other proteine compounds, which, acting like a ferment, converts solution of starch into sugar. One part of changed próteine converts 2,000 of starch. It occurs in malting and germination. Its property is destroyed by a boiling heat.

DIATHERMAL. Bodies which allow radiant heat to pass through them, as rock salt.

DIATHESIS. A predisposition to a particular class of diseases.

DIBBLE. An instrument to make holes in the soil, used in transplanting plants with little root. It is commonly no more than a short section of a spade handle, the lower part or point shod with iron, and sharp. Steel transplanting trowels are used for larger plants.

DICHOTOMOUS. Bifurcate. It is used in natural history to indicate a division into two parts, especially when repeated several times, as in some stems.

DICOTYLEDONOUS. One of the great divisions of the vegetable kingdom, including most plants and trees of temperate climates. They bear seed with two lobes, like the bean, have leaves freely veined, and the trees grow with a conical trunk. The term is synonymous with exogenous.

DIDELPHYS. A genus of animals resembling the opossum and kangaroo, which bring forth minute young, and afterwards nourish them in an external pouch. Marsupials.

DIDYNAMOUS. Flowers with four stamens, two being longer than the rest.

DIETETICS. The study of the varieties of food.

DIFFUSION OF GASES. Penetration of gases. The expression of a phenomenon which occurs when one gas is set free into another. They mutually expand or diffuse into one another, so as to produce, in time, an equal mixture. The rapidity of diffusion differs with different gases. By reason of this law, noxious vapors rising from the earth are presently diluted into the atmosphere. The composition of the air is the result of the diffusion or admixture of the several gases it contains. This passage takes place through all porous vessels, tissues, etc. In virtue of this property, gases are said to act as a vacuum towards each other.

DIFFUSUS. Spreading. Used in botany.

DIGESTER. A strong iron or copper pot, the lid of which fits steam-tight, and either screws on, or is pressed by clamps, and is furnished with a safety valve. It is used for boiling or digesting substances at a heat greater than boiling water, and is especially useful for extracting jelly and glue from bones, skins, horns, etc.

DIGESTION. In physiology, the change through which food passes in the stomach for the production of chyme. Food received into the stomach is speedily attacked by the gastric fluid, which has the power of rendering soluble the insoluble parts: this it effects by producing a change analagous to fermentation. The gastric juice is from a portion of the membrane of the stomach in a peculiar state of change, being in reality active only because in a state of change. The food acted on is converted into chyme; this passing into the bowels, is separated into a fluid part, chyle, which is absorbed by the absorbents of the intestines, and thus reaches the blood. The remaining thickened chyme, receiving several excretions, becomes feculent matter and is voided. The process of digestion requires from one to four hours, or more, according to the food. Raw substances are digested more rapidly than boiled, fresh than salt, and is best conducted when the body and mind are in a state of rest. In chemistry, digestion is the exposure of any substance, to the action of water or other solvent at a low heat for a long time.

DIGITALIS. The generic name of the foxglove (*D. purpurea*), a poisonous sedative.

DIGITATE. In botany, any leaf divided into several segments originating in a common centre.

DIGYNIA. Flowers with two styles.

DILL. *Anethum graveolens.* An aromatic plant, the seeds of which are used as a medicine. The oil distilled, is used in solution in water for colic in infants. It is an annual, requiring a dry, rich soil. Sow in drills in March or April, keep clear of weeds, thin out to ten inches. The leaves are sometimes used like parsley.

DILUENTS. Any fluid, as water, which dilutes.

DILUVIUM, DILUVION. Accumulations of gravel found upon the ordinary rocks in many places.

DIŒCIA, DIOICA. Flowers, the stamens and pistils of which are on distinct plants, as the hop, hemp, etc.

DIOPTRICS. That part of optics which investigates the passage of light through glasses, etc.

DIOSCOREA. The generic name of the yam.

DIPLOE. The cellular layer between the outer and inner layers of the scull bones.

DIPSACUS. The generic name of the teasel.

DIPTERA, DIPTERANS. Flies or insects with two wings only. They are furnished with a sucker.

DISCUTIENT. Any application which has the property of resolving or hindering the formation of tumors or boils.

DISK. Any flat, round body. In botany, any space existing between the insertion of the stamen and the ovary.

DISSEPIMENTS. The dividing membranes formed in ovaria by the union of the sides of two carpels.

DISTICHOUS. Two rows of seeds, leaves, etc., arranged side by side.

DISTILLATION. A chemical process, in which the more volatile parts of a mixture are separated by heat. It is conducted in a still of metal, usually copper, except where a great heat is necessary, as in destructive distillation, when iron is used. Earthen-ware and glass are used for many chemical distillations. Vessels of this kind are called retorts or alembics. The heat employed is regulated to the purposes of the operator. If the object be to separate alcohol from water, the heat must not rise above the boiling of alcohol (176°). As the vapor rises, it is at first cooled along the tube, or beak of the retort, and flows down it into the receiver; but the tube becoming heated, steps must be taken to produce the condensation. This is managed in the laboratory by keeping pieces of wet rag on the tube, or by passing it through another larger tube of metal which is cooled by a stream of water. In larger operations, the still beak enters another long tube, which winds several times in a bucket of water, and is thus kept cool, the water being occasionally renewed. Distillation is employed to separate alcohol, ether, vinegar, and other products from mixtures; to obtain the essential oil of plants; and when much heat is used, to separate gas from coal; tar and vinegar from green wood; hartshorn from bones, whalebone shavings, etc. When a distilled product is re-distilled, it is said to be rectified.

DISEASE. Diseases of animals and plants are now so common, that every intelligent farmer wishes to understand the symptoms indicating the more common diseases, and the treatment thereof. Diseases in plants are chiefly fungoid. In animals, especially in the horse, disease is occasioned by the various causes operating in the human family, that is an artificial condition of life. Prevention may be exercised in a great measure, by strict attention to proper sanitary conditions, and serious consequences may generally be avoided by watching, and combating the growth of early symptoms. The principal diseases will be found treated of under their appropriate names, which see.

DISEASES OF SHEEP. (See Sheep.)

DISEASES OF SWINE. (See Swine.)

DISINFECTION. Disinfection is very different in its action from deodorizing, previously treated of, since to properly disinfect we must absolutely destroy the poison germs, many of them of the most virulent nature. These sources of infection are generally so subtile as to be entirely unobserved by our special senses. Thus, the water of a well, limpid, sparkling, pleasant to the taste, and apparently pure, may have been contaminated with sewage, the steepings of privies, etc., and contain deadly typhus, and other germs. Hence the care now used in guarding against this in cities, by supplying the water from the purest sources, and in disinfecting thoroughly where infectious or contagious diseases are prevalent. The drainage of barns, stables, and the outbuildings of farm yards, finding its way into wells, have often been prolific sources of disease on farms; so, foul cellars have been especially prolific of disease. The want of disinfection in stables has caused germs of disease to linger and spread, costing large sums of money from mortality in stock. Thus the disinfection of all barns, stables, sheds, or other places where malignant disease is suspected, should receive the most careful attention. Every part should be stopped tight, and flowers of sulphur and wood tar, in the proportion of one pound of the former to two quarts of the latter, mixed with tow, and allowed to smoke thoroughly until the whole building is thick with smoke. So the hospital should be fumigated with the same, two or three times a week, but not sufficiently to set the animals coughing. Every part of the building should also be thoroughly washed with dilute carbolic acid, and the clothing also wet with it. All discharges should be treated with chloride of zinc, dissolved in water, in the proportion of one ounce to one or two gallons of water. The attendants taking care of animals with malignant diseases should never approach or handle the well ones. A disinfectant that has no smell and is not poisonous, known as chloralum, is made by dissolving three pounds of chloride of aluminum in two gallons of water, or in like proportions. Another cheap and powerful disinfectant, but poisonous, if taken, is made of eight ounces of chloride of zinc, sixteen ounces of sulphate of iron and one gallon of water. Dissolve and, to each pint used, add one gallon of water. Among disinfecting substances may be named, chlorine. This is set free by adding oil of vitriol and a little black manganese to common salt, as a disinfectant of the air, but must be used in vacated buildings, and is better if used in the full light of day. So flowers of sulphur, burned by a heat only sufficient to produce smoke, will accomplish the same purpose and, if used carefully, it will not injure stock. A disinfectant that may be used in occupied buildings is formed by adding a little chlorate of potassa, at short intervals, to half a pint of strong muriatic acid, in a strong vessel, as a thick tumbler. If pure carbolic acid is used for sprinkling flowers or washing walls, 100 parts of soft water may be added to one pint of acid. The impure carbolic acid of gas works may be used undiluted.

DISTEMPER. (See Strangles.)

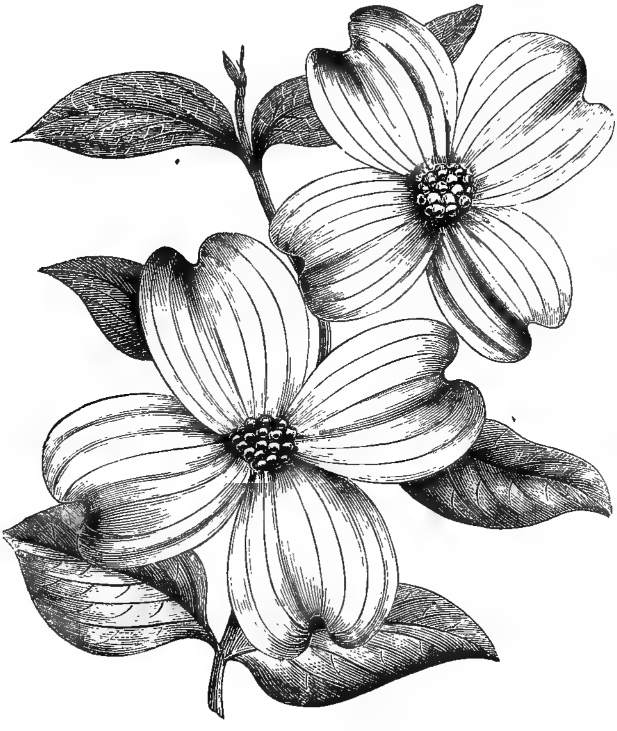
DITCHING. (See Draining.)

DIURESIS. Excessive urination; hence Diuretics, medicines causing urination, as nitre, juniper berries, turpentine, cubebs, etc.

DIVARICATE. To spread out widely.

DIVERGENT. Branches separated by an angle.

DIVISIBILITY. The extent to which matter may be divided. In gilding, the thickness of gold on a surface is often as little as the 110,000th part of an inch. Yet matter is not infinitely divisible as has been supposed by some.



WHITE-FLOWERING DOGWOOD BLOSSOMS.

DOCK. This is a name applied to a variety of plants, especially to a class of tap rooted perennials of the genus *Rumex*, (*R. crispus*) Sour Dock, Curled Dock, or Narrow Dock, as it is variously called. *R. obtusifolius*, Bitter or Broad-Leaved Dock; and *R. acetosella*, Sheep or Field Sorrel, are the most noxious; all foreigners, and introduced from Europe. For the two first-named, clean cultivation, and the last, manure and lime, are corrections.

COLT'S FOOT. *Tussilago farfara.* It is also sometimes called dock. It is not especially noxious. An infusion of the whole plant is considered valuable for coughs and pulmonary complaints, being mucilaginous, and tonic. The leaves dried and smoked in a pipe have also been recommended for asthma.

DODDER. A weed consisting of thread-like stems, which bind together the plants among which it grows. It is occasionally destructive to small crops, such as flax.

DODECAHEDRON. A solid of twelve sides. In crystallography there are two varieties: the rhombic and angular dodecahedron, according to the figure of the sides.

DODECANDRIA. The class of plants containing twelve stamens.

DOE. The female of the deer.

DOG'S-TAIL GRASS. (*Cynosurus cristatus.*)

DOG'S TOOTH GRASS. Doub grass. (See Bermuda Grass.)

DOGWOOD. *Cornus.* There are a number of varieties, some of them ornamental, chiefly small trees. *C. florida* is a tree fifteen to twenty and occasionally forty feet high, and in rare cases eight to nine inches in diameter, remarkable for its flower-like involucrum and firm wood. It is rather common in wood lands North and South, but in the West somewhat rare. Of this tree Dr. Darlington says: It is valuable for many purposes in mechanics. Cabinet-makers sometimes employ it in the manufacture of small articles of furniture. The wood-chopper selects it for wooden wedges. The young, straight stems make good hoops, and the slender branches once furnished distaffs. The bark is an excellent tonic, said to be almost equal to the Peruvian in efficacy. In the last century, according to Kalm, there was so much faith in the virtues of the Dogwood that, when the cattle fell down in the spring, for want of strength, the people tied a branch of this tree on their neck, thinking it would help them, a superstition that has now given place to common sense. As an ornamental tree, it is worthy of a place in lands and yards. Some farmers plant Indian corn when the involucres of the Dogwood are first developed, as do others when the buds of the hickory are the size of a squirrel's foot. Some of the ornamental varieties are very beautiful. The cut shows the flowers of the White Flowering Dogwood, natural size. There are several other species, with flowers in large, flat cymes, common in thickets. They all possess more or less beauty.

DOLERITE. A trap rock, consisting of augite and feldspar.

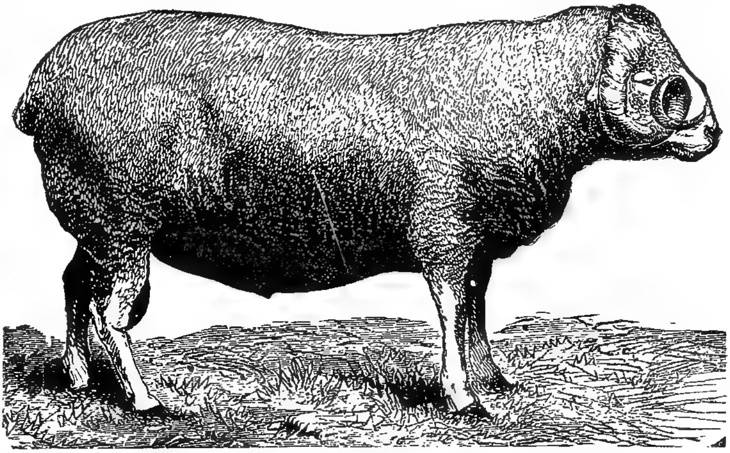
DOLOMITE. Magnesian marble, or granular limestone containing magnesia.

DORSAL. Belonging to the back.

DORSET SHEEP. Dorsetshire, England, has long had a race of sheep peculiar to itself, heavier in every respect than the Highland Sheep and, like them, with exceptionally heavy horns. They may possibly become of value when the mountainous region of the United States, between the Mississippi and the Pacific slope, becomes settled. The fleece is light and, like that of the Highland Sheep, it does not mat together. The mutton is excellent, in quality, as is that of all sheep fed in mountainous countries. Fortunately in the United States, there is comparatively but little country so mountainous and inclement as to require stock of any kind, adapted only to extremely severe climates. The cut we give of a Dorset Ram will serve as an illustration of this breed of sheep, now but little raised even in its native English locality.

DRAGON-FLY. A common name for neuropterous insects. The neuroptera, lace-wings, ant lion and white ants are all predacious and thus useful.

DRAINING. The subject of drainage is one of the most important that can interest the farmer. Modern appliances aided by science has now rendered the task of thorough drainage so simple and easy that there seems no excuse for allowing the soil to lie water-soaked, for perhaps two or three weeks at a time in the spring, rendering the soil sour, or sodden to that degree as sometimes to reduce its value permanently, and always one-half during the growing season, when an expense of from ten to fifty dollars, according to the amount of drainage required per acre, will place it in the best possible condition for the cultivation of crops, add from two to three weeks to the length of the season, and add also from ten to twenty bushels of grain, and in far greater proportion to the fertility per acre in some other crops. In fact in all crops in the garden, nursery and orchard, there are but few natural soils but will pay for draining. Whether this is to be accomplished by means of open ditches and superficial drains (water carriers) is a question each farmer must decide for himself. Where tile are to be had near at hand and at reasonable prices, these are in every case cheapest, except in the case of boundary fences, to be formed by a ditch and embankment. Even here, it is an open question, depending entirely on the value of the land. The objection to open ditches and banks is, they are constantly filling up, are harbors for vile weeds and verminous animals, and serious obstacles to clean cultivation generally. Thorough drainage is always to be considered in the light of a permanent investment. The work done and well done but little expense is thereafter required. Thus if a piece of land requires drainage, lines of tile at regular intervals, it may cost fifty dollars per acre, in particularly difficult cases, more. Hence, taking fifty dollars as the average, if the crop is increased five dollars per acre, the cost of the draining pays ten per cent. per annum. The labor of cultivation is always largely reduced on drained land over that undrained. Hence, this must also be taken into consideration. There is another matter, and one not less important than the others mentioned. The value of the land is not only increased in dollars and cents, but the fertility of the soil is also increased, both from its greater friability, and also, its power of absorbing fertilizing matters from the air, and the conservation of the artificial fertilizers employed. These are notable facts, which will be fully attested by every intelligent man who has undertaken thorough drainage in a systematic manner, and carefully noted results. The following are lands that may be considered to require thorough drainage, by covered ditches, containing a water-way beneath: Any soil so retentive that water will stand in a hole, for forty-eight hours after a heavy rain. Any soil where clover or wheat is liable to be killed in winter. Any soil having a very retentive sub-soil within two feet of the surface. Any soil where tufts of wild grass, or semi-aquatic plants make their appearance from time to time. Flat lands near the dwelling house, or those to be used for gardens or orchards. Slopes of hills where water rises to the surface, along impervious strata cropping out, or which, at certain seasons contain seeps, as they are termed. And, in certain cases, where special crops are to be cultivated, any soil that can not be plowed within thirty-six hours after a heavy rain. In relation to the size of the water-way at the bottom of the ditch; this will depend on the quantity of water to be carried away, the declivity (gradient) of the tile, its uniform slope, smoothness, etc. In article Tile will be found tables showing capacity, etc. In preparing for thorough drainage, the first thing requisite is to find the slope and fall of the land. Where this is slight, an engineer must be engaged to get the contour lines, establish gradients, and pegs for determining the depth of the ditches. Under ordinary circumstances, however, especially where single lines only are required, the eye, with the help of the water running in the ditch, will be sufficient. One thing, however, must be remembered; the gradient must never be decreased from below the starting point, without increasing the size of the tile, and a catch basin should always be placed at this point. That is a barrel or structure of brick, to catch and pass off



DORSET SHEEP.

the inflow of the small tile, and at a lower level than that of the inflow from the small tile. The material for water ways in the covered ditches should always be of tile if possible. In some timbered, and in some stony countries, however, where tile is not easily had, the ditches may be filled with brush, poles, slabs, stones or other refuse material. If stones, are plenty, they may be thrown in irregularly, filling the ditch to within twenty inches of the top, and if the clay be rammed hard over them they will last indefinitely, yet it is far better that a row of small stones be laid along each side and covered with flat stones, or round stones of a size sufficient to leave a water way below. If the rock is shelly but solid, flat slabs are best, as shown in Fig. 1 and 2.

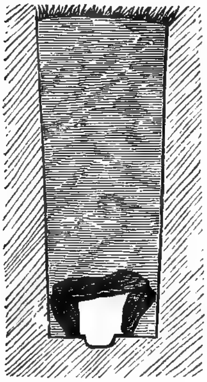


Fig. 1.

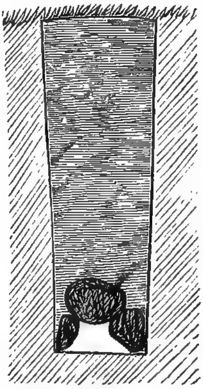


Fig. 2.

The manner of using poles and slabs, or poles entirely, is shown in Fig. 3 and 4. If a very great quantity of water is sometimes to be carried, a combination of tile and stone may be economical. The tile and stone drain is shown at Fig. 5. Fig. 6 and 7 show two manners of forming the bottoms of ditches with earth sides to hold the covering, of plank or stone.

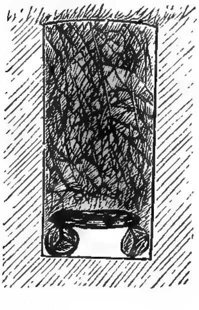


Fig. 3.

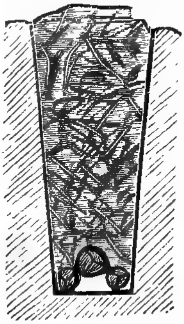


Fig. 4.

In fact, in stiff adhesive clays, if a channel be carefully cut, with shoulders, as shown in Fig. 6 and 7, planks or even sods will make a covering to the water way that will last for many years. It should be remembered however, that when plank, slabs, or poles are used for covering, they should be sawed of proper length to fit across the ditch, hence the necessity of accuracy in paring the sides of the ditch. Sometimes it is desirable to make a drain subserve a double purpose of draining the land and affording a supply of water for stock and other purposes. All that is necessary to accomplish this is to select depressions, where the tile may come near the surface; make a tight box sunk so its top is just even with the top of the ground; allow the water to flow into this box at the surface of the earth, covering the tile with a mound sufficient to keep out frost and prevent the poaching of cattle. In situations where this may not be feasible, an excavation ten or twelve feet wide on two sides may be made as shown at Fig. 8, so that stock may come and drink, the whole to be so guarded that stock cannot enter the trough.

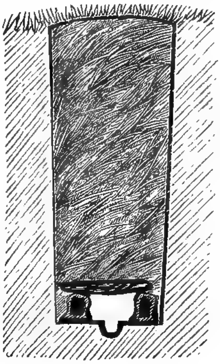


Fig. 5.

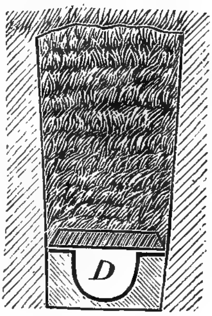


Fig. 6.

In conclusion, something of the history of draining from the earliest times, will not be uninteresting. There is no record of underdraining—carrying away superfluous water from the soil—until the time of Augustus. Tiberius and Columella, who lived then, first speak of underground causeways, while preceding writers, as Cato, Varro, and Virgil, write only of open ditches. Columella speaks of both open and closed ditches three feet deep, the closed ditches filled to half their depth with pebbles, stones and facines (bundles of brush).

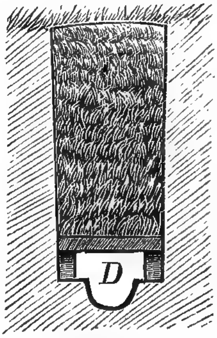


Fig. 7.

Captain Walter Bligh, who wrote about 1652, advocates drains underground three to four feet deep, or the depth of an iron shovel, below the area of oozing water. He has been credited with being the father of underdraining, but it is evident he got what he knew from classical sources. Probably Oliver de Serres, a French writer, whose Theatre of Agriculture was printed in the year 1600, is the first modern writer who really taught thorough drainage. He not only advocated the single ditches of Columella, but treats of successive lines, describing also the main lines to be covered, and also the precautions necessary to secure effective drainage. He insists that for the best results the ditches should be at least four feet deep. This accords with the best experience in underdraining to-day. The invention of tile for draining has also been ascribed to England. This, however, is again a mistake Again it is the French who are ahead. A letter to the late John H. Klippart, written by a member of the French Agricultural Society, states that within the town of Maubeuge, France, stood a monastery, the date of the erection of which is not clearly known, but it is in the pure Gothic style. The lands attached to this monastery were renowned for their fertility. After the French Revolution the estate was sold. In excavations, made in the process of alterations, two regular systems of pipe drains were found laid at a depth of four feet, one with the pipes radiating to a sinking well, the other of pipes all parallel, ending at a collecting pipe, which discharged into the cellar. These pipes are represented as having been ten inches long, four inches in diameter, one end expanding into a funnel shape, the other tapering into a cone, made of earthen ware, vitrified in burning, and evidently made in a lathe and by hand. Of the age of these drains, nothing is known, but a grave of 1620 was over one of the drains. The most interesting fact in reference to this piece of drainage is the masterly manner in which it was laid, to have remained draining the land perfectly for nearly three hundred years, and in dimensions, materials and system nearly like that of the present day; a most eloquent substantiation of the imperishable nature of properly laid underdrains, as it is of the fact that underdraining must be considered a permanent investment; and also that whatever the cost of first-rate work, it is a good investment upon all lands requiring underdraining, provided always that the value of the crops raised will pay the cost. In other words, lands upon which draining will pay the interest of fifty dollars per acre, may be drained as a good investment. Elkington, an English farmer, in 1793, is probably the first man who, in modern times, carried out a systematic plan of draining, the result of his discoveries from time to time while engaged in experiments in draining his lands. Yet Elkington's skill, however, lay in the use of the auger to tap subterranean sources of water, that could not be reached by the ditches. From this came the idea, later, of boring through impervious strata, into a loose and dry one to get rid of surface water. The shape of the tile has long been a matter of discussion. The horse shoe tile, the worst possible shape, has long been abandoned. The sole, single and double prevents the rising of the bottom of the ditch into the tile, but so does the round tile. The objection to sole tile is their weight, and that they can not be fitted with collars when necessary. Hence, sole tile also have been pretty much abandoned. The perfection of shape for the inside of tile is the egg shape, but, since all tile distort more or less in drying and burning, no tile that must be laid one particular side down, can be made to show perfect joints. Hence round tile, both as to the outside and inside, are now generally adopted. With these, joints sufficiently close may be had, rendering collars unnecessary, except in peculiar situations and soils In relation to the mains and their proper size, the lateral tiles running to them, may be quite small, two inch tile being the size generally used in the United States. If the drains are forty feet apart, the proper distance, except in the most tenacious clays, 1,000 tile per acre will be required. An important consideration in buying tile is that they should be smooth, hard burned, and give a clear, metallic sound on being struck. Tile, however, should not be so hard burned as to vitrify, or glaze. So all crooked tile should be rejected. In making a drain, as is sometimes required along a loose piece of land, or perhaps with laterals running from them, for the first 2,000 feet of drain two inch tile will generally suffice; for 7,000 to 10,000 feet three and a half inch tile will suffice, and for 20,000 feet of drain four inch tile will usually carry all the water. Experiments have shown that a one and a half inch tile, laid with a fall of one foot in each hundred feet, will discharge over 12,000 gallons in twenty-four hours, or equal to a rainfall per acre of 350 inches in a year, or nearly nine times the average rainfall per acre in the United States. Yet six and even twelve inches have been known to fall in twenty-four hours, or twelve to twenty-four times the capacity of the pipe named. Yet this is of so rare occurrence that it is not worth considering. One inch in twenty-four hours is uncommon, hence, practically, a much smaller pipe than is usually considered necessary may be used. Another advantage of small pipes is, that the thorough flushing they sometimes get, serves to clear them entirely of sediment. Thus we have given the main points in draining, so any person should be able to lay underdrains where the fall is palpable. In fine gradients we must have recourse to a drainage engineer, and to works especially devoted to drainage, remembering always that the cost of careful engineering is probably the best investment, where critical work is needed, and is cheaper than any other part of the outlay. As to the capacity of tile in carrying away water, so much depends upon inclination (fall) that tables are of but little practical value. It has been found, however, by experience, that laid at a depth of four feet, that one and a quarter inch pipes will carry away all the water of a

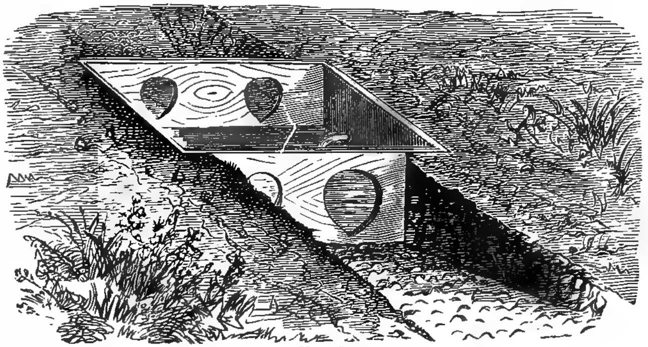


Fig. 8.

saturating rain in twenty-four hours, quickly enough for the good of the soil. This size will drain two acres. That two and a half inch tile will carry away the water from eight acres, and three and a half inch tile will carry the water of twenty acres. In closing this article, it seems necessary that the beginner be advised against making the ditches too wide, especially on the bottom. The ditch should not be wider on the bottom for small tile than four inches, and for no large tile should they be wider than the size of the tile. Thus for a ditch four feet deep to be dug entirely by hand, from sixteen to eighteen inches in width at the top is fully wide enough, provided the proper draining tools, long bitted narrow spades are used. These should be of the lighest possible description, combined with superior temper, and may now be found at any respectable agricultural implement warehouses.

DRASTIC. Medicines which act violently.

DRENCHES. The giving of medicines in a liquid form, is called drenching. A common utensil from which to give, is a horn properly prepared. A strong, long necked bottle is better. In giving the dose, hold the animal's head up so the line of the nose is horizontal. Draw out the tongue, but do not pull violently on it and allow free movement of the lips and jaw, and also sufficient movement of the tongue to assist the act of swallowing. If the animal make an effort to cough, release, to prevent choking. Induce an effort to swallow by gently rubbing the throat, and pressing in the space between the lower jaw bones. In giving drenches to horses, the head may be held up, by means of a forked stick supporting a loop passed over the upper jaw. In giving drenches to cattle, unless very unruly, by pressing the back to the shoulder, passing the left hand over the face, putting the thumb in the nostril and with the fingers opening the mouth between the nippers and grinders, the animal may be held still and the drench administered by allowing it to trickle gently down the throat. If poured down quickly it will enter the first stomach where it should never go. In case of locked jaw, or paralysis of the organs, both food and medicine may be pumped into the stomach through the nostrils by means of a flexible tube. This, however, should always be done, if it be possible, under the advice of a competent veterinary surgeon. The following formulas, for drenches, are by the late Dr. Dadd, and will be found useful: Physic Drench cathartic,—six drachms pulverized aloes, one ounce of syrup of buckthorn, one ounce of tincture of ginger. Alterative Drench, to change morbid action,–one ounce of sulphur, two drachms powdered mandrake, one pint of thin gruel. Antispasmodic Drench, for spasmodic action, either nervous or muscular,—one ounce tincture of assafœtida, one ounce tincture of valerian, three ounces syrup of garlic, one pint of gruel. For spasmodic cough,–one-half ounce balsam copaiba, three drachms sweet spirits of nitre, one-half drachm sulphuric ether, one-half ounce tincture of musk. Half of the above quantity to be given, night and morning, in gruel. Tonic Drench, for weakness and debility,—three ounces port wine, one-half ounce tincture of cinnamon, four drachms powdered goldenseal. To be given in thin gruel. Should the bowels be torpid, omit the port wine, and substitute one and a half ounces of pale brandy. Diuretic Drench,—one-half ounce fir balsam, two drachms sweet spirits of nitre, one ounce tincture of assafœtida. To be given in a thin mucilage of slippery elm. Nauseant and Diaphoretic Drench, to increase the function of cutaneous exhalants in febrile diseases,—two drachms powdered lobelia, one drachm powdered bloodroot. To be given in warm water, repeated at given intervals. Stimulating Drench,—one-half ounce tincture of capsicum, one-half ounce tincture of ginger, one-half ounce tincture of cinnamon. To be given in gruel. Narcotic Drench, to relieve pain and induce sleep,—three drachms tincture Indian hemp, one-half drachm of chloroform. To be given in warm water. An infusion of poppies, or hops, is a good anodyne. Sedative Drench, to lessen arterial action,—four drachms tincture of arnica, one pint of water. To be repeated, gradually lessening the dose. Cooling and Refrigerating Drench, for fevers or thirst,—one-half ounce cream of tartar. To be given in an infusion of lemon balm. Phthisical Drench, for phthisis pulmonalis,—ten grains powdered iodine, twenty grains powdered hydriodate of potassa. To be given daily in a decoction of comfrey (*symphytum officinale*). Vermifuge Drench,—four drachms aloes, twenty drops oil of wormseed, one ounce powdered male fern (*aspidium felix mas*). To be given in one pint of weak soap suds an hour before feeding. Parturient Drench, given to arouse the uterus in protracted labor,—three and one-half drachms spurred rye (*secale cornutum*). To be given in a decoction of birthroot (*trillium purpureum*). Antacid Drench, to correct flatulency,—two ounces lime water, one-half ounce tincture of gentian, one-half ounce tincture of ginger. To be given in an infusion of horse mint (*monarda punctata*). Lithontriptic Drench, for urinary calculi,—two ounces of lime water, four ounces honey, one pint infusion of sassafras. To be given daily, for a fortnight or more. Saline Aperients,—either of the following is a dose: twelve ounces epsom salts, twelve ounces glauber salts, eight ounces rochelle salts, one to two ounces sulphur. Demulcents, intended to lubricate and sheathe mucous surfaces,—mucilage of slippery elm, mucilage of gum acacia (arabic), mucilage of gum tragacanth, mucilage of Iceland moss, mucilage of benne leaves (*sesamum indicum*), mucilage of licorice root. The mucilage is made by pouring boiling water on a certain quantity of either of the above articles, named under demulcents, and stirring until the required consistence is obtained. The dose is as often as may seem to be required. The late Mr. Stewart, a well known English authority, during his life insisted, and we think properly, that draughts, particularly when pungent or disagreeable, are dangerous. That by no care can the danger be altogether avoided. That no draught should be given unless the horse be in danger of dying without it. That a draught is seldom or never absolutely necessary but in diseases that make the horse lie. (See Ball. Bolus.)

DRESSING. The application of plasters, etc., to wounds. The application of manure.

DRILL. A long, straight line, in which plants are grown. Drill husbandry is the cultivation of crops in drills instead of broad-cast.

DROSOMETER. An instrument for measuring the quantity of dew that collects on the surface of a body exposed to the open air during the night.

DROUGHT. The question of moisture sufficient for the growth of plants, in particular seasons especially, is one of the most important problems which the farmers beyond a line one hundred miles west of the Mississippi, have to solve. As we proceed west the integer becomes an increasing one. Where irrigation may be practiced, (see Irrigation) only in isolated localities, and the land is of sufficient value to warrant the outlay, the difficulty is surely overcome and maximum crops may be raised. On all that vast area, east of the Rocky Mountains, which may not be susceptible of irrigation, on account of the absence of streams, the only feasible plans are those mechanical means for the resistance of drought, and such methods as will tend to induce moisture. The planting of timber belts, to induce rainfall, and the deepening of the soil so that it may drink up and conserve moisture, are among the many important. The history of the settlement of the trans-Mississippi region, has shown that as the country was opened up, and timber planted, the rainfall was increased. Water for stock is pretty surely obtained by the digging of wells, and thorough cultivation has been shown to have so conserved moisture that, except in extraordinary seasons, the crops have been good. This is important as showing the value of cultivation, and the thorough disintegration of the soil, as a means of alleviating the effects of drought in particular seasons, all over the West and Southwest. It is not the yearly amount of rainfall that is so important in the maturing of crops, but its periodicity. England, with a moist, wet, sloppy climate, has not much more than half the rainfall of some of the Western States; yet England seldom suffers from drought, while the West often does. Some portions of the South Pacific coast never have rain, and yet produce good crops from the large deposition of dew, and the frequent mists through condensation of the moisture of the air at night. Although much light has been thrown upon the questions relating to meteorology, within the last ten years, the science is yet in a crude state; yet that precipitation of moisture may be accom plished by human means, there is no doubt. How it may be done to give supply to now partially arid regions, remains to be discovered. Something has been done through the planting of timber belts and groves, and much moisture may be conserved to the roots of plants by thorough and careful cultivation. These two means, if we except that of artificial irrigation, are the best known for alleviating the effects of drought.

DRUPE. In botany, a one-celled, one or two seeded, fleshy fruit; as the cherry, plum, peach.

DRY ROT. The name of a disease which attacks wood by destroying the cohesion of its parts. It frequently depends on fungous plants. The fungi most destructive are *Merulius lacrymans*, *Polyporus destructor*, and several species of *Sporotrichum*. Defect of ventilation is a prolific cause in the timbers of buildings.

DUCTILITY. The property of being drawn or beaten into a fine film. Gold, platinum and silver are the most ductile of metals.

DUCTS. The tubes or tubular vessels found in the wood, roots, leaves, etc., of plants.

DUODENUM. The intestine immediately next to the stomach.

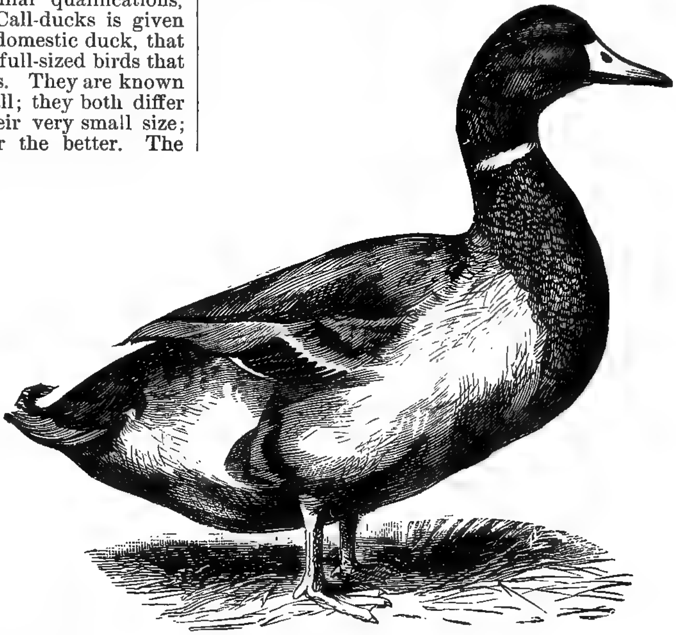
DURA MATER. The fibrous covering of the brain

DURAMEN. The heart wood.

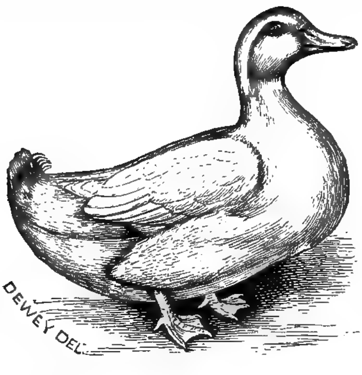
DYKE. An embankment. In geology, a mass of condensed mineral matter, as granite, porphyry, basalt, trap, etc., and intersecting strata, and evidently produced by injection, in a molten condition, through the strata.

DYNAMICS. The science which examines the laws and condition of motion, in contradistinction to mechanics, which investigates the conditions of rest and action of forces not producing motion.

DUCK. *Anas.* The family comprises many varieties. The domestic varieties, as compared to the wild, are but few. The most important of the domesticated ducks are, the Mallard, the Aylesbury, the Rouen, the Musk, or Brazilian duck, incorrectly called Muscovy, and also Guinea duck, the black East Indian, the Wood duck, the Mandarin and the black Cayuga duck. Of these varieties the Wood duck is principally valuable for the brilliant and varied plumage of the males. The common duck of our barnyards is a mongrel made up of numerous varieties, and has nothing to commend it in this day of pure breeds. They are of almost every mixture of gray and white, many of them resembling the wild Mallard, showing in a striking manner, by reversion, one of the origins of this bird. The period of incubation of the duck is from twenty-eight to thirty-six days, depending on the season, the variety, and the temperature of the air. In suitable localities ducks are profitable, and any locality is suitable where they may be able to reach a pond, running stream or marshy land. In all such locations they will, in a great measure, provide for themselves during the summer. If kept in confinement they soon pine, and if fed exclusively on artificial food the cost of keeping will be more than the value of the ducks. The young of all ducks are great insect destroyers, and among the most agile of young fowls. Hence in the garden, or on the farm, a few broods, hatched under a hen, and the coops placed among rows of vegetables where insects abound, will be found to amply pay for themselves. They are also prolific layers, laying about one hundred eggs in a year. The first food of young ducks should be curds, hard boiled eggs chopped fine, rubbed up with bread crumbs, and moistened with milk. At the end of a week they will greedily eat Indian meal-mush in which a few onion tops, chopped fine, have been mixed. The Aylesbury is the largest, except the White Musk, and by far the best white duck. It is distinguished by its large size, its cream-white plumage, and its characteristic light yellow or cream-colored bill and orange legs. When well bred, adult Aylesbury ducks weigh from eight to ten pounds per pair, while the best specimens will reach twelve. This duck takes its name from the town of that name, where it has long been bred with great care. The Aylesbury is a prolific layer, it being not unusual for the duck to lay more than one hundred eggs, and in some instances one hundred and fifty, in a single season. The average weight of their eggs is about three ounces. Early-hatched birds sometimes lay in the fall. It is quiet and easily fattened, and fine for the table. The Black East Indian or Buenos Ayrean duck, a native of both sections that contribute to its name, is not as well known as it deserves to be, though it is more remarkable for its beauty and excellent game flavor than for its size, being less in size than the Aylesbury. Metallic tints, varying with the light from green to a gilded purple, decorate their form of uniform velvet-black, their bills and feet being of the same hue. The female has the same general color as her mate, and is nearly as beautiful, while her disposition is far more amiable. These ducks require but common feeding to be fit for the table, their flesh being prized for its high game flavor. The Mallard duck is only interesting as being generally regarded as the progenitor of our common domestic duck, and of the Aylesbury and Rouen. It is found all over the northern part of both continents in its wild state, congregating during winter in vast flocks. It is bred in England and Ireland, in marshy districts in a partially reclaimed state, under the name of the Marsh duck. It is small, hardy, prolific, dark gray, and is esteemed as a game bird. The Musk duck is a native of Brazil, South America, where it is still found in large numbers in its wild state. It is occasionally called the Brazilian duck. In their wild state these ducks are very dark colored, while with us they are changed to various mixtures of brown, black, and white, and sometimes a blending of brown and drab. The adult drake weighs from nine to ten pounds, while the duck rarely exceeds half his weight. They have long bodies, short legs, and a very clumsy appearance upon the ground, which they much prefer to large bodies of water. They like to perch upon the branches of a low tree, a fence, or a low building, especially during the night. They do not rank high for the table, even when young; and the males are tyrants in the poultry yard. Time of incubation from thirty-four to thirty-six days. The Rouen duck has for a long time been as distinguished in France as is the Aylesbury in England. It is the largest and, in some respects, the best duck of all our domestic varieties, though less beautiful in form than the Aylesbury. Its color is pleasing, closely resembling the wild Mallard. These ducks have broad, clumsily-built bodies, and when highly fattened they are very ungainly in their movements. They are remarkably quiet, easily fattened, and are most excellent layers of very large eggs, and have no equal for the table in the domestic family of ducks. The adult Rouen not unfrequently reaches from twelve to fifteen pounds per pair. The Wood duck, so called from its habit of building its nest in the hollows of trees, and also from its frequenting the edges of river groves in search of acorns—one of its principal foods in the autumn—is one of the most beautiful of the duck tribe and easily domesticated. It is, however, quite rare in collections, its small size making it unprofitable either for its eggs or flesh. Mr. Townsend Glover mentions as among the rare ducks, at the Paris Exposition of 1865, the following. The Red-billed Tree duck, (*Dendrocygna antumnalis*) from Guinea and Brazil, appeared to be quite domesticated, and when I saw it it was feeding upon the short turfy grass in its enclosure in a very goose-like manner. It is a very ornamental bird, the bright red bill and legs forming a striking contrast to the shaded gray and black color of its plumage. The White-faced Tree duck from Brazil, in the same paddock, is also one of the perching ducks, but is of a smaller size, with bluish bill and legs, and instead of the usual quack given by our tame duck, this bird makes a kind of whistling sound. Our common wood or summer duck is also domesticated here. This species of duck ought to be more highly prized by our countrymen than it now is, and most probably it would be were it a foreigner and cost a very large sum of money to import. In these gardens it is as tame as our domestic Mallards, and reproduces with as little trouble. The Mandarin ducks, from the north of China, were all in very plain plumage, but, when in full summer dress, the male is said to be the most beautiful bird of the duck tribe. It somewhat resembles our summer duck in size, shape, and color, but is said to be infinitely more beautiful. These ducks were introduced into Holland about 1850, and reproduce very readily in a state of domestication. The Bahama duck, *Anas* (*dafila*) *Bahamensis*, is very easily domesticated, and resembles a small Mallard with a pointed tail, but the bright red color on the base of its bill renders it a most beautiful object when swimming. Of these varieties we may remark that, the Mandarin duck is generally disseminated. They were originally imported to the United States in 1854. In its plumage it resembles the wood duck, but is more beautiful and elegant. It is chiefly valuable as an ornamental species. Of the Cayuga Black duck, one of the most superior, as it is among the largest of either American or foreign ducks, Mr. C. N. Bement writes as follows: Of the origin of the Cayuga duck I can not give anything reliable. This duck has been bred in the country so long, that all trace of the origin is lost. Tradition says they are descended from a sort of wild duck that stop in Cayuga lake and Seneca river, on their passage north and south, fall and spring; yet from hunters I have never been able to obtain or hear of any closely resembling them, either in weights or feathers. Yet they are called the Big Black duck, Cayuga, or Lake duck. The Black Cayuga duck in perfection, is black with a white collar on the neck, or white flecks on the neck and breast—rarely black without white, and as the white seems inclined to increase, we usually select them nearly or quite black for breeding. The duck has a faint green tint on the head, neck, and wings. The drakes usually show more white markings than ducks, and the green tint on head and neck is more strongly marked. They differ from the East Indian and Buenos Ayrean ducks very materially; they are much larger, longer in body, and shorter in leg, better feeders, but are not so intense in color; indeed, beside the East Indian, the Cayuga looks brown. When well fed, the duck begins to lay about April, and usually gives an egg every day until eighty or ninety are laid, when she will make her nest and sit, if allowed; if not, she will generally lay a litter in September. The Cayuga ducks are hardy, of good size, and for the table are superior to other ducks; the flesh quite dark and highly flavored. If well fed, they become very fat; can be readily made so fat that they can not raise themselves from the ground by their wings; twelve pounds to fourteen pounds to the pair would be a good average weight. I once had a small flock that averaged, at six months, sixteen pounds the pair, but they had been forced to their utmost, and never gained weight after six months. The Cayuga duck is very quiet in its habits; they are rarely able to rise from the ground, a fence one foot high will turn them; they are not disposed to wander from home; they commence laying about the last of March and lay fifty to ninety eggs, when they wish to sit, which they do well, but they are careless mothers; they cross readily with other ducks, and produce is certain. Of the other varieties of ducks, valuable for ornament or peculiar qualifications, Tegetmeier says: The title Call-ducks is given to two small varieties of the domestic duck, that bear the same relation to the full-sized birds that Bantams do to ordinary fowls. They are known as the grey and the white Call; they both differ from ordinary breeds in their very small size; for show birds, the smaller the better. The shape of the head is also distinct; they are most esteemed when possessing a full round forehead, with a broad, short bill. In color, the grey Call should be an exact counterpart of the Rouen and wild breeds, not only in plumage, but also in legs, feet, and bill. The white Call should be clothed in feathers of pure and unsullied white; the bill, however, is not flesh-colored, as that of the Aylesbury, but a bright clear unspotted yellow, any other color being regarded as disqualifying the birds from success in a severe competition. Call-ducks, as their name implies, are remarkable for their loud and continuous quacking, in a shrill, high note, which can be heard at a great distance, and which renders them admirable as decoy ducks to allure the wild species to their destruction. As fancy water-fowl on ornamental pieces of water, both varieties are very attractive. The Penguin duck is characterized by greater length of the femora, or upper bones of the legs; and of the bones of the feet, whilst the tibiæ remain unchanged. In consequence of this peculiarity of structure, the duck, in walking, is obliged to assume an erect attitude, like that of the Penguin. Beyond this quaint peculiarity, the Penguin duck has no specialty to call for particular observation, or to distinguish it from the ordinary species, of which it is evidently only an accidental variation, perpetuated by the care of man. The colors of the Penguin duck are varied, and the bird breeds freely with any of the common varieties. The Hook-billed duck is another accidental variation which has been propagated by man. It is characterized by the bill being turned downwards, instead of being straight, as in the other varieties. It is a very old breed, having been described by Willoughby in his Ornithology, 1676, and also figured by Albin in his Natural History of Birds, 1734. In Holland, this variety was formerly not unfrequent, and was frequently delineated by the old Dutch masters. In color and size, the Hooked-billed ducks vary considerably. The Tufted, or Crested duck is another variation which has been perpetuated and increased by the care and selection exercised by man. It is characterized by a large tuft of feathers on the top of the skull, very like that of a Polish hen. In some cases this globular crest attains a size of three inches in diameter, and renders the birds very remarkable objects. In the skulls of some specimens, that we have examined after death, we have noticed a deficiency of the bones of the forehead, their place being supplied by a cartilaginous thickening of the membranes under the base of the crest. The Pekin duck is comparatively a rare bird in the United States, having been first imported about 1871, and at present not largely disseminated. They are larger looking than the Aylesbury, but seldom weigh heavier. The cut we give will show the form and general appearance. The following, from the American Standard of Excellence as revised at the last meeting of the American Poultry Association, will show the points to be regarded in exhibition birds, including drakes and ducks: *Head*—long and



ROUEN DUCK.



PEKIN DUCK.

finely formed; color of plumage, white; eyes deep leaden-blue. *Bill*—of medium size, deep yellow, and perfectly free from marks of any other color. *Neck*—rather long and large in the drake; in the duck, of medium length; color of plumage, white or creamy-white. *Breast and Body*—breast, round and full; body, very long and deep and, in adult birds, approaching the outlines of a parallelogram; color of plumage, white or creamy-white throughout. *Wings*—short, and carried compactly and smoothly against the sides; color of plumage, white. *Tail*—rather erect, the curled feathers in the drake being hard and stiff; plumage, white. *Legs*—thighs short and large; color of plumage, white; shanks, short and strong, and of a reddish-orange color; plumage, downy, and of a faint creamy-white. There are standards, both English and American, for each particular breed of ducks, for which the reader is referred to volumes issued especially for this purpose, but which will interest but few except those who breed ducks of absolute purity and for exhibition purposes.

DYNAMOMETER. An instrument now generally in use for measuring the force exerted in any draft, or dead pull. One of the principal objections to the earlier dynamometer was, when it was used to test draft of farm implements, the inequalities of the soil produced so much vibration in the index, that the measurements were most unsatisfactory. Improvements of late years have obviated this difficulty, so that the measurement of force is now practically correct. These instruments are used chiefly by manufacturers to test the draft of their machines and implements, and by committees in testing machines and implements at public competitive trials, especially in plowing matches.

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EARTH. In an agricultural sense, earth is clay, sand, loam, peat, bog earth, etc., in a mixture seldom pure, comprising various soils adapted to the growth of plants. Mold, on the contrary, is humus earth, or that arising from the decomposition of barnyard manure, leaves, or other vegetable substances. Except pure sand, earth has tenacity to a greater or lesser degree, clinging together more or less when damp, according as sand predominates in its composition; mold, except when saturated with water, easily falls apart. Thus earth is divided into three classes: The more tenacious, as strong loams and clays; sandy soils, and humus; or mold. The loams contain the most humus, the sands the least. We have heretofore spoken of dry earth, especially dry clay, as a deodorizer. (See Deodorization.) The effect of the sun's rays on the temperature of the earth below the surface, the power of the soil in holding heat, its absorbent qualities, and power of taking up and holding moisture, and its disintegrability are among the most important uses of earths in the growth of plants, for upon these characteristics the economy of vegetable life is chiefly due. (See article Soil.) Meteorology also exerts an important influence upon the productive capability of the earth. In inquiring into the qualities of soils, the natural system would be to judge from the color, cohesion, consistence, their capability of holding moisture, the growth of vegetation, including the varieties, as adapted to various soils, etc. This was, in fact, the only means the ancients had of determining the value of soils. Nevertheless, this is by no means a critical test. The color of soils, in fact, is but a slight indication of their true value, some very dark soils being infertile, and some light-colored soils being quite fertile. In fact, it is but little more than 100 years ago since the physical properties of soils first commanded the attention of scientific investigators. And really, the first investigations were limited to the weight of soils, and their facility of absorbing water. Thaer, while he paid great attention to the physical properties of soils in his Analysis of Earths, did not submit them to a series of comparative experiments. It was not until 1816 that Schübler, when appointed at Hoffwyl, professor of physics and chemistry applied to agriculture, that a real stride was taken. He asked himself the question: Where is the science I am expected to teach? He found it did not exist. He then entered upon the study of agriculture as a physicist, and sought the best means for determining and comparing the diverse physical properties of soils. He found that the specific weight of earth was always in relation to its power of retaining heat, and of drying quickly; that the facility for retaining water embraces that of absorbing the moisture and the oxygen of the air with rapidity, etc. The physical properties of arable soils, and the physical influences of the atmosphere, have a greater direct action upon vegetation than those properties and influences purely chemical, because the first are anterior to and serve as a basis for the last. Boussingault, proves how far this question was in its infancy in his day. He says: At an epoch which is not yet very far distant, it was believed that a close connection existed between the composition and the quality of arable soil. Numerous analyses soon modified this opinion by demonstrating that the mineral elements have not always the importance which is attributed to them. Schübler tried even to prove that the fertility of a soil depends a great deal more upon its physical properties, its aggregate condition, its aptitude for imbibition, etc., than on its chemical constitution. That which characterizes cultivable soil, whose base consists of disaggregated mineral substances, is the presence of organic remains more or less modified, such as humus and compost. Vegetable earth, properly called, results from this association. In regard to its intimate nature, we fear not to affirm that, in spite of its apparent simplicity, we have still a very imperfect knowledge of it. This absorbing faculty, as mysterious as unexpected, which the soil exercises on ammonia, lime, potash, and the salts of different bases, discovered by Thompson and Way, is a palpable proof of it. The chemical composition and the physical properties do not admit of pronouncing upon the degree of fertility of earth. Direct observation is necessary. It is imperative to cultivate a plant in the soil, and ascertain its vigor and development. The analysis will be useful in determining the quantity and quality of assimilating elements. The memoir of Schübler comprises one hundred pages. An abstract of the principal parts which may interest farmers, excluding all the tables of the physical properties of different soils we give from a work on agricultural meteorology, by M. Andre Poey, as follows: In determining the weight of the soil, a particular distinction is to be made between the peculiar specific gravity of the several portions of earth, and the absolute weight of a determinate volume, as of a cubic inch or foot of the several soils. Sand, either in its wet or dry state. is the heaviest part of arable soil, certain fine slaty marls approaching the nearest to sand in this respect. Calcareous and silicious sands differ but little in this point, calcareous sand being, however, the heaviest of the common constituents of arable soil. The clays are lighter the more clay and the less sand they contain. Lime exhibits great difference in weight, according to its fineness and mode of preparation. In slaked lime the weight is remarkably less, even after it has been resaturated with carbonic acid. The explanation of this seems to be the great expansion of quicklime on its combination with water. Dolomite sand, or a combination of lime and carbonate of magnesia, is much heavier than either of its component parts in a separate state. Its specific gravity rises to 2.82 and 2.83, and even magnesian stony marls often possess this greater weight. The carbonates of magnesia, obtained by precipitation from solutions, are the lightest of the usual ingredients of the soil. In arable soils magnesia is usually found in combination with lime or silica, where its form is coarser, and its physical properties resemble more closely those of sand. Compound arable soils are generally lighter as they are proportionally richer in humus. This fact alone does not positively indicate the fertility of a soil, since the humus itself differs in weight, and the other pure earths exhibit diversity of weight according to their fineness; consequently, mixed earths may acquire very different average weights. On this point specific gravity furnishes more certain evidence than absolute weight. The designations of light and heavy soils, as usually employed, refer to the different consistence of the earths, and not to their specific gravity or absolute weight; clay soils, wet and dry, are heavier than sandy soils. When different earths are artificially combined, a cubic inch of the compound gives a greater weight than the common average of the component earths, whether mixed in equal portions, according to weight and volume, or in other quantities. By the term, power of the soil to contain water, we understand the property of earths to receive and retain water within their interstices, without allowing any to escape. It is of the greatest importance to vegetation, for on it depends the quantity of aqueous nourishment the soil can receive and supply to the roots of plants—an essential source of vegetable nutriment. The sands are most deficient in this power; its degree varies, according to fineness in the grain, from twenty to forty per cent.; silicious sand has the least power of all. Gypsum powder approaches the sands in this respect, and has even less power of containing water than calcareous sand. Slaty marl, despite its proportion of clay, exhibits very little of this power, and renders soil both warm and dry. This marl is frequently applied to the improvement of vineyards in Germany. In carbonate of lime this water-holding power varies according to the fineness of the particles; a distinction is important, therefore, between the fine lime separated by decantation and the earthy lime as found in the form of sand in arable lands. Carbonate of magnesia exists in a coarse-grained state, combined with lime or silicious earth, in arable soils, and retains water only in a slight degree. Humus, with its large natural proportion of half-decomposed organic remains, as wood, leaves, roots, etc., has the greatest degree of this power. One hundred parts of the fine earth formed by decaying wood in old trees are capable of absorbing nearly two hundred parts of water; and some light turf earths can contain from three hundred to three hundred and sixty parts, when not dried artificially. Where we meet with the power of retaining more than ninety parts of water, we may depend upon an abundant commixture of organic matter. The two qualities of firmness and consistency of soil are of great importance in regard to the fertility and the manipulation of land; the terms, universal in husbandry, of light and heavy soil, rest mainly on these properties, and they therefore deserve investigation in regard to both dry and moist conditions of the earth. If we compare the consistency of earths with their weight, we shall see that the customary terms of heavy and light soil are founded upon the cohesion of soil within itself and its adhesion to agricultural implements, and they therefore indicate its working properties rather than its weight. The comparative ease with which roots penetrate the soil will probably accord with these conditions. The consistency and firmness of soils in the dry and wet state increase in the same ratio. Clay lands, either wet or dry, are the most difficult to work; sandy soils and those containing much humus, are the most easy. The firmness and consistency of a soil are not in the direct degree of its power of containing water; thus, fine lime and magnesia and humus possess but little consistency, although they can contain much water. We can not, therefore, infer the existence of the one property from that of the other. Consistency generally exceeds in clayey soils, but not invariably. Fine, slaty marl, notwithstanding its great proportion of clay has but slight consistence. The finest kind of pipe-clay in its dry state is only forty-two, and therefore less by half than that of the heavy, gray clay of arable soils. Light, sandy soils gain cohesive power by moisture; therefore, a damp climate, with a large average quantity of rain, will be found most advantageous to sandy districts. Even the purest sand, which in its dry state loses all its consistence and falls into a shapeless powder, regains a certain degree of cohesiveness on again being wetted. With all the earths, adhesion to wood exceeds that to iron; and the apparent contradiction of the fact that, in wet weather land is more easily worked with wooden than with iron implements, is explained not by the less degree of adhesion to wood, but by the weight of the iron implements causing them to sink deeper into the soil. The diminution of the consistency of soil by the penetration of frost is another important integer. After the thorough freezing of soil in a wet state, its degree of consistence is greatly decreased. This is epecially the case with clays and soils of great firmness, where the diminution amounts to nearly one-half; with loamy clay the reduction reaches from sixty-nine to forty-five, and with ordinary arable soil from thirty-three to twenty. Completely dry earths suffer no change from the action of frost. This is because the crystallization of the water in the interstices of the soil by freezing forces the several particles of earth from their position, and thus renders the points of contact fewer. The beneficial influence of breaking up the soil before winter sets in, to allow the frost to penetrate more readily, depends upon this diminution of consistency. If the soil is worked in too wet a state in early spring the beneficial results are lost by again bringing the earthy particles into closer contact. The throwing out of plants in changeable winters is caused by the alternate freezing and thawing of the ground, and the accompanying displacement of earthy particles forcing the roots of smaller plants out of the earth, but not displacing the larger ones. The capability of soils to become speedily dry, is a question of considerable importance in vegetation whether a soil gives up its acquired moisture again to the air quickly, or retains possession of it for a long time in its force. The terms a hot or cold, a dry or wet, soil rest chiefly on this capacity. Sand, gypsum, and slaty marl dry most quickly, and are consequently called hot soils. Carbonate of lime varies in this respect according to the different forms in which it occurs. Calcareous sand dries quickly, and fine carbonate of lime slowly. The latter has, besides its chemical action on humus, the advantage of loosening the soil after it is dried. This property of the earths, to require a longer or shorter time to become dry, might seem to stand in the same relation as their power of containing water and, with thin layers, this is nearly always the case; but with layers some inches in depth the proportion deviates considerably; the deeper layers, in this case, drying more slowly, according to their degree of consistency, and to their greater or less contraction on drying. Dry soils, with a large proportion of clay, exhibit this variation in an especially striking manner. Upon the diminution of bulk on drying, it is well known that most soils contract on drying, and cracks and fissures ensue, which have an injurious effect on vegetation, as the finer roots, which frequently supply the bulk of nourishment, are either bared or torn asunder. Gypsum diminishes its volume in an inconsiderable degree. Fine carbonate of lime loses but little bulk, while clay exceeds it, and humus exhibits a remarkable degree of contraction. The addition of sand, or carbonate of lime, to clay, diminishes this property of contraction. Many kinds of marl fall into small pieces on drying, because of the great difference which clay and lime, the elements of marl, experience in their diminution of bulk on drying, after having been moistened, these individual parts changing their volume in different degrees, and thus causing a more easy disintegration. Humus experiences, on drying, the greatest diminution of bulk, contracting at least one-fifth, and expanding again under the action of moisture. This is why the upper surface of the earth, in damp, turf bottoms, containing much humus, frequently rises or sinks several inches, according as the soil is penetrated with more or less water. The elevation of these soils is more remarkable during a sharp frost, after wet weather, the freezing, by its expansion, still further increasing the volume of the particles of water within the turf. Hence, too, the reason why these turf bottoms have, in their wet state, a remarkable elasticity if heavily trodden upon. The property of the earths to absorb moisture from the atmosphere is important. Most of the earths which are commonly found in soils have the property, in their dry state, of absorbing moisture from the atmosphere, and this influences, considerably, their different degrees of fertility. All soils, except silicious sand, thus absorb moisture. Slaty marl, similar to the sands in some conditions, surpasses them in this respect; clay soils, especially those containing humus, absorb most freely. Humus, although possessing the greatest power of absorption, exhibits degrees of difference according to its kinds; purely vegetable humic acid absorbs moisture more freely than that obtained from animal manure. The degree of absorption lessens as soils become saturated with moisture, which generally occurs in a few days. A portion of the absorbed moisture becomes vaporized by the action of sunlight, and thus is performed a natural operation which exerts a very beneficial effect upon vegetation. The earths absorb, at night, moisture which they partially give off during the day While fertile, arable soils absorb moisture freely, this is not an infallible test of their properties, and the test requires much modification in its application. The property of earths to absorb oxygen gas from the atmosphere is also important: Alexander von Humboldt, many years ago, pointed out this property of the earths, and experiment confirms it, always providing that the earths are in a moist condition. All the earths lose this property upon drying, and regain it as soon as they are moistened. Humus exhibits it in the greatest degree; the clays approach nearest to it, and the sands absorb least. Fertile earths absorb more than those poorer in humus and clay. The included air, standing over them, at last becomes so void of oxygen, that lights are extinguished, and animals die in it. The methods of absorption differ; humus combines partly with the oxygen, chemically, the inorganic earths absorb the gas without intimate combination. When earths are frozen or covered with an icy surface, absorption of oxygen ceases; and the action increases with the warmth of temperature, varying from 59° to 65¾° Fahrenheit. Many phenomena prove that oxygen is an important agent in vegetable, as well as in animal economy. It is particularly necessary to the germination of seeds and the growth of plants. By turning up the soil in any manner fresh layers are brought into contact with and fertilized by the oxygen, and as a moist condition of soil favors this absorption, it should be preserved. In relation to heat, the earths have the power of retaining the warmth which they accumulate from the atmosphere and the heat of the sun, and of giving it out to surrounding bodies. It is different from specific heat, and its degree depends upon the capacity of the body for conducting heat. The sands possess this power to the greatest extent; hence the heat and dryness of sandy districts in summer. Their slight water-containing power, in consequence of which little warmth is lost by evaporation, increases this condition. Slaty marl stands next to sand in this capacity; and this, joined to its greater power of retaining water, contributes largely to its fertility. Humus has the least power of retaining heat, and turf soils abounding in humus warm but slowly, because they contain water, only a small portion of which they lose rapidly by evaporation. Magnesia, combined with sands and slaty marls, largely possesses this heat-retaining power. The greater the mass of an earth the more extensive will be its power of retaining heat. We may, therefore, from the absolute weight of an earth, conclude tolerably well in regard to the extent of its power. The various earths acquire heat from the sun in different proportions, and this property may exert a sensible influence on vegetation. Land consisting of light-colored clay warms less quickly and powerfully in the sunlight than a dark, dry soil; black garden-mold, rich in humus, becomes much warmer than meager limestone or clay soils. Very different external circumstances may affect the warming of the soils, and may be classed as follows: first, the different colors of the surface earths; second, the different degrees of dampness present during the exposure of the earths to the sun's influence; third, the component materials of the earths; fourth, the different angles at which the sun's rays fall upon the soil. The influence of the color of soils on the quantity of heat received by them may be tested as follows: Place thermometers in the several soils, covering their bulbs an eighth of an inch high with earth; sprinkle the surfaces, by means of a fine lawn sieve, with lampblack for a black color, and magnesia for a white, leaving one soil of its natural color. In August, with a temperature in the shade of 77° Fahrenheit, the increase with the black color was found by Prof. Schübler to be from 77° to 123½° Fahrenheit; the white, from 77° to 110° Fahrenheit; and the natural color from 77° to 112½° Fahrenheit. Thus, the increase of temperature with the black-colored earth was 46½°; with the white, 33°; and with the natural, 35½°. Other colored earths exhibit corresponding differences of degree in the temperature of their masses. When exposed for hours to the sun they never attain the the same degree of heat—the black earths acquiring the greatest heat and the lighter ones remaining cooler. If we expose earths of the same kind in a dry and a wet state to the sun, the wet earth never attains an equal degree of heat with the dry. The depression of temperature arising from evaporation amounts to 11¼° to 13½° Fahr. As long as the earths remain saturated with water they show little difference in their heat-acquiring powers, as they give off to the air, in this condition, nearly equal quantities of vapor in the same length of time; as they gradually dry, the difference in temperature increases. Light-colored earths, with great water-containing powers, acquire heat slowly, while dark-colored sand and slates, containing less moisture, become heated more quickly and powerfully. The different ingredients which enter into the composition of soils have, in themselves, far less influence on the capacity of soils to become warmed by the sun than their color and dryness. If we impart, artificially, to earths of the same color and expose them in a similarly dry condition to the sun, the differences in temperature will be inconsiderable: so that the various capacities of earths, in their natural state, for receiving heat from the sun, depend particularly upon their color and dryness. The inclination of the ground toward the sun has a very considerable influence on the degree of heat which the soil receives from its rays, and the greater warmth is produced as the incidence of the ray approaches more nearly to a right angle, or 90°, with the surface. If the actual increase of the temperature in the sun over that in the shade be between 45° and 63°, as is often the case on clear summer days, this increase would be only half as great if the same light spread itself, in a more slanting direction, over a surface twice as extended. This is the reason why heat so frequently increases on the slopes of mountains and rocks which have an inclination toward the south. When the sun is at an elevation of 60° above the horizon, as is more or less the case toward noon in the middle of summer, the sun's rays fall on the slopes of mountains which are raised to an inclination of 30° to the horizon, at a right angle; but even in the later months of summer the sun's rays frequently fall on them under a right angle in cases where the slopes are yet steeper. Such declivities, particularly in the geographical latitude of Germany, are therefore peculiarly suited to the cultivation of plants which require a high temperature, such as the vine. By an accurate comparison of the power of the sun's ray's to warm the soil, with reference to the different seasons, we shall perceive more distinctly the influence of the different inclinations of the ground toward the sun. The capacity of soils to develop heat within themselves on being moistened is that powdery substances in general, and consequently the earths, possess the property of developing warmth when moistened while in a dry state; but in nature they are scarcely ever found in this perfectly dry condition. The rain falling in warm seasons is many degrees colder than the lower stratum of the atmosphere and the upper surface of the earth, which it immediately moistens; so that the earth in hot weather becomes rather cooler than otherwise by the rain. When the earth has previously been very dry, the cooling of it by the rain can only be reduced about 1° Fahr., and this would have little effect on vegetation, and in the colder seasons, when the earth is already damp, so slight a development must be inappreciable. The galvanic and electrical relations of the earth show that the pure earths, as sand, lime, magnesia, and gypsum, in their dry state, are non-conductors; the clays are imperfect conductors, and the clayey earths are weak, imperfect conductors. The presence of the moisture and of oxide of iron, found in all the clays, appears to be the base of this phenomenon. Upon the influence of the simple earths on the germination of seeds the development of the germ depends upon the looseness, moisture, and temperature of the soil, as well as upon its warmth and consistence. In moist silicious and calcareous sand the grains germinate in summer in a few days, and develop well, but suffer as hot weather approaches. In gypsum powder they develop indifferently. In sandy clay no proper development takes place. This is also the case in loamy and stiff clay. In pure clay no change whatever occurs, but the grains develop well when transferred to proper soil. In pure carbonate of lime, carbonate of magnesia, and slaty marl, as well as in pure humus, garden mold, and arable soil, the seed germinate well—the young plants in warm weather developing themselves most beautifully in the humus, and in the carbonate of magnesia, in consequence, probably, of the greater power of containing water which these earths possess. Upon soil, as adapted to climate, we shall find that in such warm countries as have also a small mean quantity of rain, those kinds of soil which have a great power of containing water will, if other circumstances are the same, be the best; while those soils which have, on the contrary, a small power of containing water will be found better suited for countries with a greater amount of rain. Those very soils, therefore, may be fertile for one country which become no longer so for another, under a change of external circumstances; the usual alternation of dry and wet years being on the same principle, more favorable to the one or to the other country, according as their predominating soils respectively possess a greater or less degree of this power of containing water. To summarize the whole, in the examination of soils, the determination of their power of containing water, and of their weight, consistency, and color, in connection with their chemical analysis will, in the majority of cases. be sufficient to enable us to conclude, with great probability, as to their remaining physical properties. The more an earth weighs, the greater also in general is its power of retaining heat; the darker its color, and at the same time the smaller its power of retaining water, the more quickly and strongly will it be heated by the sun's rays; the greater its power of containing water, the more has it in general the power also of absorbing moisture from the atmosphere when it is in a dry state, and oxygen when it is in a damp state, and the slower it usually is to become dry, especially when it is endued at the same time with a high degree of consistency. Lastly, the greater the power of containing water, and also the greater the consistency of a soil, the colder and wetter of course that soil will be, as well as the stiffer to work, either in a wet or dry state, and the more judicious therefore will it be to break it up before the setting in of the frost, in order that its consistency may be improved by the due penetration of the frost during the winter; and for the cultivation of many plants, the more requisite will it be found for the permanent improvement of such a soil, to counteract its too great consistency and power of containing water by mixing it with looser earths, lime, marl, coal or wood ashes and sand. If soils of different kinds be wetted until the fluid drops, it will be found, as determined by Schübler, that 100 pounds of dry sand retain 25 pounds of water; 100 of calcareous sand, 29 of water; 100 of loamy soil, 40 of water; 100 of clay loam, 50 of water; 100 of strong clay, 79 of water; 100 of peat, 100 and more. Good soils hold from forty to fifty per cent. of water. Soils not only hold water, but absorb it from the air unequally. Thus, a quantity spread out to the same extent of sand, absorbed 0 pounds of water; of calcareous sand, 3 of water; sandy loam, 21 of water; strong clay, 30 of water; garden mold, 35 of water. In the same way, they retain moisture very unequally, sand losing it four times more rapidly than mold. A well-tilled soil is continually absorbing from the air, gaseous matter, and its fertility is, in a considerable degree, connected with this property. Molds absorb eleven times, and clay nine times as fast as sand. Black, well-tilled, and drained soils become more rapidly heated, and to a greater degree than such as are wet, of a light color, or baked. In the same way, those that heat rapidly, cool rapidly, and are more subject to frosts. By experiments, mold cools in one third the time, and clay in two thirds the time of sand; so that, if they be equally heated, the sand will be warm for hours after the mold is cold. Hence the latter absorbs dew and contracts frost much more quickly than sandy soils. The adhesiveness of earth is an important integer. Pusey, in measuring the force necessary to turn furrows in various soils, found the required draft to be, for loamy sand, 230 pounds; for sandy loam, 250 pounds; for peat soil, 280 pounds; for clay loam, 400 pounds; for strong clay, 661 pounds. Thus it appears that the toughest soil required nearly three times the force to plow it, that the most friable soil did. Improvements in plows of late years have reduced the force necessary in plowing fully twenty per cent. Coal ashes, the spent ashes of soap makers, sand, vegetable matter, strawy manure, powdered charcoal, baked and pulverized clay, and lime, lighten a stiff soil, and clay marl, air-slacked lime and wood ashes, stiffen those too porous. So again, as to the physical qualities of earths, light soils are usually fertile where they rest on pretty stiff clay, and a stiff clay resting on a porous sub-soil, retains sufficient water to ensure fertility. Thus we see, the character of any soil is modified in a great measure, and as to fertility depends very much upon the nature of the sub-soil. All these being important for farmers to understand.

EARTH, CHEMICAL. In chemistry, earths are those metallic oxides which are colorless, nearly or quite insoluble in water, the metallic basis of which is obtained only with difficulty, and which rapidly oxidize. Lime, magnesia, baryta, strontia, alumina, glucina, thorina, zirconia, yttria, and silica are these earths, but lime, alumina, and silica form the bulk of the soils and rocks of the globe. Magnesia is also rather abundant, but most of the remainder are rare bodies. With the exception of silica, which is an acid, they are bases.

EARTH-WORM. *Lumbricus terrestris.* Earth-worms are, on the whole, serviceable to soils, by loosening and perforating them, and injure plants and roots but little. They indicate rich soil. Salt applied at the rate of ten bushels to the acre, or a heavy liming destroys them effectually for a season. Their injury to plants consists chiefly in drawing the leaves into their holes and sucking the juices.

EARTHY MANURES. Marl, lime, clay, and sand are so called. They serve to give the soil new mechanical qualities, and also supply phosphates and other mineral constituents, calculated to render it more productive.

EARWIG. *Forficula auricularis.* A troublesome insect in Europe, but rare in the United States.

EBULLITION. Boiling. To know the boiling point of different fluids is often of great importance. Water boils at 212°, alcohol at 176°, sulphuric acid at 600°, mercury at 662°, linseed oil at 640°, oil of turpentine at 316°, nitric acid at 248°, and ether at 100°.

ECZEMA. (See Grease Heel.)

EDUCATION, INDUSTRIAL. (See Agricultural Colleges, and Industrial Education.)

EDULCORATION. In chemistry, the repeated washing, by pure water, of precipitates or powders until they are freed from soluble impurities.

EFFERVESCENCE. The disturbance made in a fluid by the escape of gas. Soda water effervesces.

EFFLORESCENCE. Some salts, like carbonate of soda or soda ash, by exposure to air lose their transparency, and become white, crumbling into powder. This is termed efflorescence. In geology the appearance of crystals upon earthy, rocky, or other mineral surfaces, is termed efflorescence.

EGG. Birds and most insects and fishes and some other animals, are generated from globular-formed bodies called eggs, produced within the mother. These, after being deposited by the parent in favorable situations, and exposed to the proper influences of temperature, etc., undergo a succession of changes, which at last result in a fully developed living creature. (See Embryology.) This, breaking through the outer crust that has confined it, enters upon its new existence. The eggs of the lower orders of animals are collected and held together in great numbers by a viscous membrane, and are called spawn. Those of the birds are deposited singly. They consist of a calcareous shell, white or colored, formed almost wholly of carbonate of lime; the other constituents are minute quantities of animal matter, phosphate of lime, carbonate of magnesia, oxide of iron, and sulphur. Lining this hollow shell is a thin and tough membrane, composed principally of albumen. At the larger end of the egg is a space between the outer shell and this membrane, which, very small when the egg is first laid, gradually increases with its age. It is called the *vesicula aëris*, and is filled with air, in which the proportion of oxygen is larger than in the atmosphere. This, it is said, is for the respiration of the unhatched chick. Within the membrane is the white of the egg, or the albumen, a viscid liquid, in membranous cells, which encloses the yolk and the real germ of the animal. As this germ left the place of its production in the body of the female, and passed into the egg-discharging canal, the albumen gathered around it in successive layers, a portion in very delicate membranes, called the *chalazæ*, which are attached to the poles of the yolk, and serve to suspend it in such a manner that the smaller and lighter half must always be uppermost. The outer layer of the albumen is less thick and viscid than that next the yolk. Around it the lining membrane and calcareous shell are successively added before the egg is laid. The composition of the albumen is: water, 85 parts; pure albumen, 12; mucus, 2.7; and saline matter, 0.3, including soda with traces of sulphur. The yolk, called *vitellus ovi*, is also a glairy fluid, commonly of a yellow color, enclosed in its own membrane, and consists of a great variety of constituents, viz.: water, 41.486; a form of albumen called viteline, 15.76; margarine and oleine, 21.304; cholesterine, 0.438; oleic and margaric acids, 7.226; phosphoglyceric acid, 1.2; muriate of ammonia, 0.034; chlorides of sodium and potassium and sulphate of potassium, 0.277; phosphates of lime and magnesia, 1.022; animal extracts, 0.4; and 0.553 of coloring matter, traces of iron, lactic acid, etc. Upon one side of the yolk is a round spot, yellowish white, called the *cicatricula*, the germ of the ovum, which by the arrangement of the chalazæ, already referred to, is always kept uppermost, and next to the source of heat supplied by the animal in sitting. As that is developed into the fœtus, the albumen first furnishes nourishment to it, and when this is consumed more is supplied by the yolk. Eggs of the hen are hatched by being kept at a temperature of 104° for three weeks. Their vitality has been retained after they have been exposed to a temperature of 10° Fahr.; and it is a remarkable fact that the freezing point of new-laid eggs is much lower than that of the water and albumen of which they principally consist, and both of which congeal at about the same temperature. Eggs, too, that have been once frozen, or have been long kept, freeze at the point their constituents would seem to require. The specific gravity of new-laid eggs is from 1.08 to 1.09. By keeping they diminish in weight from evaporation of water, and the substitution of air through the pores of the shell. This diminution has been observed to continue for two years; an egg weighing originally 907½ grains being reduced, as remarked by Dr. Thomson, to 363.2 grains. When they have lost so much weight as to float upon water, they are generally unsound. The preventing of this evaporation by covering their surface with a coating of varnish, wax, gum arabic, or lard, checks their putrefaction. It is said that if every new-laid egg was at once rubbed over with sweet butter it would be a rare thing to see one unsound. The Scotch sometimes drop them in boiling water for two minutes, by which the membrane within the shell is partially coagulated and rendered impervious to air. Hen's eggs vary so much in gravity, that it is a wonder they continue to be sold by numbers instead of weight. A dozen of the largest have been found to weigh twenty-four ounces, while the same number of smaller ones of the same stock weighed only fourteen and a half ounces. The fair average weight is said to be about twenty-two and a half ounces to the dozen. The relative weights of the portions of the egg as given by Dr. Thomson are: shell and membrane, 106.9; albumen, 604.2; yolk, 288.9. About one-third of the entire weight may be regarded as nitrogenous and nutritious matter, a greater proportion than that of meat, which is rated at only from twenty-five to twenty-eight per cent., while the nutritive portion of the oyster is only about twelve per cent. The white of the egg, from its tendency to coagulate into a hard and indigestible substance, is likely to disagree with the stomach of invalids, when the yolk may prove perfectly harmless. Raw eggs are more wholesome than boiled, or even than those lightly poached, which are very digestible. Eggs become more difficult of digestion by being kept. In medicine the shell is used as an antacid, its animal composition seeming to adapt it better for the stomach than chalk, the mineral form of carbonate of lime. The white is employed for clarifying liquors and syrups, which it accomplishes by entangling the small particles floating in them as it coagulates, and either rising with them to the surface, or sinking to the bottom. An astringent poultice is formed by causing it to coagulate with a piece of alum briskly stirred with it. This, under the name of alum curd, is used as an application to the eye in some forms of ophthalmia. The white is also used as an antidote to corrosive sublimate and salts of copper. The yolk is sometimes given in jaundice, and forms an excellent diet in dyspepsia. It is preferable to the white in making emulsions. The largest sized eggs of which we have any account are some found in 1850 in alluvium in Madagascar. They belong to a bird which it is supposed has recently become extinct, to which M. Saint Hilaire has given the name of *Æpiornis maximus.* Two of the eggs are preserved in the French academy. One of them measures thirteen and a half inches on its longest diameter, and eight and a half inches on the shortest. The thickness of the shell is about one-eighth of an inch. The capacity of the egg is about eight and a half quarts, six times that of the ostrich's egg—equal to 148 hen's eggs, or 50,000 eggs of the humming bird. From some of the bones of the bird which have been preserved, its height is calculated to be about twelve feet.—New American Cyclopedia.

EGG PLANT. *Solanum melongena.* The Solanum family furnishes two of the most valuable plants for the use of man, the potato and egg plant. The tomato was originally classed as a Solanum, but now is classed as a Lycopersicum, The cultivation of the egg plant is of very ancient date. It was a plant of southern Asia, and the Indian Archipelago, although said not now to be found there wild. Its cultivation was known to the Romans, and from them spread over the entire southern portion of Europe. It has been known in America since the eighteenth century. Being an inter-tropical plant, the least frost completely kills it, and even cold winds so reduce its vitality, that it should not be transplanted to the open air until the days and nights are permanently warm. The seeds must be sown, in the North, in a hot bed, about the first of March, and have a strong heat and continuous moisture, until they germinate. Thenceforward they must have plenty of air, but be kept from chilling winds. When two or three inches high, they are transplanted into another hot bed, at a distance of four inches apart, and kept steadily growing, until they fairly cover the spaces. Then they are transplanted into six inch pots, or better, into troughs, made by nailing a back of siding on a bottom of inch boards, six inches wide. These are made three feet long for ease of handling. When placed in the beds, the back of one trough makes the front of the next. Thus, at a distance of six inches apart, they make strong plants, often coming into blossom before going into the open air. In transplanting, the balls of earth are carefully preserved, and placed in the ground entire, a little water is given them, and dry earth is then drawn over the ball, covering it about one half inch deeper than it stood in the trough. By this plan they are scarcely checked, and will grow and perfect their fruit of a size for cooking, by the first of August, in the North. The egg plant is cooked in a variety of ways; sometimes by baking, but generally by paring, slicing one half inch thick, and frying soft and brown in butter. Persons accustomed to their peculiar flavor, become very fond of them.

ELAIN. The fluid oil existing in fats, etc., which may be separated by pressure, by cold, or by digesting in seven or eight times its weight of boiling alcohol, which acts upon the fat or tallow in such a way that the elain floats above the alcoholic solution, and the solid, or stearin, sinks below when cold.

ELASTICITY. The power certain bodies possess of returning back to their original bulk or position when bent or compressed. Gases are the most elastic bodies known, fluids the least, and metals differ exceedingly in this respect. Some phenomena of elastic bodies are the following· An elastic body (the elasticity being supposed perfect) exerts the same force in endeavoring to restore itself, as that with which it was compressed or bent. The force of elastic bodies is exerted equally in all directions, but the effect chiefly takes place on the side on which the resistance is the least. When an elastic solid body is made to vibrate by a sudden stroke, the vibrations are performed in equal times, to whatever part of the body the stroke may be communicated. Thus, sonorous bodies always emit sounds of the same pitch; and the difference of the pitch depends on the greater or less frequency of the vibrations of the sonorous body. A body perfectly incompressible can not be elastic, therefore bodies perfectly solid can have no elasticity, and hence, also, the small degree of elasticity belonging to the liquids, which are eminently incompressible.

ELATER. Click-beetle, Spring-beetle. *Elaterides.* This beetle, from its habit of suddenly springing in the air, and landing on its feet when placed on its back, is well known, especially among children. The larvæ are all destructive from their habit of feeding on the roots of vegetation, and should be destroyed. It is supposed by some, that the Wire worm is the larva of this beetle. Such is not the fact. They are the larvæ of a species of *Iulus* belonging to the *Myriapoda*, so named from their great number of feet. The Wire worm of England, has only six feet, nevertheless we have several grubs allied to them, but which are not common. The following is from a report of the late Dr. Le Baron, Entomologist of Illinois Our largest and most striking species is the well known *Elater* (*Alaus*) *occulatus*, of Linnæus. It is usually nearly an inch and a-half in length, though individuals are not unfrequently seen which scarcely exceed an inch. Its gray color is produced by a dense sprinkling of small whitish spots and lines upon a black ground. These spots are composed of minute whitish scale-like hairs. But its most conspicuous character is the two large eye-like spots on the top of the thorax, which are expressed by the specific name. The larvæ inhabit partially decayed wood, and are often found in the trunks of old apple trees. The *Elater rubricollis,* Say, is a little more than half an inch long, black, with a light-red thorax, bordered and pointed behind with black. The *Elater sanguinipennis*, Say, is black, with light-red elytra; three-tenths of an inch in length. The *E. apicatus,* Say, is similar, but larger, being nearly half an inch in length, and the elytra are tipt with black. The *E. nigricollis,* Say, varies from less than half to three-quarters of an inch in length; black, with whitish elytra. The *E. linteus,* Say, resembles the last, but is distinguished by having the suture and tip of the elytra black. *E. scapularis,* Say, is a little less than four-tenths of an inch long, greenish-black, with the base of the elytra and the hind points of the thorax, clay-yellow. The tarsal joints are lobed beneath. It is now included in the genus *Athous.* The *Limonius armus,* Say, is also light-red on the shoulders of the elytra, but the thorax is wholly black, the tarsi are simple, and the length is only a quarter of an inch. Several species of *Corymbetes* have the elytra brownish-yellow with transverse zigzag black bands. *C. hieroglyphicus*, Say, half an inch long, has two bands; and *C. hamatus*, rather smaller, has but one band near the tip. The *Melanotus fissilis*. Say, (*cinereus*, Weber?) and the *M. communis*, Sch., plain brown species, usually about half an inch in length, but subject to considerable variation in size, are amongst our most common beetles. The two species closely resemble each other, but the latter is a little smaller, and the thorax is proportionally longer and less convex. The *Melanactes piceus*, DeG., is a large glossy black species, an inch or more in length. It is not uncommon in the latitude of Southern Illinois, where it is sometimes jarred from peach trees upon the curculio-catcher. Riley has found and figured its supposed larva, which is one of the most beautiful objects, and often attracts the attention of the curious in the regions where it is found, south of latitude 39°, by its luminosity; the animal glowing in the dark with a beautiful green light.

ELATERIUM. *Momordica eleterium.* An indigenous annual vine, bearing a small fruit like the cucumber, the juice of which is a drastic purge.

ELBOW. The shoulder joint of cattle. A bend in carpentry.

ELDER. *Sambucus Canadensis.* An indigenous shrub, very tenacious of life, common in the Northern and Middle States, also in the West, getting a permanent foothold along fences, hedge-rows and waste places, on the premises of slovenly farmers. It should be eradicated wherever found. Birds are fond of the berries, and it is thus generally disseminated. A kind of wine is sometimes made of the berries, and the juice is also used in coloring fictitious port and other dark wines. A decoction of the fresh leaves is said to be obnoxious to some insects and also to moles. Sheep are said to eat the leaves, as a natural remedy for rot. It has also been recommended for hedging. There are, however, better remedies for sheep rot, and as a hedge-plant it is simply worthless. It may be killed by keeping it cut down during the season of growth and by the grubbing of the roots in the fall.

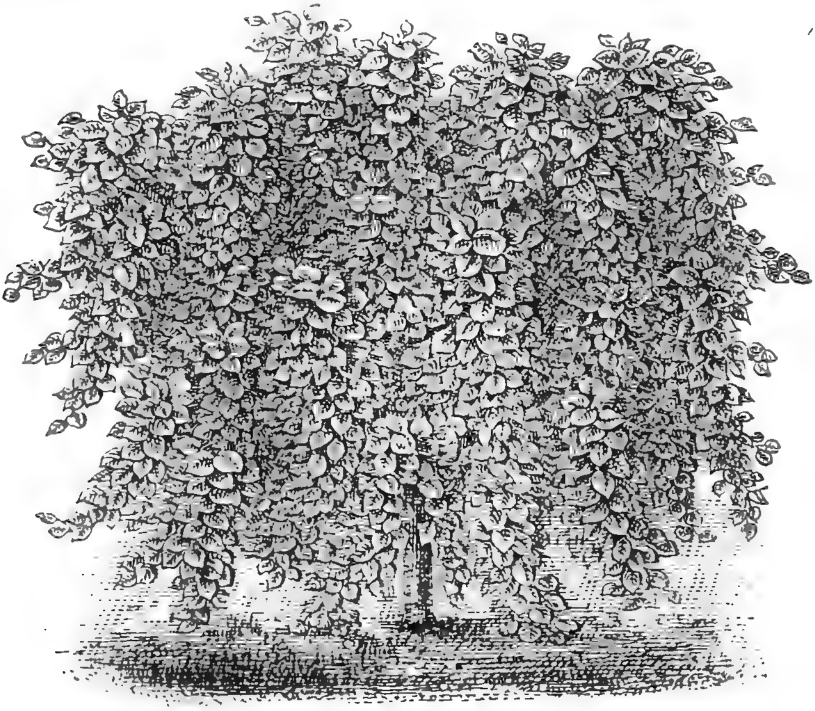
ELECTIVE AFFINITY. A chemical term, meaning the preference exerted by a body to combine with another in place of one already in union. Thus, potash will unite with sulphuric acid, although it be already combined with iron; the iron is separated, and gives place to the potash, which is preferred or elected. It is governed by electrical forces, like all other cases of chemical union.

ELECTRICITY. This is one of the most important and potent forces in nature, and especially interesting to the agriculturist, now that it is known to be a valuable factor in the growth of plants, and also in its various action in the phenomena of nature as affecting rainfall, the formation of hail, its influence in tornadoes and various other meteorological phenomena hitherto unsuspected and even yet not well understood. The influence of electricity on vegetation and the internal electricity of vegetables are two of the most interesting of the subjects connected with electricity, and the following data in relation to the influence of electricity, compiled from various sources, show that the causes which liberate electricity in organized bodies under the reign of life, or a little after it, are of three orders, physical, chemical, and organic, the latter belonging to certain vital functions not clearly defined. There exists in vegetables an ascending sap and a cortical sap, the latter not having the same composition as the former and, according to some physiologists, having a descending motion. Both are separated by tissues, and produce electric effects like those of a pair of galvanic plates. These effects are so much the more remarkable, as they relate to the formation of the bark and that of the wood. The parenchyma, which is analogous to the pith, occupies the circumference of the bark, while the pith itself is found at the center of the ligneous system. This inversion responds to reverse electric effects. Each stem or branch being composed of an interrupted series of heterogeneous concentric layers, their successive contact gives rise to electric effects rising from the heterogeneous liquids moistening these layers. The ascent of the sap is not only due to endosmosis and to capillary attraction, but also to the presence of buds, which draw from the stem and branches the substance for their development. The buds afterward are not slow in forming leaves, which become the seat of a continual evaporation, which concurs with the ascending motion of the sap, and influences the manifestation of electric effects. After the discovery of voltaic electricity, Dr. Baccomio undertook to construct piles with organic matter of vegetable origin, as Metteucci has since done with portions of the muscles of different animals. The first experiments, however, had no value. Becquerel, Wartmann, and Donné, by means of metallic plates or wires in connection with a multiplier, obtained currents in vegetables and fruits. The existence of electric currents constantly circulating in vegetables, and between them and the earth, is manifested not only in the direct experiments which have been made, but according to the following physical considerations. In the vertical section of a stem, the ascending sap, before its entrance into the vegetable by the roots, is composed of water, holding in solution air, carbonic acid gas, and very small quantities of saline and organic matter removed from the soil. As to the parenchymous sap elaborated in the leaves, it loses insensibly a portion of its constituent parts for nutrition. Both saps are found in the conditions requisite to form contacts by insensible transitions, and consequently to produce electric currents without the intervention of metallic plates. On the other side, the earth being in direct and permanent communication with vegetables, through the medium of the roots, participates in their electric state, resulting from the diverse elaborations which take place in their tissues, just as we have seen atmospheric temperature influence the heat of vegetables. From very delicate experiments, confirmed by Riess, Pouillet concludes that the action of vegetables upon the oxygen of the air is one of the most permanent and powerful causes of atmospheric electricity. A gram of pure carbon, in changing to the condition of carbonic acid, liberates electricity enough to charge a Leyden jar. Now the carbon entering into the constitution of vegetables cannot give less electricity than freely burning carbon; hence we may conclude, that upon a surface of vegetation of one hundred square meters, (0.099 rood) more negative electricity is produced in a day than would suffice to charge the strongest electric battery. Buff took up the experiments of his predecessors, without putting platinum plates in direct contact with the organs of vegetables, and operating much as Dubois Reymond has done in his researches on animal electricity. In order to change as little as possible the natural conditions in which a plant is found, Buff employed water as the medium of communication between different parts of the plant and the galvanometer. He first compared the electric state of the leaves with that of the roots. He then examined branches separated from the vegetable; afterward the young and fresh bark, the buds, flowers, etc. He regards it as established by his experiments, that the roots, and all the external parts of plants which are filled with the juices of vegetation, are negative relatively to the surface, more or less moist, of the leaves, the flowers, the fruits, and the young branches. Buff thus explains this fact: The interior of the plant contains various juices, which can not pass through the epidermis, while the exterior moisture always soaks a little into this membrane. We have then in contact a membrane soaked with water, and vegetable organs charged with liquids of various natures. If, now, we establish between this membrane and these organs a closed circuit, a current must evidently be produced. But it appears evident, adds Buff, that this current has a relation, very indirect and remote, to the phenomena of vegetation. Becquerel reaches these conclusions. Derived currents are produced in the stems of vegetables by platinum needles, one introduced into the bark, the other into the wood, directed from the parenchyma to the pith. Similar currents are produced in the bark, proceeding from the cambium to the parenchyma, directed inversely to the preceding. The sap, or the liquid of the cortical parenchyma, if retained in contact with the air for a few seconds, suffers such a modification that on putting it anew in contact with sap found in the green part of the parenchyma of the bark it becomes negative to it. Derived terrestrial currents are produced through the medium of the roots, of the pith, and of other parts of the stem. The direction of the terrestrial currents shows that in the act of vegetation the earth constantly takes an excess of positive electricity, and the parenchyma of the bark and of the leaves an excess of negative electricity, which is transmitted to the air by the exhaled water. The distribution of the ascending juices and of those of the cortical parenchyma warrants us in believing that currents circulate constantly in vegetables, directed from the bark to the pith, passing through the roots and the earth, or perhaps without passing through them. Chemical actions are the primary causes (it cannot be doubted) of the electric effects observed in vegetables. These effects are varied, and up to the present time we have been able only to observe a small number of cases. The opposite electric states of vegetables and the earth give rise to the thought that by reason of the power of vegetation upon continents and islands they may exert a certain influence upon the electric phenomena of the atmosphere. So Becquerel and Wartman believe that closed currents constantly circulate in the interior of each plant, which are directed from the bark to the pith, and thence to the extreme branches; they attribute the production of these currents to the presence of two different liquids reacting chemically upon each other by the intervention of tissues that are scarcely permeable. De la Rive remarks that it seems demonstrated that hitherto we have no proof of an electric state in living vegetables analogous to that which we have found in the muscles and nerves of animals; and that all the traces of electricity that have been collected may be attributed to ordinary chemical reactions, and in some cases to atmospheric electricity. The phenomena of the osmotic force lately studied by Graham, are not contrary to this conclusion, since it is to a chemical action that he attributes the production of the electricity that accompanies endosmosis. A curious experiment made by Donné is as follows: He found in apples and pears an electric current passing from the stem to the eye, making the stem end electro-negative and alkaline, while the end of the eye is electro-positive and acid. The peach, apricot, and plum present a reverse current. In the plane perpendicular to that which passes through the stem and the eye, the electric current ceases at equal distances from the centre of the fruit. The juice of these fruits has the the same electric properties. Donné thinks that these effects are not due to the acid and the alkaline quality of the fruit, but that all the juice of fruits is not of the same composition at the stem and the eye, and this is sufficiently heterogeneous to produce these electric currents. When an apple or pear is cut in two, the stem end will be found the sweeter, while in the peach or apricot the eye is the best. On the action of electricity on the germination and growth of plants, we find that the earliest experiments seem to have been made by Dr. Maimbray, of Edinburgh, in the autumn of 1746. He electrified two myrtles, and found that they put forth small branches some inches in length, and even came into blossom during the month of October. This did not happen to myrtles not electrified, and he attributed the phenomenon to the influence of electricity. This experiment was repeated in Switzerland, France, Germany, and Italy. In the preceding year, 1745, Boze had observed that water issuing from a vessel in minute drops would pour out in a continuous stream when the vessel was electrified. The cause of this phenomenon was investigated by L'Abbé Nollet, who thought that this electrical effect in capillary glass tubes might have some connection with the sap in plants, and hence produce the unusual growth observed by Maimbray. His first experiments were made on fruits, green plants, and moist sponges, and he invariably found that evaporation had been hastened by the action of electricity. In October, 1747, he took two small wooden bowls, filled with the same kind of earth, sowed them with similar mustard seed, and found that after two days several of the seeds in the electrified bowl had come up, while no alteration had taken place in the other. The following day nine of the electrified seeds had come up—none of the non-electrified ones; and this superiority was kept up till the plants in the first bowl were ten inches high, and those in the second not more than a quarter of an inch. In repeating this experiment, in different ways and with other seeds, the same results were always obtained. The electrified plants, however, appeared rather weaker than those which had not been so treated. In the same year (1747) John Browning read a paper before the Royal Society of London, on the effects of electricity on vegetables. In this paper he describes his own experiments as well as those of Baker, who electrified a myrtle at the Duke of Montague's, in Ditton. In the months of April and May, 1747, Jallabert electrified various plants two hours every day regularly, exposing them to the open air after the operation, and found that all of them, and in particular a carnation, grew rapidly and flourished remarkably. In the autumn of 1747 he electrified bulbs of hyacinth, jonquil, and narcissus, which were beginning to grow in glasses of water. Those which were electrified grew more rapidly, the leaves were larger and the flowers opened sooner than those not electrified. He found that the electrified bulbs gave off more moisture in a given time than other plants. He also repeated the experiments of Nollet on mustard and cress, with similar results, and attributed these effects to an acceleration of the movement of the sap caused by electricity, analogous to that observed by Boze in capillary tubes. Boze, of Wittemberg, electrified, in 1747, different kinds of plants and shrubs, the growth of which invariably seemed to be accelerated. Similar results were obtained in 1748 by L'Abbe Menon, of Angers, who, in a letter to Reaumur, states that, by the aid of electricity, he had greatly facilitated the growth of offsets of ranunculus, even in the depth of winter. In 1752, J. Freke, in his curious treatise on the nature and properties of fire, quotes experiments with electricity on the leaves of the sensitive plant, the irritability of which was then considered by many of electrical origin. In 1771, Nuneberg, of Stuttgard, took two boxes, each containing five bulbs in all respects alike, and electrified one of them; the plants grew far more rapidly than those in the other box, the relative size after eight days being as eight to five. In the same year, Sigaud de la Fond, of Montpellier, found the bulbs of hyacinths when electrified grew faster and formed more healthy plants than those not electrified. In 1776, L'Abbe Bertholon made some experiments on the conducting power of plants for electricity, in which he showed the great difference which exists between different plants, those, generally speaking, being the best conductors which were the most succulent or contained the largest quantity of moisture. The announcement was made, in 1775, by C. H. Koestlin, that negative electricity was detrimental to vegetation, both animal and vegetable life being retarded by it. This appears to be the first distinct observation as to the different influences of positive and negative electricity, for the preceding experiments seem to have been made with positive electricity alone. According to Gasc, Linnæus proved the influence of electricity on plants. In 1779, a naturalist in London determined to repeat the original experiment of Dr. Maimbray, and accordingly electrified a myrtle for many hours a day for some time in the middle of December. The result was that the tree formed buds and threw out small branches in a remarkable manner. In 1781, Count de Lacépède describes some experiments which he had made on vegetables, observing that invariably in electrifying a plant he found it grow or increase with more vigor than usual, and that the germination of seeds and sprouting of bulbs placed in water was always hastened in a very decided manner by electricity. Dr. Marat described in 1782 some experiments he had made on the germination of electrified seeds, from which he draws the conclusion that it exerts powerful influence on the fertility of the soil. On the seventh day the plants began to make their appearance in the electrified vessels, and at the end of a fortnight they were as forward as similar plants sown on the same day, but kept in a room nine degrees above the freezing point. In the three vessels which were not electrified the seeds had not begun to germinate. In 1783, L'Abbe Bertholon published the first book on electricity applied to vegetables, after making numerous experiments. The results of Nollet and Jallabert were confirmed by Bertholon. He observed that interrupted electrification appeared to have more influence than when continued, in accelerating vegetation. He gives some curious facts on the colors, odors, and taste of fruit and flowers, on the development of which he thinks that electricity exerts a very remarkable influence. Fruits nearly ripe, on being electrified, were found to acquire the odor and taste of ripeness sooner than others not electrified. Flowers or plants just coming into blossom arrived sooner at perfection, and the colors were more brilliant than is ordinarily the case. When plants in flower were electrified, the blossoms were observed to become more brilliant in color, and of a richer and more delicate tint, than other flowers of the same kind. All these experiments were made with positive electricity, but with negative electricity the effects for the most part were reversed; germination was retarded, the growth and formation of the leaves were checked, the development of fruit and flowers, and the secretion of coloring and odorous matters was impeded. He states that these effects may be observed by experiments on a small scale as well as by carefully watching the electric condition of the atmosphere on a large scale. Bertholon attributes the increase and development of certain insects which feed on plants to the agency of electricity, which he says exerts the same influence upon them as on the seeds of plants. He accordingly proposes to kill them by an excess of electricity, passing the shocks of Leyden jars through the trunks of trees on which the larvæ are deposited, and provided the shock is not too powerful the tree will not be injured. All the ordinary diseases to which plants are subject may, he thinks, be diminished, counteracted, or entirely cured by a judicious use of electricity. In 1784, Achard published his observations, in several essays, on the electricity of rain, snow, and hail, on electrifying fluids, on germination, and the influence of electricity on the growth of vegetables, in which he confirms the results of preceding philosophers; also, on the influence of electricity in promoting the fermentation and putrefaction of vegetable and animal matters. He found both negative and positive electricity accelerated the putrefaction of animal matter, causing barley and other fermentable substances to pass into spirit with increased rapidity. From 1786 to 1790 Perzieret made numerous experiments on chervil, wheat, beans, rye, peas, mustard, radish, lettuce, trefoil, etc., and in nearly all cases the electrified plants came up first, grew larger, and had longer roots than the others; the leaves were more numerous, larger, and of a decidedly more beautiful green. In 1788, Carmoy described a variety of experiments on the germination of wheat taken from the same ear. After twenty-three days the young plants were measured, when it was found that the unelectrified had grown eleven inches ten lines, the positive eighteen inches five lines, and the negative nineteen inches nine lines. A number of other experiments of the same kind are given, the general result of which is that electricity appears to accelerate germination, negative electricity being more powerful than positive. In 1789, L'Abbé d'Ormoy electrified mustard seed and lettuce for several days in moist earth, and found their germination always accelerated. He found also that electrified seeds had always the start of the non-electrified, and so beneficial did he find it to germination that even old and dry seeds, which seemed spoiled and would not germinate, did so rapidly when previously electrified for some hours. Almost the same results were published by Bertholon at nearly the same time. He inclosed parcels of seeds in tin-foil, and kept them constantly electrified for some days before sowing, when he found that they germinated remarkably soon. These experiments were made with seeds of spinach, endive, and turnip. He describes experiments in which he found seeds to germinate sooner when placed on the plate of a charged electrophorus. At the end of the last century, the discovery of voltaic electricity, and the brilliant results to which it led, completely eclipsed the hitherto favorite study of frictional electricity. Bozières, one of the first, entered this new field of investigation by two papers containing numerous experiments made from 1786 to 1790, in chervil, wheat, beans, rye, peas, mustard, radish, lettuce, trefoil, etc., the result of which was that, in nearly all cases, the electrified plants came up first grew larger and had longer roots than the others. The leaves were more numerous, larger, and more beautifully green. These researches confirm the original experiments of Nollet and Jallabert, and prove that the views of Ingenhousz were incorrect, and the effects in question were not results of imperfect experiments, due to the unequal influence of light, but were really caused by electricity. In this view Bozières was borne out by the experiments of Bilsborrow in 1797, who found germination decidedly accelerated by positive electricity, and still more by negative. In 1807, Sir Humphry Davy published some interesting experiments on seeds and growing vegetables. Seeds placed in pure water at the positive pole of a voltaic circuit germinated much more rapidly than under ordinary circumstances, but at the negative pole they did not sprout at all. He remarks that without supposing any peculiar effects from the different electricities, this may be accounted for by the saturation of the water near the positive metallic surface with oxygen, and that near the negative pole with hydrogen, though he does not think it impossible that the same effect may be due to electricity. When growing plants were made the medium between the two poles of the battery, in one case a mint plant was killed, but another, after ten minutes, remained uninjured. Lime and fixed alkali were found at the negative pole, while chlorine and sulphuric acid were at the positive pole of the battery. These experiments were held by Du Petit Thouars as evidence of the great influence of electricity on vegetation. He held that plants contained two different galvanic arrangements—one acting vertically through the woody fibres, the other horizontally, through the medullary rays. To these opposite independent currents he attributed the principal phenomena of vegetation. Many experiments on the influence of electricity of low tension on germination have been made by Becquerel since 1833. Seeds in contact with the upper element of a feeble galvanic current grew faster, while those in contact with the zinc element grew less rapidly than similar seeds planted in glass; the negative extremity increasing, the positive retarding germination. Similar results were obtained with bulbs connected in water. The favorable influence of negative electricity of low tension on germination is attributed to the decomposition of saline substances, and consequent evolution of alkaline matter, which assists germination by combining with and neutralizing the acetic acid always evolved during germination and the growth of bulbs and buds. While the experiments quoted are interesting, it is the fact that so far, electricity has never been profitably applied artificially in the cultivation of plants. It is hardly a supposable case that it ever will be. It is, however, not uninteresting for the farmer to know the effects of direct electrical influence. Smut, rust, and other fungus growths have been more than suspected to be the effect of electrical action. If some easy and cheap means could be perfected, by which to apply electrical action to large areas, either negative or positive, cheaply and at will, it might be found of advantage to the agriculturist.

ELECTUARY. Any medicine of a thick or solid consistence, made up with sugar.

ELEMENTS. In chemistry, bodies which have never been decomposed or resolved into their components by artificial (chemical) means.

ELM. *Ulmus.* The Elm is one of the most beautiful of American trees, when planted singly. In fact, it is the most beautiful, size and grace of form and beauty being especially considered. Hence it is, without doubt, the most popular of shade trees. Michaux regarded the elm as the most magnificent vegetable of the temperate zone. The elm is not only a fast growing tree, once its roots get hold of the soil, but it is long-lived, and few trees stand the smoke and dust of cities better. Hence, it is extensively planted in avenues and parks of cities, and in the streets of villages. The American White elm (*Ulmus Americana*) is, without doubt, the most handsome of the species, reaching in its native forest, a height of eighty to 100 feet. It is, however, when planted out singly, that its real beauty comes out, assuming, as it does, many graceful forms, of pendulous beauty, and sometimes becoming almost weeping in form. Among the strictly ornamental varieties produced by the art of man, the Camperdown elm is one of these, a cut of which we give to show its peculiarities. Among the varieties of the American elm, the Corky, White elm (*U. racemosa*), closely resembles the true White elm. It grows along the banks of rivers, is more rigid in appearance, the wood is tougher and finer grained, and the corky ridges on the branches easily distinguish it from the white variety. The Slippery, or Red elm (*U. fulva*), is a valuable tree. Its inner bark furnishes the slippery elm of commerce. It reaches a length of fifty to sixty feet, and a diameter of two feet of trunk. In the West it is a common tree. The wood is tough and valuable, and is especially sought after for hubs of wheels, for the reason that it holds the spokes firmly. The Winged elm, or Wahoo (*U. alata*), is common South, and occasionally found up to latitude 40°. It is a handsome medium sized tree, and distinguished by the corky ridges on each side of its branches, whence its name. The English elm (*U. campestris*), is one of the finest trees of Europe, an immense tree of ninety to one hundred feet in height and sometimes immense circumference. The wood is valuable when grown on dry soils, but from its habit of persistently producing suckers, it is not a good tree to plant for ornament. The Scotch, or Witch elm (*U. montana*), is darker in its foliage than the English elm, a large, handsome, vigorous tree, and better as an ornamental tree since it produces no suckers.



CAMPERDOWN WEEPING ELM.

ELYMUS. The genus of lyme grasses. They are perennial, large and coarse, mostly water or seashore plants. *E. arenarius* is of service in binding together loose seashore sands, and resisting the encroachments of the sea. Salt-marsh grasses are frequently of this genus.

ELYTRUM. The outer hard wings of beetles.

EMACIATION. The act of becoming lean. It is produced by hard labor, insufficient food, and a diseased condition of the stomach and intestines.

EMARGINATE. In botany, notched, having a sharp indentation on the leaf, etc.

EMASCULATE. To castrate.

EMBROCATION. A spirituous, saponaceous, oily, or any fluid application rubbed on the skin to relieve pain or numbness.

EMBRYO. The growing point, eye, or chit of a seed. The young of animals in the act of development, a fœtus.

EMBRYOLOGY. This is the study of the mode of formation and development of the animal fœtus. The progress of our knowledge on this subject has been marked by several well defined epochs, corresponding with the successive discoveries of as many different investigators. Though many important facts bearing upon embryology were known to the earlier anatomists and physiologists, they were often misinterpreted, and their true relations consequently mistaken. Aristotle and his followers recognized three different modes of generation as occurring among animals, viz.: oviparous, viviparous, and spontaneous generation. Oviparous generation was that form in which the female parent produced eggs, from which the young were hatched, as in most fish, reptiles, and birds. Viviparous generation was that in which the young were discharged alive and fully formed from the body of the parent, as in quadrupeds and the human species; while spontaneous or equivocal generation was that in which certain animals of a low order, such as worms, insects, parasites, maggots, etc., were supposed to be produced spontaneously, without parents, from the soil, the water, or decaying animal and vegetable substances. By the progress of investigation, however, the last mode of generation was shown to be much less frequent in its occurrence than Aristotle had supposed. The first advance in this direction was made about the end of the 17th century, when Redi, an Italian naturalist, studied with care the generation and metamorphoses of insects, showing that many worms and maggots, instead of being produced without parents, were in reality hatched from eggs laid by perfect insects, and that they afterward became transformed, by the process of growth, into similar forms. He also in 1684 showed that most parasitic animals were provided with sexual organs, and produced their young in the same manner with other and larger species. Valisnieri soon afterward (1700) extended the observations of Redi, and applied the same conclusions to other species of insects, and to the parasites inhabiting vegetables. In this way the number of species in which spontaneous generation was regarded as possible or probable gradually diminished, as zoological science became more extended and more accurate; until, in 1837, Schultze demonstrated, by his experiments upon the infusoria, that even these microscopic animalcules are never produced in situations where their germs neither existed before nor could gain access from without. Since then it has been generally acknowledged by physiologists that spontaneous generation is a thing unknown in nature, and that the supposed instances of its occurrence are only cases in which the real process of generation has not been sufficiently investigated. The distinction between oviparous and viviparous animals was also supposed by the ancients to indicate a fundamental difference in their mode of generation. In oviparous animals the eggs were known to be produced by the female, and fecundated by the male, after which the young were hatched from them by incubation. In the viviparous species the embryo was thought to be produced by a mixture of the male sperm with the fluids of the female generative organs; some thinking that the material for the body of the embryo was supplied by the menstrual blood, others that it came from a kind of female sperm, or seminal fluid secreted by the female organs. In 1651 Dr. William Harvey, in his book on Generation, first announced the fact that there is no essential difference in the mode of generation between oviparous and viviparous animals, but that all animals whatsoever, even the viviparous, and man himself not excepted, are produced from ova. But though the truth of this opinion has since been amply confirmed, and its expression (*omne animal ex ovo*) has now passed into a physiological aphorism, yet it was not intended by Harvey precisely in the sense which is now given to it. Harvey never saw the unimpregnated eggs of the quadrupeds, nor did he have any idea of the real structure and function of the ovaries in these animals; and in stating the opinion that the young of the vivipara and of man were produced from eggs, he only meant to say that, after sexual intercourse and conception, the first thing produced in the uterus was not the embryo, but rather resembled an egg; and that the embryo was afterward formed from this, by the process of growth. In 1672 Régnier de Graaf showed that the ovaries, in women and in female quadrupeds, were filled with globular vesicles, visible to the eye, similar in appearance to the eggs of birds and fishes. These vesicles he pronounced to be eggs; and the organs in which they were found then took the name of ovaries. A century and a half later (1827) Ch. Ernst von Baer discovered, by the microscope, the real egg of the human female and of the viviparous animals, which is contained in the interior of the vesicles of De Graaf. These eggs were shown to exist in the ovaries of virgin females, as well as of those in whom sexual intercourse had taken place and it was accordingly demonstrated that, in all animals and in man, the eggs are formed originally in the ovaries of the female, independently of the male; and that these eggs are afterward fecundated, and developed into embryos. Another important discovery remained to complete our knowledge on this part of the subject, viz., that of the spontaneous ripening and discharge of the eggs, in quadrupeds and in man. Négrier, Pouchet, and Bischoff demonstrated (1840–'2–'3) that the eggs of the female, originally produced in the ovaries, ripen and are discharged, independently of sexual intercourse, at certain regular periods; and that the impregnation of these eggs by the male sperm is a subsequent process, taking place after the eggs have left the ovary and entered the Fallopian tubes. The origin of the embryo accordingly takes place in the same manner in all classes of animals, viz., from an egg, which is produced in the ovary of the female, discharged thence at certain definite periods, and afterward fecundated by contact with the spermatic fluid of the male; and the only real difference between oviparous and viviparous animals is that in the former species (ovipara) the fecundated egg is discharged from the body of the female and deposited in a nest, or other suitable receptacle, in which it is afterward hatched; while in the latter (vivipara) it is retained in the body of the female, and there nourished during the development of the embryo. The egg, at the time of its discharge from the ovary, consists of a globular vitellus or yolk, surrounded by a membrane termed the vitelline membrane. In very many instances this becomes surrounded, while passing downward through the Fallopian tubes or ducts, with a layer of transparent albuminous matter; as for example, in the eggs of frogs, tritons, etc. In other cases, in addition to the albuminous matter, certain membranous coverings are deposited around the egg, of a fibrous and calcareous texture, as in birds and the scaly reptiles. In all instances, however, it is the vitellus which is the essential part of the egg, and that from which the embryo is directly produced. The first change which occurs after the impregnation of the egg, is a spontaneous division or segmentation of the vitellus. The vitellus divides successively into smaller and smaller portions, in such a way as to produce at last a multitude of minute flattened bodies or cells, which are attached edge to edge, and which form, accordingly, a continuous membrane, which is called the blastodermic membrane. In eggs which have a large-sized yolk, as those of the birds, lizards, and turtles, the formation of the blastodermic membrane begins at a particular spot on the surface of the vitellus, termed the *cicatricula*, and thence spreads in every direction, so as to enclose gradually all the rest of the yolk. But in those which are of minute size, as in quadrupeds and the human species, the whole vitellus is converted into the blastodermic membrane, which after its formation encloses only a small cavity filled with transparent, watery fluid. The blastodermic membrane then becomes variously altered and developed in different parts, so as to form the various organs and tissues of the embryo. A line or furrow first shows itself, in the thickest and most condensed portion, known as the primitive trace. This indicates the future situation of the spinal column; and the different parts of the vertebræ gradually grow around it, forming a chain of cartilaginous rings, with transverse and oblique processes, which envelope the primitive trace or furrow, and convert it into a closed canal, large and rounded at the anterior extremity, or head, but narrow and pointed at the posterior extremity, or tail. In this canal the brain and spinal cord are formed and complete the development of their parts. At the same time, the remainder of the blastodermic membrane becomes more condensed and organized, forming the integument and muscles of the chest and abdomen; and these portions finally unite with each other in front, forming at the point of junction a longitudinal or rounded cicatrix, known as the umbilicus. The alimentary canal, formed in the interior of the abdominal cavity, is at first entirely closed; but two openings are afterward formed, one at the anterior extremity of the body, the other at the posterior. These openings become the mouth and anus. In frogs, tritons, and some kinds of fish, all these changes take place after the eggs are discharged from the body of the female. In birds and turtles, the segmentation of the vitellus and the formation of the blastodermic membrane are already far advanced at the time the eggs are laid. In the lizards, most serpents, and some kinds of cartilaginous fish, the development of the embryo takes place partly while the egg is still in the generative passages of the female, and partly after its expulsion. In a few species of serpents, and in some fish, the embryo is completely developed within the egg in the body of the female, so that the young are finally brought forth alive; while in all the warm-blooded quadrupeds, as well as in the human species, the fecundated egg is also retained in the uterus until the embryo is sufficiently developed to be born alive. In the frog, the eggs are deposited in the early spring, in some shallow pool, freely exposed to the light and air. Immediately after their expulsion the albuminous matter with which they are surrounded absorbs water and swells up into a tremulous gelatinous mass, which floats near the surface, with the eggs imbedded in its substance. The formation of the embryo then goes on as above described, and the young animal, at first curled up in the interior of the vitelline membrane, soon ruptures it and effects its escape. The body is at this time of an elongated form, terminating behind in a narrow, compressed tail. The integument is covered with vibrating cilia, which produce a constant current of fresh water over the surface of the body. Respiration is performed by gills, situated at the sides of the neck, which are at first exposed, but afterward become covered by a fold of integument. The muscular system is very feeble, and the young animal remains nearly motionless, attached by the mouth to the gelatinous matter around the eggs, upon which it feeds for several days. As it increases in size and becomes stronger, it abandons the spawn, and swims about freely in the water, feeding upon the juices and tissues of acquatic vegetables. The cilia with which the body was covered disappear. The alimentary canal is at this time very long in proportion to the size of the whole body, being coiled up in the abdomen in a spiral form. During the summer lungs are developed in the interior, and the young tadpole frequently comes to the surface to take in air. But the gills also continue, and are still the most active organs of respiration. Toward the end of the season anterior and posterior extremities or limbs begin to grow; the posterior sprouting externally from each side, in the neighborhood of the anus; the anterior remaining concealed under the integument, just below the situation of the gills. The tadpole passes the winter in this transition state. The next spring the lungs increase in size, and the gills become less active as organs of respiration. The anterior extremities are liberated from their confinement by a rupture of the integument which covered them, and both anterior and posterior grow rapidly in size and strength. The tadpole at this time, therefore, has both fore and hind legs and a tail The tail, early in the summer, becomes atrophied, and finally withers and disappears altogether; while the limbs, and especially the hind legs, grow to a disproportionate size. At the same time, the lungs attaining their full development, and the gills finally disappearing, the tadpole is thus converted into a perfect frog, capable of living and moving upon the land as well as in the water. The tadpole swims by the tail and breathes by gills, while the frog swims by the legs and breathes by lungs. Simultaneously with these changes, the alimentary canal becomes very much shorter in proportion to the rest of the body, and the frog becomes carnivorous in its habits, living principally upon insects, which he is enabled to capture by the great development of his muscular system, and the rapidity and suddenness of his movements The process of development of the embryo consists, accordingly, in the successive formation and disappearance of different organs which are adapted to different modes of life. When these changes take place after the young embryo has left the egg, as in the case of the frog, and produce marked alterations in the external form of the body, they are termed transformations or metamorphoses. Thus the egg of the butterfly, when first hatched, produces a caterpillar, or larva—an animal with a worm-like body, sluggish crawling movements, and no sexual apparatus, but furnished with largely developed digestive organs and a voracious appetite. This condition is succeeded by the pupa state, in which the animal changes its skin, losing the legs and bristles which were its locomotory organs, and becomes motionless, nearly insensible to external impressions, and stops feeding altogether. During this period another integument grows underneath the old, with new legs and wings; and when the skin is again changed, the animal appears as a perfect insect, or imago, capable of rapid and sustained flight, ornamented with brilliant colors, provided with different sensory and digestive organs and a well developed sexual apparatus. In those instances where the hatching of the egg is a longer process, similar changes to the above take place while the embryo is still retained in its interior. At the same time certain other organs are formed in addition, which either disappear before the time of hatching, or are thrown off when the young animal leaves the egg. With turtles, for example, the eggs, consisting of the vitellus, albumen, and shell, are deposited in an excavation in the earth or sand, and allowed to hatch in these situations. In birds, they are placed usually in nests, formed of twigs, leaves, and fibres, and there kept constantly warmed and protected by contact with the body of the female parent. This process is termed incubation, and may be imitated artificially by keeping the eggs at a temperature of 104° Fahr., and providing for a regular supply of fresh air and a proper regulation of the atmospheric moisture. During incubation the eggs of the common fowl lose twelve per cent. of their weight, of which eleven per cent. is due to the exhalation of moisture. They also absorb oxygen and exhale carbonic acid. The segmentation of the vitellus and formation of the blastodermic membrane, and of the organs of the embryo, take place for the most part according to the plan already described, but variations present themselves which make the process more complicated. The vitellus, for example, instead of being entirely surrounded by the abdominal walls, is divided into two portions by a constriction situated about its middle. One of these portions remains outside the abdomen of the embryo, though still connected with it by a narrow neck, and by blood vessels which ramify upon its surface. This sac, containing a portion of the vitellus, is called the umbilical vesicle. It supplies the embryo with nourishment during the whole period of incubation; for immediately after the egg is laid the albumen, which is at first gelatinous in consistency, begins to liquefy near the upper surface, and the liquefied portions are immediately absorbed into the yolk. The yolk, therefore, grows larger and more fluid than before, while the albumen diminishes in quantity and loses its watery portions. The blood vessels of the embryo, ramifying over the surface of the vitellus and the umbilical vesicle, in their turn absorb the nutritious fluids from it, and convey them into the interior of the body, to be used in the formation of the tissues. At the end of incubation the albumen has disappeared and the umbilical vesicle has much diminished in size, while the body of the chick has increased, at the expense of both; but the umbilical vesicle, containing the remains of the yolk, still exists, and is enclosed within the abdominal walls when the chick leaves the egg. In quadrupeds and the human species the umbilical vesicle is much smaller in proportion to the body, and less important in function, than in birds and the scaly reptiles. In the human embryo, the umbilical vesicle, always very small, disappears soon after the end of the third month of gestation. In the egg of the fowl, certain accessory membranes or envelopes begin to grow around the embryo at an early period. The first of these is the amnion, which is formed by a double fold of the blastodermic membrane, rising up about the edges of the body of the embryo, so as to surround it by a kind of circumvallation. By continued growth these folds at last approach each other and meet over the back of the embryo, forming by their union and adhesion an enclosing membrane, or sac, which is the amnion. The amnion, therefore, is a membranous envelope, which is closed over the back of the embryo, but which remains open in front of the abdomen. About the same time a vascular, membranous diverticulum grows out from the alimentary canal, near its posterior extremity, and emerging from the open part of the abdomen turns upward over the back of the embryo, outside the amnion, and just inside the shell membranes. This vascular outgrowth is the allantois. It increases rapidly in size, growing upward and downward in every direction, until it finally envelopes completely the body of the embryo and the umbilical vesicle, taking the place of the albumen as it is gradually absorbed, and lining the whole interior of the egg shell with a continuous vascular membrane. The function of the allantois is principally to aerate the blood of the embryo, by bringing it into close contact with the porous egg shell, and thus allowing the absorption of oxygen and the exhalation of carbonic acid and watery vapor. Toward the latter period of incubation, the allantois becomes very closely adherent to the egg shell, and the shell itself grows thinner, more porous, and more fragile, whence it is believed that the allantois also serves to absorb calcareous matter from the shell which it conveys into the interior of the body, to be used in the formation of the bones, the ossification of which takes place about this period. When the chick is sufficiently developed to leave the egg, usually at the end of the twenty-first day, by a sudden movement it strikes its bill through the end of the attenuated and brittle egg shell, and by inhaling the air and continuing its struggles, finally extricates itself from the cavity of the shell, leaving the allantois adherent to its internal surface. The blood vessels of the allantois are torn off at the umbilicus, which afterward closes up, and unites by a permanent cicatrix. Another important change which takes place in the development of birds and quadrupeds, in addition to those presented by frogs and fishes, is in the formation of the urinary apparatus. In fishes and batrachians the urinary organs are two, long, glandular bodies situated on each side the spinal column, which are known as the Wolffian bodies, and which remain permanent throughout the life of the animal, no true kidneys ever being produced. But in birds and quadrupeds, the Wolffian bodies, which are at first very large and important organs, disappear during the progress of embryonic development, while the kidneys are formed at the same time, and gradually take their place as urinary organs. The kidneys are accordingly substituted for the Wolffian bodies in these instances very much as lungs are substituted for gills in the development of the frog. In many species of quadrupeds the allantois attains a large size, and performs a very important function, during extra-uterine life. In the ruminating animals, cows, sheep, goat, deer, etc., it forms an elongated sac, taking the form of the uterine cavity, and lying in close contact with the lining membrane of the uterus. The cavity of this sac communicates with the cavity of the posterior part of the intestine, from which it was originally developed, and receives the secretion of the Wolffian bodies, and afterward of the kidneys. Its exterior is covered with a large number (sixty to eighty) of tufted vascular prominences, which are entangled with similar elevations of the uterine mucous membrane, called cotyledons; and the blood of the embryo, while circulating through these bodies, absorbs from the maternal vessels the materials requisite for its nutrition. In the pig, the allantois is nearly smooth on its external surface, merely presenting transverse folds and ridges, which lie in contact with similar inequalities of the uterine mucous membrane. In the carnivorous animals its middle portion is shaggy and vascular and entangled with the blood vessels of the uterus, while its two extremities are smooth and unattached In the human embryo, the amnion is formed in the same manner as already described; but the allantois, instead of constituting a hollow sac, with a cavity containing fluid and communicating with the intestine, spreads out into a continuous flattened membrane, the two layers of which are in contact with each other and adherent leaving consequently no cavity between them. It extends, however, quite around the fœtus, enveloping it in a continuous vascular membrane, which here takes the name of the chorion. The chorion is, accordingly, the same thing in the human species as the allantois in the lower animals, except that its cavity is obliterated by the adhesion of its walls. It is covered uniformly, at an early date, with tufted villosities; which become entangled with the mucous membrane of the uterus. But during the third month it begins to grow smooth over the greater portion of its surface, while at a certain part the villous tufts grow more rapidly than before, until they are finally converted into a thick, vascular, spongy and velvety mass of villosities, which penetrate into the uterine mucous membrane and become adherent to its blood vessels. This organ is then termed the placenta; and from that time forward it serves the fœtus as an organ of absorption and nourishment, its blood vessels imbibing from the circulation of the mother the albuminous fluids which it requires for growth and nutrition. The amnion in the human species is at an early period so arranged that it closely invests the body of the embryo, while between it and the chorion there is interposed a thick layer of gelatinous material. During the second and third months the cavity of the amnion enlarges, by the accumulation of a watery and albuminous fluid (the amniotic fluid) in its interior, while the gelatinous matter between it and the chorion is gradually absorbed and disappears, in order to make way for its expansion. By this enlargement the amnion approaches nearer the internal surface of the chorion, and by the beginning of the fifth month the two membranes come in contact with each other. By this means the fœtus becomes enclosed in a large cavity (the amniotic cavity), filled with fluid, so that a free space is allowed for the movements of the fœtal limbs. These movements begin to be perceived about the fifth month, at which time quickening is said to take place. They afterward become more strongly pronounced, and before birth are frequently very active. These movements are also favored by the formation and growth of the umbilical cord. The blood vessels of the fœtus, termed the umbilical vessels, which pass out from the abdomen to the placenta and the chorion, become much elongated and at the same time covered with a deposit of hard gelatinous matter, the whole being covered by a prolongation of the membrane of the amnion. This bundle of vessels covered with the above investments, is termed the umbilical cord. It grows very long and also becomes spirally twisted upon its own axis, usually in a direction from right to left. There are, in the latter periods of gestation, two umbilical arteries, carrying the blood of the fœtus outward to the placenta, and one umbilical vein, in which it is returned to the body and the internal venous system. The formation of the blood and blood vessels in the embryo takes place at a very early period. Soon after the production of the blastodermic membrane, some of the cells of which it is composed break down, and liquefy in such a manner as to leave irregular spaces, or canals, which inosculate with each other by frequent communications. These canals are destined afterward to become the blood vessels, the structure of which is gradually perfected by the growth of fibrous tissue in their walls, and their complete separation from the neighboring parts. In the interior of these canals, or imperfectly formed blood vessels, there is to be seen at first only a transparent, colorless fluid, holding in suspension a few large, roundish, nucleated cells, which move sluggishly to and fro, as the current of the circulating fluid begins to be established. These cells do not differ much at this period from those which constitute the general mass of the neighboring tissues; but soon afterward they begin to be modified in their appearance, and converted into true blood globules. Their surface becomes smooth and a reddish coloring matter is produced in their interior, which gives them a tinge similar to that of the red globules of the blood in the adult condition. The red blood globules of the fœtus, however, still differ in several important particulars from those of the adult. They are considerably larger and more globular in shape, and have also a very distinct nucleus, which is wanting in the blood globules of the adult, at least in the quadrupeds. They increase in numbers also, at this time, by spontaneous division, one globule becoming divided into two, which separate from each other and afterward become themselves divided in a similar manner. In this way the quantity of the blood globules is very rapidly increased, and they soon become also still further altered in form and structure. They diminish in size, become in the human subject and the quadruped flattened and biconcave in form, and finally the nucleus disappears. These changes are all effected during fœtal life, and for the most part during the early months, so that at the time of birth, the blood globules have already the characteristics which distinguish them in adult life. The multiplication of the blood globules by subdivision is a process which takes place only in the embryo. The perfectly formed blood globules increase in number in some other way, probably by the isolated production and growth of new cells. At the time of birth the fœtal membranes (amnion and chorion) are ruptured, and the fœtus escapes. The umbilical cord being at the same time divided and tied, the portion still connected with the fœtus soon shrivels and separates by spontaneous ulceration, while the spot at which it was attached heals in a few days, leaving a cicatrix on the middle of the abdomen, which is permanent throughout life, and which is called the umbilicus. The limbs grow, by a kind of budding or sprouting process, from the sides of the body. They are at first mere rounded eminences, without distinction of parts or articulations, but they subsequently become successively divided into fingers and toes, and the different joints of the arm and leg. The upper extremities, during the greater part of fœtal life, are larger than the lower, but afterward the lower extremities and the pelvis grow faster than the arms and shoulders, and finally become after birth, much the larger of the two. The lungs are small and solid in texture before birth, but immediately afterward they expand by the inhalation of air, and receive a much larger supply of blood than before. On the other hand, the liver is much larger in proportion to the rest of the body at an early period than subsequently. In some animals it amounts, during the first part of fœtal life, to twelve per cent. of the entire weight of the body, and is reduced to three or four per cent. at the time of birth. In the human subject it is equal at birth to three and a half per cent. of the entire weight, but is reduced in the adult to less than three per cent. Great changes take place also during fœtal life in the anatomy of the heart and circulatory system, as well as in the relative size and development of nearly all the organs in the body. These changes continue to take place after birth, though less rapidly than before, and the entire process of development is not regarded as complete until the individual has reached the adult condition. A very singular modification of the above process of embryonic development among the mammalia occurs in the marsupial animals, of which the American opossum (*Didelphys Virginiana*) is a representative. In these animals the eggs are impregnated and the formation of the embryo commenced in the usual way; but after remaining for a comparatively short time in the uterus, and while their development is still very incomplete, the embryos are discharged from the generative passages, and are immediately afterward found attached by the mouth to the teats of the parent. They are then less than half an inch in length, and quite gelatinous and embryonic in appearance. They are protected by a double fold of the integument of the abdomen, which forms a kind of pouch, surrounding the teats, and serving to enclose the young and helpless embryos. They remain in this situation during the completion of their development, continuing attached for the most part to the teats, from which they derive nourishment; and even after they have become capable of running about by themselves, they still, upon an alarm, take refuge for a time in the pouch as before. It is not known how the young embryos, when expelled from the uterus, find their way into the external pouch, so as to reach the teats, for, notwithstanding many attempts have been made to ascertain this point, the animal is so secret in her habits at the time of delivery, that they have been thus far entirely unsuccessful. Among invertebrate animals the egg is constituted, as a general thing in nearly the same way as in vertebrata, and its impregnation takes place also in a similar manner. The segmentation of the yolk goes on by repeated sub-divisions, until the whole vitellus is converted into a mulberry-shaped mass, out of which the embryo is formed. While, however, in the vertebrate animals, the embryo always lies with its belly upon the surface of the yolk, in some of the invertebrates, as the articulata (insects, spiders, crustaceans), the back of the embryo is in contact with the yolk, and the closing up or union of the two sides of the body takes place along the dorsal line, instead of the abdominal. In many mollusks, as for example in snails, the embryo, soon after the commencement of its formation, begins to rotate slowly in the interior of the vitelline sac; and this rotation continues more or less rapid until the hatching of the egg. In the invertebrate classes the metamorphoses or transformations of the young animal are more frequent and more striking than in vertebrata. In many of them the young animal, when first hatched from the egg, is entirely unlike its parent in structure, external appearance, and habits of life. In the class of insects many of these transformations are well known, and have always attracted the attention of the curious. Frequently the young animal, in passing through several successive transformations in which he is adapted to different modes of life, necessarily changes his habitation: and being found accordingly in totally different localities, and presenting at successive intervals corresponding differences of organization, the same embryo at different ages is often mistaken by the ignorant for an entirely distinct species of animal. These changes of habitation, occurring in the course of embryonic development, are termed migrations. They are often very marked in parasitic animals. Thus the tænia, or tapeworm, inhabiting the small intestines of certain animals, such as the dog, cat, etc., produces an egg containing a small globular embryo, armed with certain hard spikes, or curved prominences, capable of being moved by muscular fibres inserted into their base. The portion of the tapeworm in which these eggs are contained, known as the proglottis, is discharged from the intestine of the first animal, and the eggs, becoming mixed with vegetable matter, are devoured by animals belonging to other species, as for example the pig. Either in the process of mastication, or by the action of the digestive fluids of the stomach, the external envelope of the egg is destroyed, and the embryo set free. By means of its movable projecting spines, the embryo then makes its way through the walls of the stomach or intestine into the neighboring organs, and passing into the cavity of the blood vessels, is often transported by the current of the blood to distant regions of the body. Here, becoming arrested, it is temporarily fixed in place by the consolidation of the tissues around it, and becomes enlarged by the imbibition of fluid, assuming a vesicular form. A portion of this vesicle becomes inverted, and at the bottom of the inverted part a head is produced, upon which there are formed four muscular disks, or suckers, and a circle of calcareous spines or hooks, different from those present at an earlier period, which are thrown off and lost. In this state the animal receives the name of *scolex*, or *cysticercus*. It remains in that condition till the death of the animal whose tissues it inhabits, when being devoured with the flesh by an animal belonging to the first species, it passes into the intestine of the latter, and there becomes developed into the complete tapeworm, or *strobila*, similar to that from which its embryo was first produced. The same animal is accordingly a parasite in different organs, and even in different species, at different periods of its development. Some of the invertebrata are parasitic at one stage of their existence, and lead an independent life at another. Such are the small crustacea which infest the bodies and gills of certain fish. In the family of *œstridea*, or bot flies, the eggs are deposited by the female insect, and attached to the hairs of horses, cattle, etc.; from which situation, after the embryo has become partly developed, they are detached in some instances (as in *œstrus equi*) by licking, and swallowed into the stomach. Here the larva is set free, and attaches itself to the mucous membrane of the stomach, nourishing itself upon the fluids obtained from this source, and gradually increasing in size. After a certain period the larva lets go its hold, passes through the intestine, is discharged with the fæces, and assuming the pupa state, is finally transformed into the perfect insect. The process of embryonic development is accordingly a succession of changes, in which the structure and organization of the young animal are adapted to different modes of existence, and in which different organs and appearances, successively appearing and disappearing, replace each other in the progress of growth, and give rise to the appearance of transformation, which affect the body as a whole.—Appleton's New Encyclopedia.

EMBRYOTOMY. The cutting of the embryo or fœtus out of the womb in cases when the death of the parent is feared.

EMERY. A sand of corundum of extreme hardness, capable of wearing down all minerals and metals except the diamond.

EMESIS. The act of vomiting.

EMETIC. Drugs which produce vomiting. The horse is not made to vomit by emetics.

EMOLLIENTS. Medicines which soothe and soften any part of the body, as warm water, etc.

EMPHYEMA. A collection of purulent matter in the chest, produced chiefly by inflammation.

EMPHYSEMA. A collection of air in the cellular tissue; hence emphysematous.

EMPYREUMA. An odor of burned matter; hence empyreumatic.

EMULSIN. A modification of albumen found in almonds and other seeds, and capable of acting in a peculiar manner on amygdaline to produce volatile oil of bitter almonds.

EMULSION. A milky liquid in which an oil is suspended, as in milk.

EMUNCTORIES. The vessels of the skin which exhale perspiration are so called.

ENAMEL. The hard portion of teeth. Glass and oxide of tin fused together.

ENCYSTED. Fluid or other tumors enclosed in a sac of membrane. It is necessary, in removing them, to cut or destroy the sac also. The *Trichina spiralis* is encysted in the flesh of swine. Many of the parasites like this are microscopic in their nature.

ENDEMIC. A disease or peculiarity belonging to a peculiar people or race.

ENDIVE. *Chicorium endivia.* This plant, in great repute in Europe, is used for salads, the blanched leaves being the edible part. It is a hardy annual, said to have come originally from China. The seeds are sown early in spring in a mellow, prepared bed and, when they have attained eight or ten leaves, are transplanted in rows about sixteen inches apart, by eight inches in the row. Keep the rows clean of weeds and, when the plants have reached their full development of leaves, they are drawn together and the tops tied with bast, or other soft material. Thus the heart will become blanched. If the weather is dry, the bottoms may be earthed up considerably, but if moist, it is apt to rot the plants. The time required to properly blanch them is about ten days, in warm weather, and from this to three weeks, according to the season and temperature. Some careful cultivators cover the plants with large pots after tying, which blanches the plant thoroughly. When properly grown and blanched, endive is an excellent autumn, winter, and spring salad for those who like the slightly bitter taste which blanching can not wholly eradicate. The varieties are many and are divided into two classes, the Batavian and the Curled sorts. The large and the small Batavian are the hardiest varieties. Of the Curled sorts, the Green Curled, White Curled, and the Triple Curled, or Moss Endive, are good. Seed may be sown for succession up to the first of July. The late plants should be tied up for blanching just before freezing weather, and then taken up with earth around the roots and placed in a cool cellar just so they will not touch each other, and a little water poured about the roots. In this manner, with care, the plants may be kept until spring. Our experience with this plant is that it does not pay. The same attention given to celery will furnish a salad much better relished by most American palates.

ENDOCARP. The middle part of a fruit, the flesh of the apple, peach, cherry, etc.

ENDOGENS. Plants and trees that do not enlarge their trunks by any addition of wood exterior to that existing the year before. One of the great divisions of the vegetable kingdom, including palms, grasses, and numerous bulbous plants. The leaves are furnished with straight veins, the flowers usually divided into three parts, or some multiple of that number.

ENDOPLEURA. In botany, the internal integument of a seed.

ENDORHIZÆ. The embryo of monocotyledons, in which the radicle has to rupture the integument at the base of a seed prior to entering into the earth, appearing as if it came from within the mother root.

ENDOSMOSE. The passage of fluids through membranes. Penetration is an analogous term. Whenever two fluids are separated by a membrane or tissue without sensible pores, both of which moisten it, there is a passage of each fluid, one into the other; but this is often with different rapidities, the fluid affecting the tissue most passing with the greatest rapidity. The movement continues until the mixture on each side is similar. This also occurs with gases.

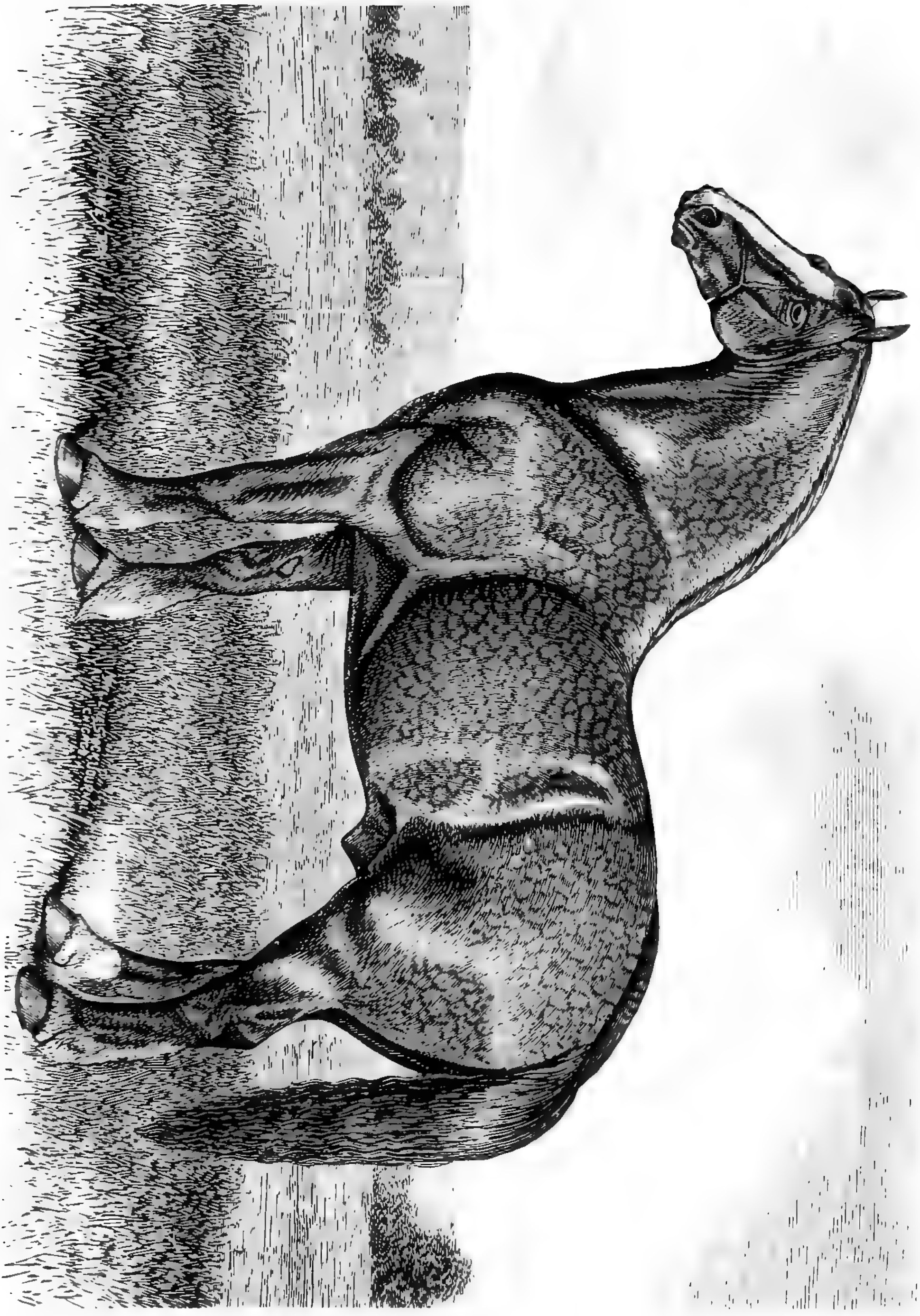
ENDOSPERMIUM. The albumen of seeds.

ENDOSTOME. The passage through the inner integument of a seed immediately below the part called the foramen.

ENDOTHECIUM. The fibrous cellular tissue lining an anther.

ENEMA. An injection.

ENGLISH DRAFT HORSE. The old Black Cart Horse of England, was one of the distinctive breeds of English horses, from an early period. They are hardly known in the United States as a distinctive breed, although they have undoubtedly exercised more or less influence on the ordinary work horses of our country. In England they are divided into three sub-families; first, the heavy massive horse, reared in the rich marshes and plains of the midland counties expressly for the London brewers; second, the smaller-sized but still tolerably heavy horse, generally employed for agricultural purposes, a strong, compact animal, but slow in action; and third, a lighter and more active animal, possessing either some admixture of blood of a smaller breed, or being the descendant of the Flanders discarded coach horse. The prevailing color among these animals is black, but the large dray horse is by no means confined to those of a black color. There are many of a bay, and still more of a brown color, as well as numerous greys and roans. There are also very many excellent compact cart horses of these various colors, better adapted for agricultural purposes; and, indeed, there are those which are generally preferred to the black horse as possessing greater activity and cleaner limbs, combined with equal compactness and strength. The dray horse was originally reared in the greatest perfection in the richest pastures of the fens of Lincolnshire, the largest being seldom less than seventeen hands high, when two and a half years old, at which age they are usually sold. The purchasers work them moderately until they are four years old, feeding them well during this period, at which age they are sold to those heavy teaming firms who aspire to elephantine horses. The modern English draft horse, however, is as much different from those of one hundred years ago as the modern thoroughbred is superior to his ancestors of two hundred years ago. The last fifty years has marked an era, in the breeding of draft animals, as has the last one hundred years in the breeding of thoroughbreds. So that in the draft horse, good feet and legs are of the utmost importance; the shoulders should be oblique, in order that the animal may have free and safe action. The stallion, should have a well-arched chest, long, lean head, and clear, prominent eye; added to this, there must be great bone, supported by strong sinews with plenty of muscle, and the animal should be so good a feeder that it will carry plenty of weight to assist all this. One of the improved English draft horses, is shown on page 303. In speaking of the English cart horse of sixty years ago, of which the modern English draft horse is an improvement, the English Cart-horse Stud Book, says: With very few exceptions (and those exceptions chestnut), black, dark brown, and grey are the only colors met with in descriptions of draft stallions living in the first quarter of the present century. To account for this limitation two reasons may be advanced: First, fashion in color may have been considered a very important element in the selection of a sire. Second, the light browns, bays, chestnuts, and roans, of the present day are probably due to extensive infusions of light horse blood. Whichever of the two reasons is accepted as the correct one, inquiry among old horsemen leaves no room for doubt that black, brown and grey were by far the most common colors of draft horses. Grey horses appear to have been more common in counties south of Derbyshire and Staffordshire, but it is probable that the coats of many of the so-called black horses had interspersed therein a considerable sprinkling of white hairs, and that they were occasionally described as greys; there is one instance, about forty years ago, of an Oxfordshire horse being sometimes described as a black, and at another period as a grey. The head was large in all its dimensions, well placed on the neck by strong, broad, and deep attachment; the forehead and face wide, expressive, and intelligent; a side view of the jaws and muzzle represented those parts to be remarkable for depth; the ears were small and carried slightly outwards, the eyes somewhat small, not prominent, but generally mild and moderately intelligent in expression; the nostrils and mouth large, firm, and well closed; the neck was long, arched, and remarkable for its depth, and for the strength of its insertion between the shoulder blades, not as it is now frequently seen, badly placed, by having the appearance of being fused, as it were, upon the front edge of the blade bones, a conformation affording insufficient room for the collar, and therefore one most defective for the purposes of heavy draft. The shoulders were massive, muscular, upright, low, and thick at the withers, thrown well outwards beyond the insertion of the neck by the front ribs being properly arched. The fore-arm was long, strong, and muscular, the knee broad and flat on all its aspects; the fore and hind cannons short and thick, frequently measuring upward of twelve inches in circumference, covered with coarse skin, and having a beefy appearance and touch, more marked in advanced age than in youth. The pastern bones of the fore leg were very short, strong, and upright, those of the hind leg being much more obliquely placed. The feet, as a rule, especially the fore ones, were large, flat, weak at the heels, and invested with horn of somewhat soft and spongy texture. Thighs narrow, being insufficiently clothed with muscle on their inner aspects to prevent the appearance of what is vulgarly but characteristically termed split up. The hocks were of rather defective formation, but showing little predisposition to disease, generally too short, too round, and not sharply defined; for these reasons it may be inferred that the hind action was limited and comparatively wanting in elasticity. The general contour of the hind legs was considerably bent, the hocks being thrown backward, and the feet forward. The breast wide and full of muscle, indicative of great strength rather than quick movement; the back longer, narrower, and dipping rather too much behind the withers. The heart-ribs were well arched, but not very deep; the hinder ones were also rounded, but short, the last one placed too far forward, giving the body an appearance of undue length and lightness. The croup bent at a considerable angle, denoting what would now be considered want of quality. The dock strong and thick, with powerful broad attachment to the trunk. The tout ensemble of the stallion exhibited grand development of the forehand, which rendered the appearance of the hind parts very mean by comparison; a conformation, however, that a moment's reflection will show to be in perfect accord with natural ordination; from mankind downwards, in the scale of mammalian creation, the entire male is deficient in that development of the posterior parts so notable in the perfect female of each species, and for apparent reasons. The growth of hair upon these old stallions was remarkably luxuriant, that of the mane and tail being abundant, strong in texture, glossy, and very often several feet in length. The cannons, fetlocks, and coronets, both fore and hind, were garnished with a profusion of coarse, long hair, distinctive of the Cart-horse breed. The silky



IMPROVED ENGLISH DRAFT HORSE.

growth in corresponding situations of the present day has probably become thus modified from the admixture of extrinsic blood, from local influences, from altered methods in the system of rearing and managing young stock, or from a combination of two or all of those causes.

ENNEANDRIA, ENNEANDROUS. Having nine stamens.

ENSIFORM. Sword-shaped. A term used in descriptive botany, etc.

ENTERITIS. Inflammation of the bowels. In the article Colic, is presented the difference in symptoms between colic and inflammation of the bowels, and for the reason that the latter is often mistaken for the former. In fact, ignorant stablemen seem fond of calling any difficulty of the internal system belly-ache, if attended with pain and, to cure it, commence drenching with the most alarming mixtures, not good for colic, and, in some cases, absolutely fatal in connection with the real disease. In nine cases out of ten most diseases of animals, not malignant in their nature, will be treated more properly by means of simple medicines, attended with good nursing, than by the more heroic of the old system of purging and bleeding. In the case of inflammation of the bowels, this treatment is about sure to kill. To relieve the pain, give two drachm doses of opium every hour or two until the pain is relieved. Use a hot fomentation to the belly. This is applied by folding a blanket inside a a rubber sheet, held in its place by the ends being brought up to the sides and fastened over the back; thus the blanket may easily be kept saturated with warm water. Do not take trouble about the bowels not moving. The pain being relieved, if the bowels do not move in two or three days, injections of warm water may be given. The diet should be attended to. Boiled food should be given, if the animal will eat it; and, whatever the food, whether of bran or meal mashes, it should always be mixed either with flax seed, or slippery elm tea. Skim milk is excellent food, in addition, if the animal will take it, especially in chronic cases. In chronic cases, where there is pain, tenderness, and a hard, drum-like feeling (tympany) of the bowels, and low fever, a ball, composed of five grains of nitrate of silver, and half a drachm of opium, made up with linseed meal or crumbs of bread, given twice a day, will be good. Increase the dose gradually to double the quantity, if the disease proves obstinate.

ENTOMOLOGY. This is the science which treats of the habits, transformations, and physical structure of insects; or the science or natural history, and description of insects. An insect is an articulate animal form, having the body composed of three distinct parts, the head, corslet or thorax, and abdomen; the legs are six in number with, usually, two or four wings attached to the thorax; and, along the sides of the abdomen minute punctures, called spiracles, by means of which respiration takes place. Formerly spiders, and crustacea, and even worms and other small animals, were included under the term insect. The term is now restricted to the hexapods, or the six-footed species, known as beetles, bugs, bees, grasshoppers, locusts, fleas, etc., primarily produced from eggs, whatever secondary modes of propagation may take place. The egg state constitutes one of the most important epochs in insect life, since on this depends all the subsequent states and developments affecting development and decay. From the egg the larva is produced. The late and lamented Dr. Le Baron, has carefully and tersely described the outlines of Entomology, and insects in general, in one of his valuable reports: From it we extract: Insects as a class, and in the widest meaning of the word, comprise three divisions, or sub-classes, commonly known as spiders, insects and millipedes. They may be distinguished by the following characters: 1. Sub-class: *Arachnida*, including spiders, scorpions and Acari, or mites. Body divided into two parts, the head and thorax being united in one; legs eight in number; without wings. 2. Sub-class; *Insecta*, or insects proper. Body divided into three parts, the head, the thorax, and the abdomen; legs six; furnished with wings, in the perfect or *imago* state. 3. Sub-class: *Myriapoda*, commonly called millipedes or centipedes. Body divided into many parts or segments, varying from ten to two hundred; legs numerous; usually either one or two pairs of legs to each segment of the body; never have wings. The exceptions to these characters are very few. In the Arachnida, some of the most minute (*Acari*) have but six legs. Insects proper are always six-legged in their last or perfect state; and they also generally have six true legs in their larva state; but some larvæ have no legs, and the larvæ of the Lepidoptera, commonly called caterpillars, have, in addition to their six true legs, several pairs of false legs, or pro-legs, which assist in locomotion. There are a few exceptional cases in which insects are destitute of wings. The fleas (*Pulices*), the lice (*Pediculi*), and the little family of insects known as spring-tails (*Thysanoura*), never have wings In some rare instances the females are wingless, whilst the males have wings. This is the case with some species of the lightning-beetles (*Lampyridæ*), and with the canker-worm moth, and the tussock-moth, and a few other species amongst the Lepidoptera. Similarly exceptional cases are also found in other orders of insects. The present work treats only of insects proper. The nervous system of insects consists of a double cord extending the length of the body, and lying upon the inferior or ventral side of the internal cavity. The two threads which compose this cord do not lie side by side; but one above the other. The lower thread swells at intervals into little knots of nervous matter, called ganglia. In insects of an elongated form, such as some of the Neuroptera, and the larvæ of the Lepidoptera, there is a ganglion at each segment of the body, making thirteen in all; but in most mature insects the ganglia become more or less consolidated. In the butterfly (*Papilio*), there are ten ganglia, counting the brain as one: in the bee (*Apis*), there are eight; in the may-beetle (*Melolontha*), there are five, and in the Cicada there are but two. The upper of the two nervous threads runs nearly in contact with the lower, but is destitute of ganglia. These two threads seem to represent the double and more compact cord which constitutes the spinal marrow of the higher or vertebrated animals. The upper simple thread is supposed to furnish the nerves of motion, and the lower and ganglionic thread, the nerves of sensation. The fibres which compose these cords separate at the anterior extremity of the body, so as to embrace the œsophagus or gullet, above which they again unite to form the cerebral ganglion or brain, which is somewhat larger than the other ganglia. From the nervous cords, and chiefly from the ganglia, fine lateral threads are emitted, which are distributed to the adjacent parts. The nerves thus far described represent what, in the higher animals, is called the cerebro-spinal system of nerves, and are sometimes called the nerves of relation, because they control the sensations and motions which associate the animal with the world around it. But in addition to these, there have been discovered a number of very fine nervous filaments proceeding from the brain, and extending down into the body, and furnished with minute ganglia of their own, which are supposed to represent the sympathetic system of nerves which preside over the internal functions, such as those of digestion and secretion. The blood of insects is a colorless fluid, which does not circulate in closed vessels or tubes, like that of the higher animals, but permeates the tissues of the body. The only vessel that can be discovered is an oblong, membranous, pulsating sac, situated in the upper or dorsal part of the body, and evidently represents the heart. This is divided into several compartments by cross-valves, which are so arranged as to permit the blood to pass only in a forward direction. The heart is prolonged anteriorly into a narrower tube analogous to the aorta. Through this the blood flows first towards the head and thence through the body, returning to the heart, which it enters through openings at its sides. As compared with that of the warm-blooded animals, the blood of insects is not only colorless, but small in quantity, and must circulate very slowly, as is proved by the fact that when their bodies are wounded no blood escapes. Most of the organs of insects, and their functions, have an obvious analogy to those of the higher animals, but their breathing apparatus is constructed upon an entirely different plan. In all the vertebrated animals the blood is carried in vessels to a particular part or organ of the body, for the purpose of being exposed to the life-giving influence of the air. This part in terrestrial animals, is the lungs, and in aquatic animals the gills. But in insects the process is reversed, and the air is carried to the blood by being distributed to every part of the body in very delicate pearl-white tubes or vessels, which present a beautiful appearance under the microscope. They are called tracheæ, or air tubes. They admit the air through little openings along the sides of the insect's body, called spiracles. The spiracles or breathing pores can be easily seen along the sides of all caterpillars which are not too densely covered with hairs. In the perfect or winged state of insects the branches of the air tubes are dilated into a great number of little vesicles or air bladders, which render their bodies lighter, and thus facilitate their flight. In some aquatic larvæ the tracheæ project from the body in the form of little tufts, analogous to the gills of fishes. The aquatic beetles are under the necessity of rising to the surface, at intervals, for air, in a manner similar to that of the aquatic mammalia, the whales and the dolphins. The digestive apparatus of insects, like that of other animals, consists of an elongated tube called the alimentary canal, extending through the body, and having a number of enlargements in its course, and in many insects presents a particular resemblance to the digestive apparatus of birds. First, there is a short, straight œsophagus or gullet; this expands into a much larger cavity, resembling the crop; then follows a smaller muscular part, analogous to the gizzard; and next, a much larger and longer cavity, which is the true digestive stomach; this becomes contracted into the intestinal canal, which sometimes runs nearly straight through the body, and in other cases is more or less convoluted; the intestine enlarges again before it reaches the end of the body into what is known as the large intestine or colon. As in other animals, the alimentary canal is much longer and more capacious in the herbivorous than in the carnivorous kinds. As a rule the canal is more capacious in the larva than in the imago state. The secretory apparatus of insects, though analogous in function, is very different in appearance from that of the higher animals. Instead of solid glands, like the liver or kidney, it has the form of masses of convoluted tubes. The salivary glands, the liver, the kidneys, and the testicles are found represented in insects. The gastric and pancreatic fluids are secreted by little cells or follicles in the coats of the stomach. The muscles of insects, like those of other animals, consist of contractile fibres, but in their situation and attachments, as compared with those of the vertebrate animals, they are reversed; that is to say, in the latter, the muscles are situated outside of, and upon the bones, which constitute the supporting part of the body whereas in insects the supporting part is the external crust, and the muscles are attached to its internal surface. The muscles are of a pale yellowish color, and are usually presented in the form of thin layers, and sometimes of isolated fibres, and are never united into the rounded compact form which they have in the higher animals. By counting the separate fibres, a very great number of muscles have been enumerated. Lyonet counted nearly four thousand in the larva of *Cossus ligniperda*, and Newport found an equal number in the larva of *Sphinx ligustri*. The muscles of insects possess a wonderful contractile power in proportion to their size. A flea can leap two hundred times its own length, and some beetles can raise more than three hundred times their own weight. This remarkable strength may probably be attributed to the abundant supply of oxygen by means of the myriad ramifications of the air tubes. Insects are evidently endowed with the ordinary senses which other animals possess, but no special organs of sense, except those of sight, have been discovered with certainty. The eyes of insects are of two kinds, simple and compound. The simple or single eyes are called *ocelli*, and may be compared in appearance to minute glass beads. They are usually black, but sometimes red, and are generally three in number, and situated in a triangle on the top of the head. In insects with a complete metamorphosis, these are the only kind of eyes possessed by them in their larva state, and in these they are usually arranged in a curved line, five or six in number, on each side of the head. We have noticed that in some insects which undergo only a partial metamorphosis, as for example the common Squash-bug (*Coreus tristis*), the ocelli are wanting in the larva and pupa states, but become developed in the last or perfect stage. The compound eyes of insects present one of the most complex and beautiful mechanisms in the organic world. They are two in number, but proportionately very large, occupying in many insects nearly the whole of the sides of the head and, in the dipterous order especially, often present across their disks, bands of the richest tints of green, brown and purple. These eyes are found to be composed of a great number of lesser eyes or eyelets, in the form of elongated cones so closely compacted as to form apparently a single organ. The larger ends of these cones point outwards, and by their union form the visible eye. Their smaller extremities point inwards, toward the brain, to which they are connected by means of a large optic nerve. When one of these eyes is examined through a strong magnifying glass, it is seen to be composed of a very great number of little facets, sometimes square, but usually six sided, each one of which represents the outer and larger extremity of one of the component parts. These facets vary greatly in number in the eyes of different kinds of insects. In the ants there are about fifty in each eye, in the Sphinx moths, about 1 300; in the house fly, 4,000; in the butterfly, upwards of 17,000; and in some of the small beetles of the genus Mordella, it is said that more than 25,000 facets have been enumerated in one compound eye; so that if we suppose that each of these component parts possesses the power of separate vision, one of these insects must have more than 50,000 eyes. How vision is effected, or how a unity of impression can be produced by so complex an organ, we are unable to conceive. Insects are evidently affected by loud noises, and moreover, as many insects have the power of producing voluntary sounds, it is reasonable to suppose that they possess the sense of hearing. No organ, however, which has been generally admitted to be an organ of hearing, has been discovered. It is the most common opinion of entomologists that the antennæ are instrumental in receiving the impressions of sound, and that the sense of hearing is located at or near their place of attachment to the head, and this view is much strengthened by the fact that in some of the larger crustaceans, such as the lobster and crab, a distinct organ of hearing is found located at the base of the antennæ. That insects are endowed with the sense of smell, is proved by the fact that the carrion-fly, and other insects which feed upon, or deposit their eggs upon, putrescent matter, detect such substances at a distance, however completely they may be hidden from the sight. The bee also discovers honey under similar circumstances, and it is therefore fair to presume that insects discover flowers, more by their perfume than by their visible characters. But no organ of smelling has been discovered, and this sense is supposed, from analogy, to be located in the lining membranes of the spiracles. It is impossible to determine, but there is no reason to doubt, that insects, like other animals, taste and enjoy food of which they partake; and the manner in which they frequently touch their food, and the surfaces over which they walk, with the tips of their palpi, which, indeed, have received the common name of feelers, renders it probable that these organs are endowed with a special sense of touch. The songs of birds, and the noises made by other animals, are produced by the forcible passage of air through the glottis, which is the narrow opening at the top of the wind pipe, aided by the vibration of certain muscular folds near the outlet, called the vocal chords. But we have seen that insects never breathe through their mouths, and, therefore, they never make any oral sounds. But the humming of bees and flies is produced in an analogous manner, by the expulsion of air through the thoracic spiracles, and the vibration of a delicate valve-like fold, just within the opening. But besides this, insects make a variety of noises, which are produced in different ways. The singing of the Cicada, which is the loudest noise made by any insect, is produced by the expulsion of air from the first abdominal spiracle, striking upon a large transparent drum-like apparatus, situated at the base of the abdomen. The chirping of crickets is produced by rubbing together their parchment-like wing covers. The well-known noise of the katydid is produced in the same way, but here the sound is intensified by a thin talc-like plate set into the base of each wing-cover. The stridulation of grasshoppers is caused by the friction of their spined shanks across the edge of their wing covers. The fainter, squeaking sounds, made by many insects when captured, are produced simply by the rapid friction of one part of their bodies upon another; in certain Hemiptera, by the friction of the head upon the pro-thorax; in the Capricorn beetles, by the friction of the pro-thorax upon the meso-thorax; and in some of the Lamellicorn beetles, by the friction of the abdomen against the wing covers. The more complex and special apparatuses of insects for the production of sounds, are possessed exclusively by the males, and are supposed to be exercised by them as calls to the opposite sex; but the simpler squeaking sounds are emitted by both sexes, and appear to be mere notes of alarm. Nothing in the history of insects is more remarkable than the striking changes of form which many or them undergo, in the course of their development. Whilst other animals progress from infancy to maturity, simply by a process of growth, and by such gradual and imperceptible changes only as their growth necessitates, many insects assume totally different forms in the course of their development, so that they could never be recognized as the same individuals, if this development had not been actually traced from one stage to another. These changes are called the metamorphoses or transformations of insects. All insects, in their growth, pass through four stages, designated as the egg state; the larva, or caterpillar state; the pupa, or chrysalis state; and the imago, or perfect and winged state. The metamorphoses of insects are of two principal kinds, complete and incomplete. In the complete metamorphosis the larva bears no resemblance to the imago, and the insect, in the intermediate or pupa state, is motionless, and takes no food. This kind of metamorphosis presents two principal varieties. In some (Lepidoptera and many Diptera,) the legs and wings are completely inclosed in the pupa case. In others, (Coleoptera, Hymenoptera, and some others,) the legs of the pupa, though useless, are free, and the rudimental wings lie loosely upon the sides. Moreover, in some (the nocturnal Lepidoptera, and many Hymenoptera,) the pupa is inclosed in a separate covering or cocoon, whereas the majority of insects have no such covering. Pupæ thus inclosed are called *folliculate.* The term chrysalis, from a Greek word meaning golden, is sometimes applied to the pupæ of the diurnal Lepidoptera, because the pupæ of some butterflies are ornamented with golden spots. Most insects, in changing from the larva to the pupa state, cast off the larval skin, but in many of the two-winged flies, (Muscidæ, Syriphidæ, etc.,) the larval skin becomes contracted and hardened, assumes an oval form, and a brown color, and thus forms a compact and closely-fitting case, in which the pupa proper is inclosed, but distinct. Pupæ thus inclosed are called *coarctate*, and their cases are analogous to the cocoons of the Lepidoptera. In the incomplete metamorphosis, the insect presents essentially the same form, and is active in all its stages, after leaving the egg. The pupa is distinguished from the larva by the presence of short, rudimental wings at the base of the abdomen, and the imago or adult state is distinguished by the fully grown wings and wing covers. It is only in this last stage that insects are capable of propagation. All the Hemiptera, or bugs proper, and all the Orthoptera, or crickets, grasshoppers and cockcoaches, exhibit imperfect metamorphosis. In treating of the development of insects, it is necessary to refer to the periodical casting of the larval skin. All the growth of insects takes place in the larva state. Consequently no insect increases in size after it has acquired wings. The larval skin seems to be an imperfectly organized membrane which does not correspond in its growth to that of the body, but yields to this growth, to a certain extent, by virtue of its elasticity. A time comes, therefore, when it can yield no farther. The insect then evidently becomes oppressed, ceases to eat, usually retires to some secluded spot and, if gregarious, huddles together with its companions, and there remains a day or two, almost motionless and without food, and in an apparently torpid and sickly condition. After a time the distended skin bursts open, and the insect throws it off, and appears in a new, bright, and elastic skin, which, in its turn, is capable of a certain degree of distension. This process, which is called moulting, takes place three or four times in the course of the larval growth, and in a few larvæ which continue more than one year in this state, the moulting is said to occur from five to eight times. In insects of very rapid development, on the other hand, such as the maggots, or larvæ of Muscidæ, no moulting takes place, and it is the larvæ of this kind which form coarctate pupæ. As a general rule insects of different sexes resemble each other so closely as to leave no doubt of their specific identity, and in many the sexes can scarcely be distinguished. But this rule is subject to many exceptions, and the naming of insects has been greatly confused by the sexes of the same insect having been described and named as distinct species. The sexual organs, especially those of the males, are usually concealed so as to be nearly or quite invisible; but the female, especially in the order of Hymenoptera, often have an exserted ovipositor of greater or less length, which readily distinguishes them from the opposite sex. An analogous structure exists in many wood-boring beetles, which deposit their eggs in deep crevices in the bark of trees; and more rarely in insects of the other orders. In the Coleoptera the males are sometimes distinguished by one or two horns, either upon the head or thorax, and many of the predaceous beetles, both terrestrial and aquatic, have the anterior feet much widened, and furnished beneath with a cushion of hairs or bristles. The antennæ usually differ in length but little, if at all, in the two sexes; but in the long-horned beetles (Cerambycidæ) the antennæ of the males are generally considerably longer than those of females. In these moths which have bi-pectinate antennæ, these parts are almost always wider in the males. Many insects in the order of Diptera are remarkable for the great size and beauty of their eyes, and these organs are almost always larger in the males than in the females. In describing insects it is customary, for the sake of brevity, to distinguish the sexes by signs, as ♂ male, ♀ female. The first representing the sign Mars and the second Venus. The classification of insects depends chiefly upon the structure of the external and visible parts. It is necessary therefore that the student should have a thorough knowledge of these parts and of the names by which they are designated. But as these parts are very greatly modified in the different orders of insects, we shall reserve a minute description of them till we come to treat of them in connection with the several orders respectively, and shall here give only a general enumeration of them. It often becomes necessary to refer to different parts of an insect's head, and they are therefore designated by particular names indicative of their situation. These are—the Hind-head, (*Occiput*). The Crown, (*Vertex*). The Fore-head, (*Frons*). The Face, (*Facies*). The Cheeks, (*Genæ*). The appendages of the head are the Horns, (*Antennæ*); the Eyes, (*Oculi*); and the parts of the Mouth, (*Trophi*, or *oral organs*). All insects have two more or less elongated and usually many-jointed antennæ situated one on each side of the head, and varying greatly, in different kinds of insects, in length and in the form of their component joints. Insects have very short antennæ in their larva state, and in some perfect insects, such as the water-beetles, (*Gyrini* and *Hydrophili*), the antennæ are not longer than the head, whilst in others, such as some of the longicorn beetles, they are more than twice as long as the whole body, and in some of the small moths of the genus *Adela*, they are five or six times as long. The uses of the antennæ are not known, but, as we have stated above, when treating of the senses of insects, they are supposed to be instrumental in the sense of hearing. The most common variations in the forms of the antennæ are expressed by the following terms: *Filiform*, or thread-like; long and slender, and of the same, or nearly the same width throughout. *Setiform* or *setaceous;* bristly or bristle-like; long and slender, but tapering toward the tip. *Moniliform*, or bead-like; when the joints are about the same size, and *Serrate*, or saw-toothed; when each joint is somewhat triangular, and a little prominent and pointed on the inner side. *Pectinate*, or comb toothed; when the inner angles of the joints are considerably prolonged. *Bi-pectinate*, or double comb-toothed; pectinate on both sides. *Clavate*, or club-shaped; gradually enlarging towards the tip. *Capitate*, or knobbed; when a few of the terminal joints are abruptly enlarged. *Lamellate;* when the joints which compose the knob are prolonged on their inner side, in the form of plates. The eyes are uniformly of a round or oval shape, and sometimes notched on their inner side, to give place for the insertion of the antennæ. In a few instances they are placed at the end of foot-stalks made by a lateral prolongation of the head. The *Trophi*, or parts of the mouth of insects, present two very strongly marked variations, one of which is fitted for gnawing solid substances, and is therefore called the *mandibulate*, or gnawing mouth; and the other is fitted for sucking fluid nutriment, and is called the *haustellate*, or suctorial mouth. The mandibulate mouth is composed of six pieces, more or less distinct, and their appendages. First, the *labrum*, or upper lip; a horny, usually somewhat semi-circular plate, attached to the anterior and inferior edge of the head, and serving to close and protect the mouth in front. Then, the *Mandibles*, or upper jaws; a pair of very hard, horny pieces, more or less hooked at the point, and often toothed on their inner sides, which work together laterally, somewhat like the blades of a pair of scissors. These are the true biting, gnawing, or masticating organs. Next are the *Maxillæ*, or lower jaws; a pair of organs working laterally like the mandibles, but softer and more pliable in their texture, generally divided into two lobes at their extremity, which are furnished more or less with hairs. The maxillæ undoubtedly assist in the operation of eating, but the precise part which they perform is not well understood. Behind the maxillæ is a single piece which partially closes the mouth behind, and which may therefore be considered as the counterpart of the labrum or upper lip, and is accordingly called the *labium*, or lower lip. In the Coleoptera this piece is usually attached at its base to the anterior face of an elevated ridge upon the under side of the head, which forms a kind of wall behind the mouth, usually deeply notched in the middle, and which is called the *mentum*, or chin. When the labium forms a narrow elongated piece, distinct from the mentum, as in most of the Coleoptera, it is now generally called the tongue, *lingua* or *ligula.* The *Palpi*, or appendages of the mouth, are near the base of each maxilla; and on its outer side is attached a movable appendage, usually composed of four or five joints, and never more than six, called the *maxillary palpus;* and near the base of the labium is attached a similar pair of organs, but with a less number of joints, distinguished as the *labial palpi.* These appendages are subject to considerable variation especially in the shape of their terminal joints and are made much use of in determining the families and genera of insects. The *haustellate*, or suctorial mouth consists of a more or less elongated proboscis or sucker, which is sometimes short and fleshy, as in the flies, (*Muscidæ*); sometimes more elongate, horny and pointed, as in the bugs, (*Hemiptera*); and sometimes very long and slender, and rolled up, when not in use, in a spiral coil, as in the butterflies and moths, (*Lepidoptera*). It is evident that all insects with a suctorial mouth must live excusively upon liquid food, or the juices of animals and plants. The *haustellum* or sucker is not a single organ, as it appears, but has upon its upper side a deep groove, in which are contained usually either two or four, but in some of the carnivorous species (mosquitoes and horse-flies) six needle-shaped pieces, which in these last make a complicated weapon with which they pierce the skins of animals upon whose blood they subsist. From a comparison of the haustellate with the mandibulate mouth, in different kinds of insects, it has been concluded that the apparent sucker, which, as we have just seen, forms a sheath for the smaller needle-shaped pieces, corresponds to the labium, and that the contained pieces must represent the mandibles and maxillæ and, where six pieces are present, also the labrum and lingua. In accordance with the proportionately great development of the labium, we find that its appendages, that is, the labial palpi, are also very prominent, whilst the maxillary palpi are very small or rudimental. This is the case in two of the suctorial orders, the Lepidoptera and Diptera; but the other order (Hemiptera) is exceptional in this respect, having neither maxillary nor labial palpi developed. The thorax is the second, or middle division of the bodies of insects. Though apparently single, it is really composed of three pieces which seem as though soldered together. These pieces are more distinct in some insects than in others, but they can always be distinguished by impressed lines upon the surface called *sutures.* The three pieces of the thorax are distinguished as the fore-thorax, the middle thorax, and the hind thorax; or, in scientific language, the *pro-thorax* the *meso-thorax* and the *meta-thorax.* In the Coleoptera the pro thorax is very large, and forms the large upper part or shield, to which we usually give the general name of thorax. In this order of insects, the meta-thorax is invisible above, and the only part of the meso-thorax seen from above is the triangular piece between the bases of the elytra, called the *scutellum.* In many insects (*Hymenoptera* and *Lepidoptera*) the pro-thorax is much reduced in size, and forms only a narrow rim, which is usually called the collar. The under side of the thorax is called the *sternum* or breast plate. Each of the three divisions of the thorax has its sternum, designated respectively as the *pro-*, *meso-* and *meta-sternum.* In many insects, and especially the Coleoptera, each section of the sternum is divided by sutures into a middle piece *sternum* proper, and a side piece, *episternum.* The appendages of the thorax are the organs of motion, namely, the wings and the legs. The great majority of insects have four wings. The anterior pair are attached to the upper part of the meso-thorax, and the posterior pair to the meta-thorax. The wings are thin, membranous, transparent organs, in some cases folded when at rest, and supported by ribs or veins running across them. These veins are found to correspond in their number and complexity to the rank of the insect in the scale, and from the ease with which they can be seen, they furnish admirable characters for the purpose of classification. In some insects, such as the grasshoppers, the fore-wings are thicker and less transparent than the hinder pair, and have nearly the consistency of parchment; and in one large order of insects, the Coleoptera or beetles, the fore-wings become converted into the hard opaque pieces known as the *elytra* or wing-cases. The elytra take no part in the flight, but serve only to cover and protect the hinder or true wings, which are folded under them when at rest. In one large order, the insects have but two wings, and are named from this character *Diptera*, or two-winged insects. In these insects the place of the hind-wings is supplied by a pair of little knobbed appendages called *halteres* or poisers. There are a few exceptional cases of two-winged insects in some of the other orders—for example, some of the smaller Day-flies (*Ephemeræ*) in the order of Neuroptera, and the males of the Bark-lice (*Coccidæ*) in the order of Homoptera. Insects have six legs, attached in pairs to the under side of each of the three segments of the thorax. The leg consists of four principal parts; the hip (*coxa*), a short piece by which the leg is attached to the body; then an elongated piece called the thigh (*femur*, plural *femora*); then another elongated piece called the shank (*tibia*); and lastly the foot (or *tarsus*); which is composed of a number of smaller pieces or joints; of which five is the largest and most common number. The feet of insects terminate almost invariably, in a pair of sharp, horny claws (*ungues*); and between these, at their base, is often one or two little pads (*plantulæ*) by means of which flies and many other insects adhere to glass, or any other surface which is too smooth and hard for the claws to catch upon. The Lepidoptera have but one plantula, and the Diptera have two. Besides the parts of the leg here enumerated, there is a small piece attached to the hind part of the hip, called the *trochanter*. This is usually small and inconspicuous, but in the hind legs of the ground-beetles (*Carabidæ*) it forms a large egg-shaped appendage, which is one of the most characteristic features of this family of insects. The abdomen is the hindermost of the three divisions of an insect's body. It is sometimes attached to the thorax by the whole width of its base, in which case it is called *sessile*. But it is often attached by a slender petiole or foot-stalk, when it is said to be *petiolated*. The abdomen is composed of a number of rings, one behind another, each ring usually lapping a little upon the one following it. The normal number of rings or segments of the abdomen is considered to be nine, and this number is actually present in the earwig (*Forficula*) and a few other insects; but in the great majority of insects, several of the terminal segments are abortive, and only from five to seven can usually be counted. In the females of many kinds of insects the abdomen terminates in a tubular, tail-like process, through which the eggs are conducted to their place of deposit, and which is therefore called the *ovipositor*. In some insects the ovipositor is simple, short, straight and stiff, as in some of the Capricorn beetles; but in others, as the Ichneumon flies, it is long, slender and flexible, and composed of three thread-like pieces, which when not in use, are separated from each other, giving these insects the appearance of being three-tailed. Insects which do not readily fly, such as the beetles and the bugs proper (*Hemiptera*), can be captured with the fingers, and are most easily killed and also preserved, for the time being, by dropping them into alcohol. For this purpose every collector should have in his pocket one or more small, strong, wide-mouthed bottles, securely corked, and filled about two-thirds full with alcohol. The common morphine bottles answer this purpose very well. The quinine bottle can be used when a larger bottle is required. The insects can be left in the alcohol till the collector has leisure to pin them. They can be taken from the bottle with a pair of forceps, or the alcohol can be turned off into another bottle, and the insects shaken out on to a newspaper, or blotting paper, which quickly absorbs the moisture. Insects which readily take flight, must be captured in a net, which is made like a small dip-net for fishes, by making a hoop of stout wire about ten inches in diameter, with the ends of the wire turned out so as to form a short handle three or four inches long, and this can be lengthened by inserting the ends of the wire into a wooden handle about two feet long. The net is made of lace or tarlatan muslin, twenty inches or more in depth. Many species otherwise seldom seen, can be obtained by beating the branches of trees, especially forest trees, and catching the insects as they fall. A common umbrella, inverted under the tree, answers this purpose very well. This is in many ways a very useful implement to the collector. It will serve to protect him from the direct rays of the sun, or from a casual shower; and the hook at the end of the handle will enable him to draw down branches so that they can be satisfactorily examined. The umbrella would be improved by being covered with white cloth, upon which small insects would be more easily detected. Most insects except those above mentioned are injured by being immersed in alcohol, and butterflies and moths would be ruined by it. These insects can be killed by wetting them with benzine or chloroform. The benzine is the cheaper, and the only objection to it is its disagreeable odor. Large insects require to be saturated with chloroform several times to destroy life. A very neat way to kill the smaller moths is to put them under a wineglass and put in with them a tuft of wool saturated with chloroform. The moths are killed by the fumes, without being wet or handled. Some use for this purpose a poisonous preparation called cyanide of potassium. In mounting beetles the pin should be passed through the right wing-cover; other insects are pinned through the thorax. The pin should be inserted so far that half of it will project below the body of the insect. The value of a collection of insects is greatly enhanced by having the legs and wings of the specimens displayed in a life-like attitude. For this purpose they must be set out with pins, and held so a day or two till they have become fixed. For spreading the wings of butterflies and moths it is indispensable to have a simple apparatus called the stretcher. It consists of two strips of nicely dressed soft pine wood, eighteen or twenty inches long, two inches wide, and about three-eighths of an inch thick, placed side by side half an inch apart at one end and a quarter of an inch at the other, so as to accommodate insects of different sizes, and held so by a cleet across each end. The space between the strips must be closed on the underside by pieces of sheet cork tacked to the board. The space between the strips is to receive the body of the insect, the pin being passed through the cork so as to bring the wings on a level with the upper side of the stretcher. The wings are spread by catching them just behind the stout front rib with a pin, or, what is better, a needle set into a little handle, and carrying them forward, till the hind margins of the fore-wings are on a straight line with each other. They can be held in this position either by strips of card laid across them and fastened with pins, or by inserting a single small pin through the wing, behind the rib, and into the side pieces of the stretcher, which on this account should be be made of the softest kind of wood. For very small moths the stretcher must be constructed upon a smaller scale. Insects must be allowed to dry thoroughly before inclosing them in the cabinet. Beetles which have been permitted to dry with their limbs contracted, can be relaxed by putting them into hot water. Boxes for the permanent preservation of insects may be seventeen or eighteen inches square, two and a half inches deep, outside measure, and one inch and a half or a trifle more in the clear, made of perfectly seasoned wood, halved together in the middle, so as to have an upper and lower part, the former serving as the cover. The lower part must be lined on the bottom with sheet cork or thin strips of corn-stalk, and the whole covered with soft white paper. The paste with which the paper is attached should have a portion of arsenic stirred in with it, to guard against destructive vermin. The upper part, or cover, should be cut in around the top, like a window sash, so as to receive a piece of glass, which is to be secured in the usual way with putty. Every insect drawer should have a lump of gum camphor rolled in a piece of muslin and pinned into one corner, to keep out destructive vermin. The presence of vermin is detected by little heaps of the dust-like gnawings under the infested specimens. Such specimens should be at once removed, and if the drawer is much infested, a teaspoonful or two of benzine should be poured upon the bottom, and the drawer or box immediately closed, so as to retain the fumes. A magnifying glass consisting of one, or, what is better, two lenses, so arranged that they can be used either singly or combined, is absolutely indispensable in studying insects. A common mistake is to suppose that insects can not be studied and classified without the use of a complex and costly microscope. Such instruments are useful only to examine excessively minute or transparent objects, and though sometimes indispensable to the professional entomologist, they are rarely used in the ordinary study of insects. Instinct is that faculty by which animals are enabled to discover their food, construct their nests, and provide for their young, and to perform these operations without having had any previous education or experience. Many of the manifestations of this faculty are truly wonderful and unaccountable. Such are the mathematically accurate construction of the cells of the honeycomb; the curious economy of the ants and bees; and the provisions which many kinds of insects make for the future subsistence of their young, even in advance of their existence. Instinct is often spoken of as an imperfect or partially developed reason, but its relation to that faculty can be, at most, only that of a very remote analogy. It differs from reason in its invariableness and its almost absolute infallibility, but most essentially in its independency of previous knowledge and experience. Reason acts only by virtue of what is already known, and man, who vastly excels all other animals in his reasoning powers, approaches perfection in any complex work only by long study and practice; the honeybee, on the contrary, constructs its first cell with such mathematical accuracy that it cannot be improved by any subsequent experience. Some of the higher animals, such as the horse and the dog, give proof of the possession of a reasoning faculty similar to our own, and inferior only in degree. But whilst the manifestations of reason are fainter as we descend in the animal scale, instinct becomes more remarkable, and in insects especially, in which reason is almost if not absolutely wanting, instinct is exhibited in its highest perfection, far surpassing, in many instances, in accuracy and prescience, the reason of man himself. Of the nature of the instinct of animals, as of that of the human mind, we know absolutely nothing; and we can only confess our ignorance by referring its wonderful manifestations to the direct agency of the Creator. In regarding insects from a practical or economic point of view, we have to consider them in both their beneficial and their injurious relations. The directly beneficial insects are almost limited to the three well-known species: the honey-bee, the silk-worm and the cochineal-insect; whereas, those species which are injurious to mankind, chiefly by depredating upon valuable cultivated crops, are much more numerous, although constituting but a very small proportion of the whole insect world. It is important to bear in mind that in these destructive operations insects occupy an exceptional or abnormal position, and that we ourselves have been the means of bringing about this state of things, by the excessive cultivation of certain plants, whereby a corresponding increase of certain species of the insects which feed upon them has been induced. It is very rarely that any such loss of balance between the insect and the vegetable worlds takes place in the state of nature; and yet, such occurrences are not wholly unknown. This has happened most remarkably in the case of wood-eating insects, there being instances on record in which extensive tracts of forest trees have been destroyed by the larvæ of some of the more minute wood-boring beetles. But, as just stated, it is in their depredations upon some one or other of the more valuable cultivated crops that insects have come into the most direct and serious conflict with human interest. These depredations, as is well known, have often been of a most extensive and ruinous character, causing the annual loss of crops to the value of many millions of dollars, and in some seasons and localities, necessitating the total abandonment of some of the most valuable and staple productions, such as wheat, barley and potatoes, and also some of our choicest fruits, such as the plum and the peach; and sometimes threatening the destruction even of the most valuable fruit of all—the hardy and widely distributed apple. These destructive operations of insects have necessarily attracted to them the most earnest attention of both practical and scientific men, and many valuable treatises and reports have been written which have been devoted chiefly to the practical treatment of the subject. It is our present intention to treat of insects from a more general and comprehensive point of view. From what has just been said, it is evident that it is in the nature of their food and their food-taking habits, that insects hold the closest relationship to human interests; and this is true not only in the direct manner above described, but also indirectly, by means of the important parts which they fulfil in the economy of nature. Indeed, the operations of insects in this last respect are of such vast importance, that it would be safe to say that if these should cease, the earth would soon become uninhabitable by mankind. These operations consist chiefly, first, in the destruction of other insects by predaceous and parasitic kinds, holding in check excessive increase; second, in the instrumentality of a large proportion of insects in their character of scavengers, whereby the decomposition of decayed and offensive matters, both animal and vegetable, is effected and accelerated; and third, in the agency of insects in causing the fertilization of plants, especially those with very deep corrollas, and those which have the barren and productive flowers upon different plants, by carrying upon their legs, in their search for honey, the fertilizing pollen from one flower to another. A long chapter might be written upon each of these topics, but we have space here barely to enumerate them. In the division of insects according to the nature of their food, all may be divided into two classes—the carnivorous insects, or those which eat animal food (*Sarcophaga*); and the herbivorous insects, or those which subsist upon vegetable substances (*Phytophaga*). Each of these classes is again divisible accordingly as the insects which compose it take their food in a fresh and living state, or in a state of decay. The former are called predaceous insects (*Adephaga*) when they live upon animal prey; and the latter are designated by the name of scavengers (*Rypophaga*). Those insects which eat living animal food, are still further divisible into predaceous insects proper, which seize and devour their prey, and parasitic insects, which live within the bodies of their victims and feed upon their substance. Those insects which feed upon decaying animal matter present three divisions: first, general scavengers, which devour particles of putrescent matter wherever they may be found; second, those which live exclusively in or upon the bodies of dead animals (*Necrophaga*); and thirdly, those which are found exclusively in animal excrement (*Coprophaga*). The herbivorous insects may be divided in a similar manner into those which eat fresh vegetable food (*Thalerophaga*) and those which subsist upon vegetable matters in a state of decay (*Saprophaga*). They can also be usefully classified according to the particular parts of the plant which they devour, into lignivorous or wood-eating insects (*Xylophaga*); the folivorous, or leaf-eating insects (*Phyllophaga*), and the fructivorous or fruit-eating insect (*Carpophaga*). The above Greek terms in parenthesis have been used chiefly in connection with insects of the Coleopterous order, in which these diversities of food-habits exist to a much greater extent than in any of the other orders, but the terms themselves are of general signification, and being very concise and comprehensive, they might, not improperly, be used in speaking of insects in all the orders, so far as they are applicable. In attempting to classify insects according to the nature of their food we meet with a peculiar difficulty, owing to the remarkable change which some species undergo in this respect in passing from the larva to the perfect state. Most caterpillars, for example, feed upon leaves, whilst the butterflies and moths which they produce subsist upon the honey of flowers, or other liquid substances. Some two-winged flies (*Asilidæ*) feed upon the roots of plants in their larva state, but become eminently predaceous in their winged state. Another remarkable example is furnished by certain coleopterous insects (*Meloidæ*), which are parasitic in their larva state, but subsist upon foliage after they have assumed the beetle form. The question therefore arises, to which stage of the insect's existence shall the precedence be given in this respect? At first view it would seem that the perfect state ought to govern, but when we take into account that insects are comparatively short-lived in this state; that having arrived at maturity they require but little food; and that some insects take no food at all at this stage of their lives; whereas all the growth of an insect takes place whilst it is in the larva state, and consequently it is in this state that they feed so voraciously; when we consider this, it seems more reasonable that in classifying insects upon this basis, the food habits of the larva should take the precedence. The terms noxious and injurious are often used indiscriminately, but strictly speaking, noxious insects are those which are endowed with some poisonous or otherwise hurtful quality; and these are divisible into two classes accordingly as they are hurtful to mankind directly, such as the mosquito, flea, and bed-bug; or are hurtful to the domesticated animals, as the horse-fly, the bot-fly, and the various kinds of animal lice. The insects which attack man directly are annoying rather than seriously hurtful, and this is usually the case also with those which molest the domesticated animals; but these sometimes multiply so as to seriously impoverish the animals which they infest. The term injurious, as distinguished from noxious, is properly applied to all those insects which damage mankind indirectly, but often to a most serious extent, by depredating upon those crops, cultivated, upon which we depend for subsistence and profit. It is worthy of remark that by far the greater proportion of the damage caused by injurious insects is effected by species of very small size, whilst the large species are generally harmless. The two most serious fruit insects, the Codling-moth and the Plum-curculio, are both below the medium size, and the Apple bark-louse, the Apple-aphis, the Hessian-fly, and the Wheat-midge, are so minute that they would not be noticeable were it not for the wide destruction which they cause to some of our most valuable crops, in consequence of their excessive multiplication. It is also an important consideration that in learning the elements of any science or art, an indispensable part of such education is to acquire a knowledge of the more common technical terms which properly belong to it, and which constitute its peculiar phraseology, and which the student will continually meet with in all writings upon the subject. The forms with which it has to deal are so numerous and diversified, and often, at the same time, so closely allied, that their classification constantly demands a minute and careful examination, and a discriminative analysis, which, regarded purely as an exercise of the mind, are scarcely inferior to those required by the abstract mathematics, whilst they possess the additional interest which naturally attaches to the study of living beings. Classification in natural history has two objects in view—first, to show the relationship which exists between organized beings, by putting them in groups, in accordance with the similarity of their characters; and secondly, to facilitate the study of them by enabling the student to comprehend a great number of different but allied forms under a comparatively small number of general heads, and thus to afford an important aid to the memory. By nomenclature is meant the giving to these groups and the species which compose them distinctive names. It is the natural tendency of the specialist to attach undue value to the minor subdivisions of his particular department, whilst he whose studies take a wider range sees more forcibly the necessity of condensation and simplification. Much can be said upon both sides of this question; but perhaps the argument may be condensed into a single sentence by saying that, on the one hand, the minute subdivision of a natural group tends to give definiteness and precision to our investigations, whilst, on the other hand, the multiplication of genera or sub-genera, upon trivial characters, unnecessarily encumbers our nomenclature, and diminishes the interest and importance which ought to attach to the generic distinction. In writing the names of insects—and the same rule applies to all other departments of natural history—it is the established custom to write first the name of the genus, usually without the author's name attached, and immediately following it the specific name, with the name of the original describer, or an abbreviation of it appended. As no one can carry all the modern genera of insects in his memory, it is an excellent practice, when space permits, to prefix the name of the older and more comprehensive genus to which such species was formerly referred, and with which most entomologists may be presumed to be familiar. In this case the modern genus is included in a parenthesis, and usually the author's name attached. To illustrate by examples: The common rose-slug is the larva of a little wasp-like insect, known scientifically as the *Selandria rosæ* of Harris. This species was first described by Dr. Harris, who gave to it the specific name *rosæ*, meaning of the rose. It belongs to the modern genus *Selandria*, which was founded by Dr. Leach, an English entomologist. This genus is a subdivision of the old genus *Tenthredo*, of Linnæus. The name written in full, therefore, will stand: *Tenthredo* (*Selandria*, Leach) *rosæ*, Harris. Our fine large Polyphemus moth was originally described by Linnæus under the name of *Attacus Polyphemus.* It belongs to the modern genus *Telea*, made by the German lepidopterist, Hübner. Its name, therefore, expressed in the simplest manner, is *Telea Polyphemus*, Linn.; or written in full—*Attacus* (*Telea*, Hübner) *Polyphemus*, Linnæus. This is ordinarily all that is essential to be known, and any additional synonyms or references should be placed in a subordinate position. It will be observed that all the family names of insects end in idæ. This is a Greek termination, meaning like or similar, and implies that all the species in any such group have a family resemblance to those of the leading genus to which it is affixed—thus: *Cicindelidæ* means *Cicindela-like* insects. In pronouncing these words the accent is placed upon the syllable preceding this termination, thus: *Cicindel-idæ*, *Carab-idæ*, etc. It is often the case that families, especially those which contain many species, admit of division into a number of natural groups of a higher rank than genera, which are designated as sub-families, and distinguished by the termination ides. Thus the family Carabidæ is divided into a number of sub-families, such as the *Brachinides*, the *Scaritides*, etc. The class of insects is divided into a number of primary groups called orders. Between these larger divisions are certain smaller ones, which serve as connecting links between them, and which some authors have merged in one or the other of the adjoining larger groups, whilst others have considered them of sufficient importance to be raised to the same rank with the larger ones. From this it has resulted that the number of orders into which the class of insects has been divided has varied, even in the works of standard authors, from seven to twelve, and

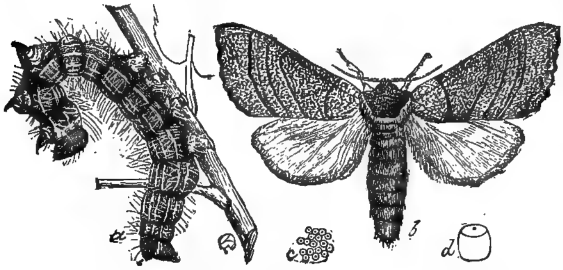


Fig. 1.

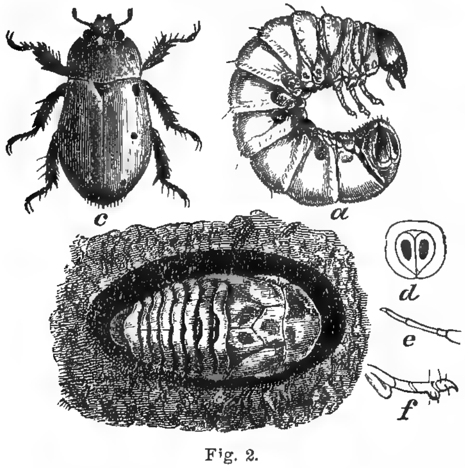


Fig. 2.

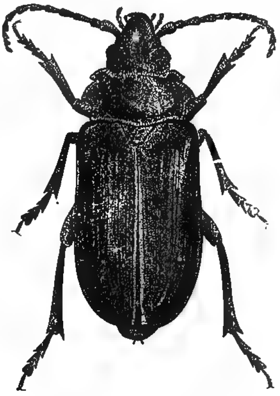


Fig. 3-*a*.

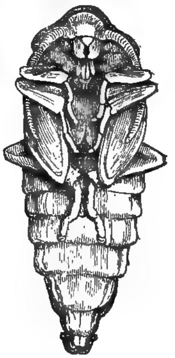


Fig. 3-*b*.

the number will be still increased if we regard as distinct orders certain apterous form, such as the lice (*Pediculi*), and the spring-tails (*Thysanoura*). But as in such an article as the present one the classification of insects should be simplified as much as possible, we have adopted the smaller number of orders, with the single exception of recognizing the division of the Hemiptera into Homoptera and Heteroptera as of ordinal value. The orders of insects are founded primarily upon the number and structure of the wings. This mode of division was first suggested by Aristotle, who gave the names which they now bear to two of the orders, namely, the Coleoptera and the Diptera. It was afterward almost perfected by Linnæus, but has been somewhat modified by the investigations of more recent authors. As illustrating some of the principal forms of insect life, we show a variety of forms, all injurious except one, the Spotted Ladybird.

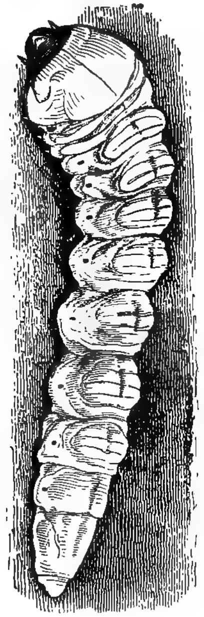


Fig. 3-*c*.

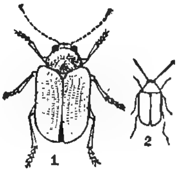


Fig. 4.

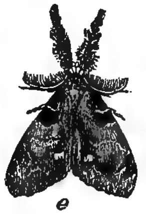


Fig. 5.

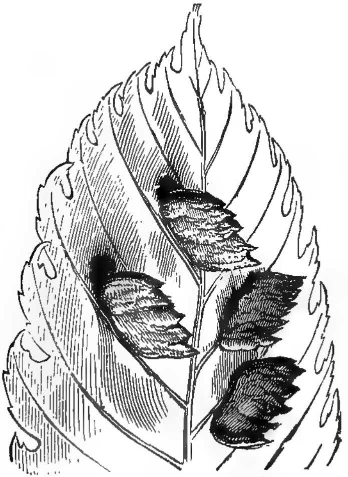


Fig. 6.

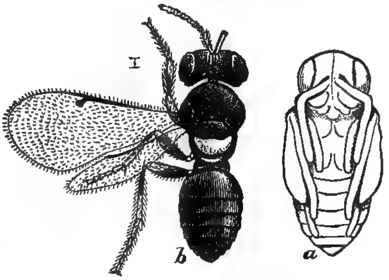


Fig. 7.

Fig. 1 shows, *a*, larva; and *b*, the moth of *Datana ministra*, the Yellow-necked Apple Tree Caterpillar; *c*, is a mass of eggs; and *d*, an egg magnified. There are various forms of this moth, some so nearly alike as not to be distinguished by the ordinary observer, and which, sometimes, live within and sometimes without their webs. At Fig. 2, is *a*, larva; *b*, pupa and *c*, perfect beetle; *d*, tip of abdomen; *e*, antennæ, and *f*, a section of one of the legs of the Spotted

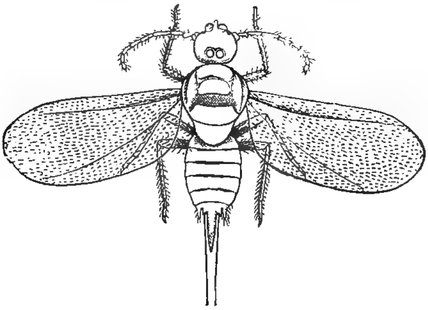


Fig. 8.

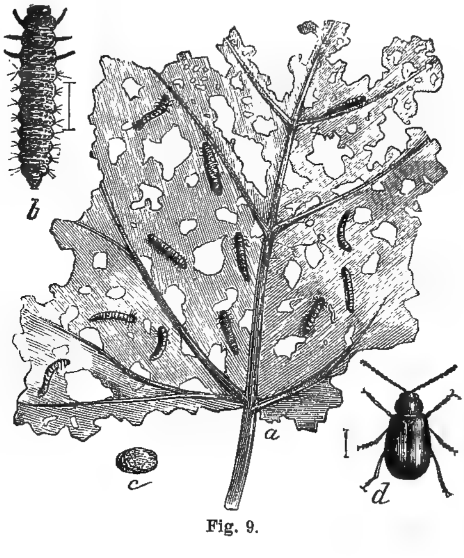


Fig. 9.

Pelidnota, the grub of which lives in rotten wood, and the beetle feeding on the leaf of the grape, and sometimes, it is said, severing the young branches. Fig. 3–*a*, 3–*b*, and 3–*c*, show the Broad-necked Priornus, an injurious class, *a*, beetle, *b*, pupa and *c*, larva. These larvæ mine the trunks of balm of gilead, poplar and some other trees. Fig. 4 is the Grape-vine Colaspis, 1, magnified, 2, natural size. It often does great damage by riddling the leaves. Fig. 5 is the Tussock moth, the larva of the various species of which feed on the leaves of a number of trees. Fig. 6 shows a Gall-making pemphigus, species of minute insects which lay their eggs on the leaves of trees, the galls or vegetable covering being formed over them. Fig. 7 shows a Chalcis parasite; *a*, pupa, *b*, perfect insect; the hair line showing natural size. These flies are most beneficial, they lay their eggs in other insects. Fig. 8 is the winged form, highly magnified, of the Maple-tree louse. (See article on Maple Tree Louse.) Fig. 9 shows a leaf attacked by the larva of the Grape-vine Flea beetle; *b*, larva magnified, *c*, earthen cell in which the beetle transforms; *d*, beetle. The hair line next the beetle and larva shows the natural size. Fig. 10, shows the Bordered Soldier Bug, they and the other soldier bugs live on other insects, and are among the few which attack the Colorado Potato beetle. Fig. 11 is the Spotted Ladybird, the beetles of all the species of which in all their transformations, eat insects, and especially the eggs of the Colorado beetle. (See article Ladybird.) Fig. 12 shows the Flatheaded Apple-tree Borer, *a*, larva, *b*, pupa, *c*, head and first two sections magnified; *d*, beetle. Fig. 13 is the well known Squash Bug.—Fig. 14 the New York Weevil, which eats the buds of the tree; *a* shows slit in the bark under which the egg is laid; *b*, larva; *c*, beetle. Fig. 15 is the caterpillar of the Archippus butterfly. The winged insect measures sometimes four and a half inches across the wings. The wings on the upper side are tawny orange, on the under side deep nankin-yellow; the veins are black, and there are yellow and white spots on the black tips of the fore wings.

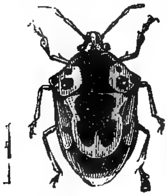


Fig. 10.

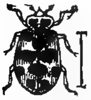


Fig. 11.

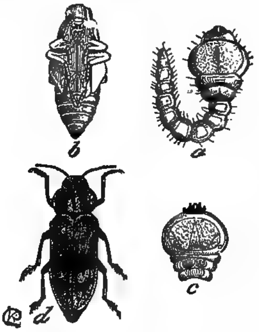


Fig. 12.

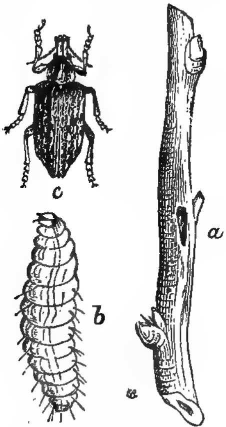


Fig. 14.

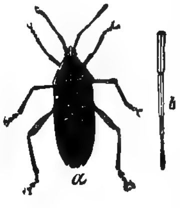


Fig. 13.

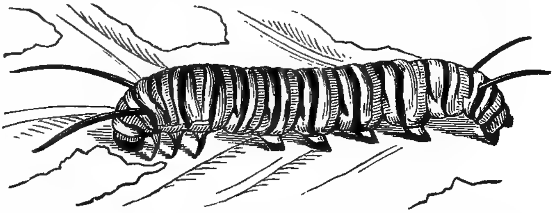


Fig. 15.

ENTOZOA. A tribe of worms, many of which are parasitic to the intestines and other parts of animals.

EOCENE. The lowest portion of the tertiary epoch of geologists, in which a few recent remains only are found.

EPIDEMIC. A disease which spreads through a community, a stable, etc.

EPIDERMIS. A light covering over the skin of animals. The outer membrane of plants. The outer film of the skin.

EPIGASTRIC. Over the stomach.

EPIGLOTTIS. A small cartilage at the root of the tongue, which protects the windpipe.

EPIGYNOUS. Any part of a flower growing upon the top of the ovarium or fruit.

EPILEPSY. This is a disease unusual in horses, but not uncommon in cattle, especially in cows, after calving. (See Apoplexy.) In all cases of this kind the first thing to be attended to is to be sure there is no pressure on the vital organs and the blood vessels. All this class of diseases are beyond cure, as a rule. The most that can be done is to relieve for the time being. These symptoms often occur from the presence of worms. In this case, after present relief is given, use vermifuges, which see. To give relief, and as a means of permanent cure, one-half ounce of bromide of potassium, and a drachm of powdered gentian, given two or three times a day, and continued for weeks, would be proper. Another remedy would be, one-half drachm of sulphate of zinc and one ounce of linseed meal, given twice a day, in the form of a ball, for two or three weeks longer. Giddiness, falling sickness, fits, stringhalt, St. Vitus dance, megrims, and vertigo, are all names for this class of diseases. They all do, or should, constitute unsoundness.

EPIPHYLLUS. Growing on a leaf.

EPISPERM. The testa, or outer coating of seeds.

EPIZOOTIC. (See Influenza.)

EQUISETUM. The scouring rush; hence *equisetaceæ*.

EREMACAUSIS. Smouldering, or dry rot, of organic matter freely exposed to the oxygen of the air, and merely moistened with water. It is altogether different from fermentation, which requires little air. By Eremacausis, acids, as acetic, nitric, etc., are produced. When much nitrogen exists in the decaying matter, it is called nitrification, especially if lime or potash be present. It is the natural decay occurring in the soil.

ERGOT. A disease of rye, and sometimes other grains, in which it turns black, and acquires an acrid, fungous taste. A fungus growth of rye. The diseased grain is poisonous, producing dry gangrene, attended with sloughing of the hoofs, horns, ears, etc., of cattle. It is of service in medicine as a uterine stimulus.

ERICA. The genus of heaths. *Ericaceæ*, a family of shrubby plants, as the heaths, rhododendrons, azalias, etc.

ERINACEUS. A genus of insectivorous animals, including the hedgehog.

ERIOPHORUM. The genus of cotton grasses.

ERODED. Gnawed, a descriptive term in botany and zoology, meaning any jagged edge. To erode, is to eat into or among, as by a cancer.

ERRHINES. Bodies which excite sneezing.

ERUCA. A larva or worm.

ERYSIPELAS. This is an inflammation of the skin and tissues beneath which, in a malignant form, spreads largely and forms abscesses. A wound for instance, will be found hot, swollen, tender and shining. This extends about the surface, and often deep into the muscular tissue. The surface will be hard, but if the fingers be rather strongly pressed upon the part, an indentation will be left. In light forms of the disease there is fever, loss of appetite, and the attack being in a limb, there will be lameness. In severe cases, these symptoms will be intensified. The breathing will be hurried, the pulse weak but rapid. There may be chills, with constipation of the bowels, and scanty and high colored urine. The thirst will be great, but with no appetite for food. The first remedial means is to give a purgative, assisted with injections to relieve the bowels. If there is much fever, add twenty drops of tincture of aconite to the water, given once an hour. The bowels having been freely emptied, give every four hours, in a bottle of water, two to four drachms of chloride of iron and thirty grains of quinine. For the swelling in ordinary cases, there is nothing better than a poultice of ripe cranberries faithfully applied. If this does not give relief, paint the swollen parts and surroundings freely, with one ounce of powdered sulphate of iron, in four ounces of lard, or if preferred, extract of belladonna and lard, equal parts, may be rubbed up together and freely rubbed in. When death ensues from erysipelas, it is from exhaustion. The animal's strength should be kept up with easily digested food. The doses given are for a horse.

ESCHAR. A scab, cicatrix.

ESCHAROTIC. A caustic.

ESCULENT. Edible plants, roots, etc.

ESPALIERS. In horticulture, trees trained by lattice work or other supports on the borders of beds, or as hedges to enclose plots of ground. The principal objects aimed at in Espaliers, are to expose the foliage and fruit of the plants or trees more perfectly to the light and sun, to prevent the branches from being blown about by the winds, and to economize space by confining them within definite limits. Espalier training is little practiced in the United States, even with grapes.

ESPARCET. A local name for Sainfoin, which see.

ESSENTIAL OILS. Oils which impart flavor and odor to plants, and are readily volatilized by heat. Many, as peppermint, rose, lemon, etc., are easily distilled, and the perfume is also yielded to oil.

ESSEX SWINE. This is one of the English light weight breeds, and to our mind one of the very best of that class ever introduced into North America, combining, as they do, stamina and vigor of constitution. The sows are prolific breeders, and good nurses, the barrows fattening easily and at any age. The size is medium, mature animals going up to three hundred pounds. In shape and color they are not unlike the Berkshire, but are longer in proportion to their size. They are pure deep black in color; face short and dishing; ears small, soft and erect while young, but falling down somewhat with age; carcass long, broad, straight and deep; hams heavy and well-fleshed to the back; bones fine, and hair thin. Like the Suffolk, the mature, fully fattened Essex yields a large amount of lard. So far as our experience goes, the Essex crosses successfully on large, coarse swine, refining the bone, rendering the crosses quiet, good tempered and kindly fattening swine.

ETERIO. A compound fruit, the ovaries of which are distinct and indehiscent upon a dry or fleshy receptacle, as the strawberry, raspberry, etc.

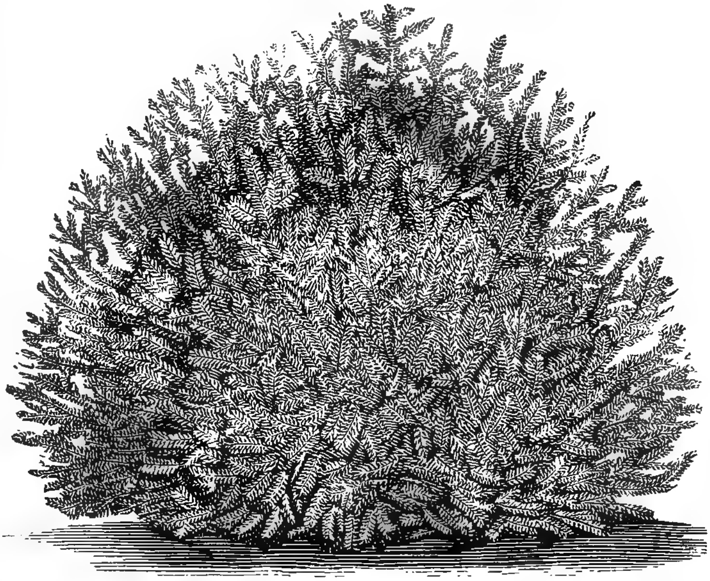
ETHER. A name applied to a highly volatile, inflammable, and aromatic fluid, obtained by distilling equal parts of alcohol and sulphuric acid. But it also represents a class of organic compounds having properties similar to ether and alcohol, and containing a common base or radical

ETIOLATION. Blanching of vegetables. This is done by excluding light either by earthing, as in the case of celery, or tying up the leaves, as with lettuce, endive etc.

EUCALYPTUS. None of the species of Eucalyptus are capable of standing the climate of the United States, except the warmer parts of Florida and some portions of California. Ten degrees of frost will kill them. *E. globulus*, or the blue gum tree of New South Wales is a fast growing, magnificent, and useful tree where it will stand the climate. Unfortunately, it is not hardy, except where we have stated, and possibly in favorable situations on the Gulf coast, and, probably, in southern Texas, near the coast line. As showing the rapidity of growth of the Eucalyptus, where it is hardy, in California, at two years old, the trees have reached a height of from fifteen to twenty-five feet, and after three years' growth a height of from thirty-five to forty feet, and from five to nine inches in diameter of stem. They are well adapted to dry situations. The principal varieties experimented with, in California, were *E. globulus; paniculata; tereticornis; viminalis; hemiphloia;* and *obliqua.* The following are some of the more valuable qualities of the genus Eucalyptii: The remarkable solidity, hardness, and durability of the timber of some of the species is well known. The large proportion of potash, amounting to twenty per cent., in the ashes of these trees has been pointed out by Baron Von Müeller. The barks of *E. rostrata*, *E. obliqua*, *E. goniocalyx*, and *E. corymbosa* are used for making paper. The barks of many species are used extensively for tanning. A substance called Australian manna is yielded by *E. mannifera*, *E. viminalis*, and other species. This manna occurs in small, rounded, opaque, whitish masses, with an agreeable sweetish taste; it contains somewhat similar constituents, and has similar action to the ordinary manna, and exudes in large quantities through punctures or wounds made in the young bark. Another product of great importance is the essential oils. These oils generally have a camphoraceous smell, the odor differing in the various species; that from *E. citriodora* has a pleasant citron-like flavor. The oil from *E. oleosa* is used as a solvent for resins in the preparation of varnishes. The oils of *E. amygdalina*, *E. globulus* and *E. citriodora* are used for diluting the more delicate essential oils used in perfumery. These oils

NORDMANN'S SILVER FIR.

contain a substance called Eucalyptol, a liquid body, having chemical characters resembling camphor. The febrifugal properties of the bark and leaves of *E. globulus* have been noted by many medical practitioners. Although careful examination of the bark and leaves has proved that neither quinine nor the other alkaloids of cinchona bark exist in the plant, yet it is admitted to possess antiperiodic properties, which are supposed to be due to the presence of Eucalyptol. Finally, cigarettes made of *Eucalyptus* leaves are reputed to be useful in bronchial and asthmatic affections. Considering the rapidity of growth, the value of the timber, the healthy emanations from the foliage, the commercial importance of the essential oils, and the beauty of the different species of the genus, it must be conceded that the *Eucalyptus* is one of the most important family of forest trees known at the present time, and that they should be extensively planted wherever climatic conditions are favorable to their growth, with the further reminder that the *E. globulus* need not be taken as a criterion of the hardiness of the genus in low temperatures, since the more alpine species are known to flourish where the *E. globulus* has failed. The supposed sanitary value is not confined to one species, but the whole family are possessed of oil-bearing leaves, and that, therefore, further experiment with the hardier species may be profitable. In this connection it should be reiterated that none of the Eucalyptuses are hardy, and, in fact, all of them are sub-tropical, and many of them really inter-tropical. Hence in experimenting with them in the United States care should be taken to use only those most hardy. Of their value as arresters of miasma there is little doubt, and it would seem proper that agricultural colleges, South, and the general government, should experiment still further with these valuable species.



DWARF AMERICAN ARBOR VITÆ—TOM THUMB.

EUPHORBIA. A genus of plants commonly yielding a milky, acrid juice. Many of them are spined, and some resemble cactuses *Euphorbiaceæ*, the natural family, including the euphorbia, crotons, castor-oil, india-rubber tree, etc.

EUROPEAN CABBAGE BUTTERFLY. (See Cabbage Butterfly.)

EUSTACHIAN TUBE. A tube passing from the interior of the ear to the cavity of the mouth, the stoppage of which, by disease, is one cause of deafness.

EVAPORATION. Vapor is passed off from water, or moisture contained in any matter, in just proportion to the heat applied, and the dryness of the air. Air saturated with moisture, can take up no more, and then the vapor of evaporation in being passed off, becomes condensed on the surface. The vapor passed off from a liquid, at any temperature, contains more heat than the fluid from which it is formed, and exhalation goes on faster or slower, according to the pressure of the atmosphere. Yet the pressure of the atmosphere does not prevent evaporation, it simply retards it. If the atmospheric pressure was entirely taken off, water would boil (theoretically) at about the freezing point, while at the sea level, water boils at 212° Fahr. In the vacuum pan, water boils at from 120° to 140° according to the perfect condition of exhaustion. It may seem strange, but nevertheless it is a fact, that evaporation is a cooling process, that is to say it has the effect of cooling the body from which it passes off. Hence the act of perspiring cools the body, by passing off the heat of the body with, and by the vapor. Ether, evaporating from a body in a draft of warm air, will cause the body even to freeze, and we all know that the earth is sensibly cooled by evaporation from its surface. Hence one of the advantages of drainage, by which the heat of the soil is conserved. If the excess of water must be carried upward by evaporation, in just proportion to the water evaporated will the soil be cooled. Hence cold, and water soaked soils produce semi-aquatic plants not found on warm, aerated soils. Moisture exhaled at a low temperature, is called vapor, and at a high temperature, steam. In another sense invisible moisture is vapor, and visible moisture is steam. If the air is suddenly cooled over a heated soil, strongly evaporating moisture, it becomes visible as steam. Hence the expression, the steaming earth. Under the common pressure of the atmosphere, and below the temperature at which water boils, evaporation goes on quietly and slowly. In deep mines, which descend below the level of the sea, water requires a greater heat than 212° to make it boil. But on high mountains, or districts rising far above the level of the sea, the pressure of the air is lessened, and boiling takes place, as under the influence of the air-pump, at lower degrees, according to pressure. The vapors exhaled from a liquid at any temperature contain more heat than the fluid from which they sprung; and they cease to form whenever the supply of heat into the liquid is stopped. Yet, a thermometer held in the steam proceeding from hot water rises no higher than when placed in the water itself. The additional heat, therefore, contained by the vapor, is latent, and does not become sensible to the thermometer until the vapor condenses. Any quantity of water requires, for its conversion into vapor or steam, five and a half times as much heat as is sufficient to heat it from the freezing point of 32° to the boiling point of 212°. The quantity of heat absorbed by one volume of water in its conversion into steam, is about 1000° Fahr.; it would be adequate to heat 1,000 volumes of water one degree of the same scale; or to raise one volume of boiling water, confined in a non-conducting vessel, to 1180°. Were the vessel, charged with water so heated, opened, it would be instantaneously emptied by vaporization, since the whole caloric equivalent to its constitution as steam is present. When, upon the other hand, steam is condensed by contact with cold substances, so much heat is set free as is capable of heating five and a half times its weight of water, from 32° to 212° Fahr. If the supply of heat to a vessel be uniform, five hours and a half will be required to drive off its water in steam, provided one hour was taken in heating the water from the freezing to the boiling point, under the atmospherical pressure. (See Exhalation.)

EVERGREENS. A term applied generally in the United States, and especially in the North, to the conifera, or cone-bearing trees, as pine, spruce, hemlock, cedar, juniper, arbor vitæ, etc. In its broad sense, the term should include all those tropical forms, as the orange, palms, and other trees which retain their foliage, shedding their leaves as they successively ripen, the younger ones coming forward to supply the place of those cast off. (See different species as treated of under their proper names.) Pages 316 and 317 contain two forms of coniferous evergreens, as illustrating ornamental species: Nordmann's Silver Fir and the Dwarf American Arbor Vitæ—Tom Thumb. Nordmann's Silver Fir is said to be abundant on the Crimean mountains, and those of the Black Sea, and Mr. Josiah Hoopes, author of the Book of Evergreens, says it is hardy at his home in Pennsylvania, never being affected by the most severe winters and retaining the beautiful color of its foliage in all seasons and in all vicissitudes. Tom Thumb originated with Ellwanger & Barry, Rochester, N. Y. Its form is rounded, with slender shoots, but occasionally betrays its origin by forming a shoot with fully developed leaves.

EXACERBATION. An increase of violence in the symptoms of fevers.

EXCORIATION. A bruise or abrasion of the skin.

EXCRESCENCE. Any unnatural growth or tumor.

EXCRETION. In physiology, the separation of useless or injurious portions of matter from the system, as urine, expired air, feces and perspiration.

EXFOLIATION. The separation of diseased bone from that which is sound in the progress of a disease.

EXHALATION. Evaporation at ordinary temperature, more especially from a living or solid surface.

EXHAUSTION. In physics, the removal of air or gases from the interior of bodies.

EXOGENOUS. A term applied to those plants a transverse slice of whose stem exhibits a central cellular substance or pith, an external cellular and fibrous ring of bark, and an intermediate woody mass, and certain fine lines radiating from the pith to the bark through the wood, and called medullary rays. They are called exogens, because they add to their wood by successive external additions, and are the same as what are otherwise called dicotyledons. They constitute one of the primary classes into which the vegetable world is divided, characterized by their leaves being reticulated; their stems having a distinct deposition of bark, wood, and pith; their embryo with two cotyledons; and by their flowers usually formed on a quinary type. Our forest trees and most garden vegetables are of this kind.

EXORRHIZÆ. Exogenous or dicotyledonous plants, the roots of which extend directly from the embryo.

EXOSMOSE. The passage outward of fluids, etc., the reverse of Endosmose, which see.

EXOSTOSIS. A tumor on a bone. In botany, any knot or tumor on a trunk or large root; the wood is often finely curled.

EXOTICS. Foreign plants. Any plant not native to a region of country. Introduced plants; the potato is exotic to Europe.

EXPANSION. The increase in dimensions produced by heat. Gases expand most rapidly and extensively, fluids next, and metals least.

EXPECTORANTS. Medicines which assist in throwing off phlegm.

EXPERIMENT. Experiments in agriculture are, and must necessarily always be, of supreme value, since the art must ever be progressive, and varieties and conditions ever changing. The testing of new varieties should be carried forward every year, more or less, and by every farmer; for, only by this means can certain knowledge be obtained of varieties of trees and plants adapted to a particular soil and situation. Agricultural Colleges, through their experimental plots, may render much useful information as to varieties probably useful in various localities, and thus simplify experiments, and bring down varieties to be tested by the individual farmer to a very few. Nevertheless, the farmer must, after all, test each for himself to arrive at certain results as to adaptation and value to his particular soil. So in the feeding of stock, in plowing at different depths, and with variously laid furrows; as to mechanical means for ameliorating the soil; upon various manures, and the best mode of application; in relation to permanent pasture grasses, and the new varieties adapted to our meadows. In all these there is a wide field, and much to be learned by the American farmer. In Europe this subject has long received particular attention. In the Eastern States something has been done in this direction. In the West comparatively little has yet been attempted in carrying forward a systematic series of experiment, even by the better class of our Agricultural Colleges. They are, however, making progress in this direction, and the next decade will, probably, see even that class of Industrial Colleges that have been carried farthest into scholasticism, and away from the industries, wheeling into the true line of their work in this direction.

EXPERIMENT STATION. (See Agricultural College.)

EXPORT AGRICULTURAL PRODUCTS. The article Agriculture gave the agricultural exports up to and including 1879. It will therefore here be only necessary to give the chief agricultural exports for 1880 and 1881. These are given up to March first of these years as follows: Exports of live stock, 1880, $12,065,195; 1881, 20,681,738. Exports of other food, 1880, $374,568,342; 1881, $456,244,111. The productions during these years are, respectively, corn, 1,547,910,970, and 1,537,535,900 bushels; cotton, 5,073,581, and 5,761,252 bales; wheat, 448,756,630, and 480,849,723 bushels; wool, 232,500,000, and 264,000,000 pounds. These being the amounts for 1880 and 1881, respectively. (See article Agriculture.)

EXPRESSED OILS. Such as are obtained by pressure, as olive, linseed, rape, castor and almond, as distinguished from volatile or essential oils.

EXTRACT. The solid remaining after boiling down an infusion or decoction to dryness. The term extractive is applied to that portion which is of a brown color, soluble in water, and forms a coloring matter with alum solution.

EXTRAVASATION. In surgery, whenever blood or other fluids are thrown out from the veins into the skin, brain, or other parts, it is termed an extravasation. It frequently arises from a blow.

EXTRORSAL. Bent or turned from the direct position; a descriptive term in botany.

EXUVIÆ. The skins cast by snakes, lobsters, insects, etc., in the changes they pass through.

EYES, INFLAMMATION OF. Conjunctivitis, as inflammation of the eye-ball and the lining membrane of the eye-lid is called, may be caused by a blow, chaff, or other substance irritating it. First find the cause, turn up the lids and look closely for irritating substances, remove by means of a feather or the forceps. If the inflammation is decided, a little blood may be drawn from the angular vein, which passes over the face below the eye, and reduce the inflammation by covering the eye with soft cloths kept constantly wet with cold water. If the inner structure of the eye is involved, use an ointment composed of one ounce extract of belladonna, and half an ounce of honey. For chronic cases of sore eyes, three grains of sulphate of zinc to one ounce of water, makes a good lotion. Periodic ophthalmia or moon blindness, can not be cured. It is constitutional; the cause not well known, but perhaps malarial or rheumatic. It finally results in total blindness. In an early stage of the recurring attacks, one half ounce of powdered Peruvian bark, and one drachm sulphate of iron, given twice a day, the dose to be doubled when a return of the attack is expected, has been found beneficial. In these attacks, the eye gradually becomes more and more clouded, extending over the eye in the same way the moon waxes, and then gradually disappearing. The state of the moon, however, has nothing to do with the growth, no more than wolf teeth do. There are no wolf teeth in a horse's mouth, but irritation of the teeth often does intensify inflammation of the eyes.

EYE, IN PLANTS. The bud, embryo, or growing plant.

EYE SPOT. Albugo, or White Spot. This is a blemish of a bluish or pearly white on the pupil of the eye, the result of inflammation, interfering more or less with the sight. Light touches with a stick of nitrate of silver, will sometimes apparently lessen the disability, but it should not be used, nor in fact should the eye be tampered with at all except in cases of simple inflammation produced by local causes. Others should be treated by a veterinary surgeon.

F

FAGOT. A bundle of small wood.

FAGUS. The generic name of the beech.

FAIRS. The systematic holding of agricultural fairs is comparatively a modern idea. Fairs as they have existed for a long time in Europe, have been until lately, devoted almost solely to barter and sale. During the last century these have steadily dwindled in importance, as commerce and better systems of trade began to bring every article of use more immediately to the purchaser, until now but very few fairs of this class are held. In the disposition of highly bred stock, annual auction sales are among the means used to get rid of surplus animals, and now, under the direction of agricultural and horticultural societies, National, State, county, district, and even township fairs are held for the display of all agricultural, mechanical, manufactured and art products. The rise and progress of these fairs is interesting and instructive, and the contemplation of the improvements made from year to year, in all that constitutes the result of human energy, is a most valuable study. It is but little more than 150 years since the establishment of the first agricultural society in Great Britain, but in 1723, there was established, in Scotland, a society to which its founders gave the name of Improvers in the Knowledge of Agriculture. It became extinct in 1755, but was succeeded by another, which was merged into the Highland Agricultural Society. This association, in 1787 received a royal charter, and in 1834, it was re-chartered. Annual fairs were thenceforward held, at each of which premiums were given to the amount of £10,000. In Ireland, an agricultural society was established in 1747. From the influence exerted by the members of this organization many others sprang up in various parts of the island, which were productive of great benefit, not only among the aristocratic landed gentry, for whom all these earlier organizations were instituted, but also among the small proprietors and tenant farmers, and, indirectly, among the laborers themselves. In 1777, The Bath Agricultural Society, of England, was organized, having for its aim the encouragement of agriculture, arts, manufactures, and commerce, in the counties of Somerset, Wilts, Gloucester, and Dorset. Through its volumes, published yearly, it disseminated a vast amount of practical information relative to the culture of the various crops then grown, and especially of those recently introduced. The breeding of cattle, horses, sheep, swine, and other stock, was fully treated of in their reports, which also contained much valuable data concerning manufactures, both general and as relating to agriculture, arts, and commerce. Among the contributions to its literature we find such names as Dr. Falconer, Dr. Campbell, Sir Christopher Hawkins, Hobhouse, Arthur Young, M. DeSaussaure, Dr. J. Anderson, Dr. Fothergill, Rev. Alexander Campbell, Count DeBerchtold, Gen. Abercrombie, and other eminent men of the day. This shows the interest taken in agriculture, in England, almost a century ago, by the best minds. This interest has borne abundant fruit, in making England, to-day, for the number of acres cultivated, the most productive country in the world, both as to the variety of staples grown and the quantities obtained yearly from the soil We find, by the transactions of the Bath Agricultural Society, for the year 1810, that there were then in Great Britain (besides the board of agriculture, of which Sir John Sinclair was president and no less a person than Arthur Young, Esq., secretary,) eighty-one agricultural societies in regular working order; and to show that they believed, also, in women's rights, we might point to the fact that one of them, the Badenach and Strathspey Society, had a woman for president, in the person of the celebrated Duchess of Gordon. The Royal Agricultural Society, of England, which has exerted so wide-spread and beneficial an influence upon agriculture throughout the civilized world, was founded in 1838, and adopted for its motto, Practice with Science. Within seven years it had established, or had been the means of establishing, four hundred other societies; one hundred and fifty of these being practical farmers' clubs. Ten years later, in 1855, the societies and clubs amounted to over seven hundred. The most important of these clubs, the London Central Farmers' Club, became so firmly rooted, was so thoroughly supported, and its influence was so widely felt, that it received the appellation of the Bridge Street Parliament, and gave rise to the aphorism by a celebrated English statesman, that neither our fleets, however well manned, nor our armies, however valorous, nor our diplomacy, however successful, can do so much as the plow. This society like many agricultural societies in the United States holds annual exhibitions, which are peripatetic in their nature, and the distinction of being selected as the place for the yearly show is a much coveted one. In most of the counties of England, there are county agricultural societies, which, also, hold annual exhibitions. These societies, as a rule, are in a healthy condition, and of great value to the farmers; but, now, the recognized representatives of the farming interests are the chambers of agriculture, composed of landlords, farmers, grain merchants, and others concerned in interests connected with the soil. There is a Central Chamber, subordinate to which are County Chambers; and these, in turn, are the superiors of the local or district Chambers. These organizations are of comparatively recent growth, and the interest taken in them is immense. While eminent citizens of England, in the last century, were seeking, by every legitimate means, to foster the interests of agriculture, a corresponding class in the then infant States of America were not idle. Manufactures at that day were comparatively unknown, or only in their infancy. Then the foremost men of the nation were farmers, and derived their revenue directly from the soil Of those engaged in the various professions of life, many still clung to the pursuit of their youth, and gave their farms their personal supervision. A large proportion of the heroes of the Revolution left the plow for the battle-field, and when the war was over returned again to their peaceful art The first agricultural society ever incorporated in America was that established in South Carolina, in 1785, called the Society for the Promotion of Agriculture. Its objects included the institution of a farm for experiments in agriculture, and the importation and distribution of foreign productions suited to the climate of that State. Another prominent object was to direct the attention of farmers and planters to the economies connected with the agriculture of the State, and to enlist them generally in the improvement of their condition. The society accomplished an excellent work, among other things, that of introducing the cultivation of the olive and the vine into the State. Societies for the promotion of agriculture were always regarded by the planters and statesmen of the South as being of the first importance; and naturally so, for the reason that agriculture always was the dominant—in fact, almost the exclusive—interest there; more than this, however, from the settlement of the country until about 1860, it was confined to special products, as, at first, tobacco, then cotton, and, later, sugar; these, with blooded horses and cattle, comprising the chief sources of wealth of the southern planter. In the earlier history of the South, her clubs and societies were composed of men of wealth and position, and, like the earlier kindred societies of Great Britain, were exclusive in their nature. More recently, agricultural societies in the South have taken on a more popular character, and the last ten years has witnessed a wonderful increase in the number of clubs and similar organizations, which have had the effect to re-awaken interest in this rich and diversified portion of our common country. It is to be hoped that this will be the means of developing the immense resources of this fertile region. A Society for the Advancement of Agriculture was incorporated in New York in 1791, but it became defunct after a brief existence of ten years. In 1792, the Legislature of the same State incorporated another organization, under the title of the Society for the Promotion of Agriculture, Manufactures, and Arts, and again, in 1804, a Society for the Promotion of Useful Arts, in the recital of which arts, agriculture is first named. This society published seven volumes of Transactions previous to 1815. A National Agricultural Society early occupied the attention of leading minds in the United States, and as early as 1794, Washington, then President of the United States, began to interest himself in the matter. In relation to this society we find that a letter was addressed by him to Sir John Sinclair, on the 20th of July, 1794, and contains the following reference to this subject: It will be some time, I fear, before an agricultural society, with congressional aid, will be established in this country. We must walk, as other countries have, before we can run; smaller societies must prepare the way for greater, but, with the lights before us, I hope we shall not be so slow in maturation as older nations have been. An attempt, as you will perceive by the inclosed outlines of a plan, is making to establish a State Society in Pennsylvania for agricultural improvements. If it succeeds, it will be a step in the ladder; at present, it is too much in embryo to decide upon the result. The first proposition for the establishment of such an institution was made by Washington, in his annual speech, delivered on the 7th of December, 1796, when he met the two Houses of Congress for the last time. Then a committee of the House of Representatives made a report, on the 11th of January, following, recommending the institution of a society for that purpose, under the patronage of the government, which might act as a common center to all other societies of a similar kind throughout the United States. The report is accompanied by a plan, the principal articles of which are that a society shall be established at the seat of government; that it shall comprehend the Legislature of the United States, the Judges, the Secretary of State, the Secretary of the Treasury, the Secretary of War, the Attorney General, and such other persons as may choose to become members, according to the rules prescribed; that an annual meeting shall be held at the seat of government, at which are to be elected the president, secretary, etc., and a board, to consist of not more than thirty persons, which shall be called the Board of Agriculture; that the society shall be a body corporate; and that a report shall be made annually. The first national association of this description was the Columbian Agricultural Society for the promotion of rural and domestic economy, which was organized by a convention held in Georgetown, District of Columbia, on the 28th of November, 1809. The first agricultural exhibition in America was the National Fair held by this society at the Union Hotel, in Georgetown, District of Columbia, on the 10th of May, 1810. Among other premiums awarded were three, of $100, $80, and $60, respectively, for two-toothed ram lambs, showing the great importance attached at that early day to improving the breed of sheep. At this exhibition it is recorded that President Madison wore his inauguration coat, made from the Merino wool of Colonel Humphrey's flock, and waistcoat and small clothes made from the wool of the Livingston flock, at Clermont. The first field trial of implements in America was the plowing match at the fifth semi-annual exhibition of the Columbian Society, on the 20th of May, 1812. The war with England, which occurred at that time, overshadowed everything else; and, after holding a sixth successful exhibition, on the 18th of November, 1812, the time for which the society had been organized (three years) having expired, it was dissolved at the close of that year. Its successful exertions in awakening a more general interest in the various departments of husbandry, not only in the immediate vicinity of its exhibitions, but in the adjacent States, merit a grateful remembrance by the agriculturists of America. On the 14th of June, 1852, a National Agricultural Convention was held at the Smithsonian Institution, in the city of Washington, under a call issued by the following agricultural societies, at the instance of the Massachusetts Board of Agriculture; The Massachusetts State Board of Agriculture; Pennsylvania State Agricultural Society; Maryland State Agricultural Society; New York State Agricultural Society; Southern Central Agricultural Society; Ohio State Board of Agriculture; American Institute, New York; Massachusetts Society for the Promotion of Agriculture; Indiana State Board of Agriculture; New Hampshire Agricultural Society; Vermont Agricultural Society; and the Rhode Island Society for the Encouragement of American Industry. The convention was composed of one hundred and fifty-three delegates, representing twenty-three States and Territories. Among those who were present during its sessions were Fillmore, President, and Daniel Webster, Secretary of State. The objects of the society, as declared by the preamble to its constitution, were, to improve the agriculture of the country, by attracting attention, eliciting the views, and confirming the efforts of that great class composing the agricultural community, and to secure the advantages of a better organization, and more extended usefulness among all State, county, and other agricultural societies. The first fair of the Society was held at Springfield, Mass., in 1854, and thereafter yearly until the outbreak of the late war, when the practical efforts of the Society ceased, it having been found that the State fairs had grown into such magnitude as to eclipse its efforts. In 1870 an organization was perfected, in New York, to establish a National Board of Agriculture, but up to this time the organization has held no fairs, and has not gone beyond the preliminary stages of organization. From the fact that now every notable district, and counties hold annual fairs, and from the fact that from this cause our State fairs, many of them, are losing in their attractions, the probability is that an Annual National Fair could not be successfully sustained without outside aid. The New York State Agricultural Society held its first regular fair in 1840, the sum of twelve and a half cents being charged as admission. Since that time the society has grown in magnitude year by year, and the legislature being finally roused to action, through the able pen of the lamented Judge Buel, and the efforts of his contemporaries it soon became the first of the agricultural fairs of the nation. The American Institute Farmers' Club, founded in 1843, had a more than usually active career for thirty years, or until the summer of 1873, when, from various causes, many of them of chronic standing, it ceased to hold its regular meetings. During the first twenty years of its existence, it effected a vast amount of good and, through its published transactions and the newspaper press, exercised an immense influence, reaching over the whole country. It has numbered many eminent men among its members, and its fairs, held annually in New York city, have always excited much interest. But far back, beyond any of these societies, Massachusetts may claim the honor of success, in offering prizes for the advancement of agriculture. In 1803 the trustees of the Massachusetts Society for Promoting Agriculture, offered among others, the following premiums: To the person who shall discover a cheap and effectual method of destroying the canker-worm, a premium of $100, or the society's gold medal. For a heap of best compost manure from the common materials of the farm—of not less than 200 tons—with a description of the method, $50. For the most thrifty trees from seed, not less than 600, and not less than at the rate of 2,400 per acre, of oak, ash, elm, sugar-maple, beech, black and yellow birch, chestnut, walnut, or hickory, $25; or, if all of oak, $50; to be claimed on or before October 1, 1806. For accurate analyses of the constituent parts of several fertile soils, respectively so of poor soils, and how, by actual experiment, to remedy the evils, so that it can be practiced by common farmers, $50. And if it shall appear to the satisfaction of the trustees, that the improvement is more than equal to the expense, then an additional $100. From the beginnings thus sketched, agricultural societies and farmers' clubs have multiplied and spread, until now there are none of the States, and but few of the territories, which are destitute of more or less organizations of this character. These hold annual fairs, and distribute large amounts in premiums yearly, embracing the entire scope of agricultural and horticultural art, and domestic manufactures. Agricultural societies are in active operation in nearly every county of the Northern States. In the South, the popular interest in these matters is spreading and deepening steadily. It should be but a few years, at most, before this section of the Union will be enabled to organize societies as generally as have the East and West. In horticulture, its votaries have not been derelict, but have fully kept pace with agricultural societies which, even to-day, are largely stock and implement shows. In 1840 the American Pomological Society was formed. Their sessions are biennial, their meetings are attended by the most eminent horticulturists of the Union, and their exhibitions are contributed to by the various State horticultural societies. This organization, in connection with the State horticultural societies, has aided most materially in fostering correct horticultural knowledge, and in keeping alive a spirit of progress. Now, nearly every State in the Union has an active working society. In 1876 there were reported, as in active operation, agricultural societies in the States named below. Of these, as stated before, the oldest are the Society for the Promotion of Agriculture, established in Philadelphia, Pa., in 1785; the Massachusetts Society for Promoting Agriculture, Boston, Mass., in 1792, and the Agricultural Society of South Carolina, Charleston, S. C., in 1795. Dividing the American century into four parts, the number of societies now in existence were organized as follows: From 1776 to 1801, inclusive, 3; from 1802 to 1826, 16; from 1827 to 1851, 375; and from 1852 to 1876, over 1,500. The number of societies in the various States are reported for 1880 as follows: Alabama, 13; Arkansas, 15; California, 16; Colorado, 5; Connecticut, 47; Dakota Territory, 3; Delaware, 10; District of Columbia, 5; Georgia, 77; Illinois, 133; Indiana, 99; Indian Territory, 1; Iowa, 144; Kansas, 106; Kentucky, 33; Louisiana, 9; Maine, 49; Maryland, 27; Massachusetts, 74; Michigan, 70; Minnesota, 43; Mississippi, 11; Missouri, 86; Montana, 1; Nebraska, 35; New Hampshire, 21; New Jersey, 23; Nevada, none reported; New York, 153; North Carolina, 27; Ohio, 138; Oregon, 7; Pennsylvania, 94; Rhode Island, 6; South Carolina, 10; Tennessee, 55; Texas, 41; Utah, 33; Vermont, 25; Virginia, 36; Washington Territory, 10; West Virginia, 11; Wisconsin, 81. Of these the principal State and district societies appropriate large sums, as premiums yearly, running even to $60,000 in the case of the St. Louis Fair Association. Illinois gives about $20,000 yearly, and some other States as much. The interest, however, is annually centering in district and local fairs, each managed by a business corporation, as in the case of the St. Louis Fair Association, and it is beginning now to be seriously argued before our various State Departments of Agriculture, whether their efforts for the advancement of agriculture may not be more legitimately employed than in the running of fairs as a source of revenue.

FALCATE. Shaped like a scythe: a descriptive term used in botany and zoology.

FALCO. The genus of hawks.

FALCON. (See Buzzard.)

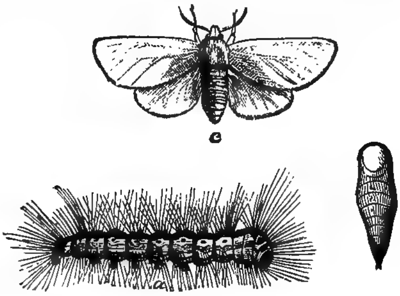
FALL DANDELION. (See Dandelion.)

FALLING SICKNESS. (See Epilepsy.)

FALLOPIAN TUBE. A tube communicating between the womb and ovarium of the mammalia.

FALLOW. Originally, this term meant the exposure of the naked soil to rest, after ploughing several times, to destroy weeds and repair its fertility. This practice is now considered almost useless, as requiring much time and expenditure otherwise better employed. A crop of oats, clover, rye, buckwheat, lucerne, lupins, turnips, or other cheap vegetable in flower is now ploughed in and called a green fallow. In this way land is rapidly improved, especially if a liming is given. To turn in heavy herbage the ox-chain is fastened to the clevis and land-side handle of the plough, and this pressing down the plants, allows them to be buried. Green fallowing is the most rapid and cheap method of bringing up poor lands; it incorporates into the soil the nitrogen bodies wanted for high cultivation, enables the improver to proceed without the expense of cattle for raising manure, and saves the time necessary to wait for the manure. The herbage so turned in yields more vegetable mold than it would otherwise form if applied in any other way. Fallows can be made at any time, in summer for a fall crop, or in autumn for spring.

FALL WEB WORM. *Hyphantria textor.* This is a common caterpillar, and particularly annoying from its habit of forming its large webs, not only on forest trees but also on fruit trees, August being the season when they are formed in the North. The caterpillar is greenish-yellow, dotted with black, very hairy and slender; moth white and unspotted. The cut



FALL WEB WORM.

shows, at *a*, caterpillar; *b*, chrysalis, and *c*, moth. This insect is named from the tent-like character of the web in which the larva congregate. They usually destroy all the leaves on a branch, before passing to another, and should be exterminated wherever found. They are especially destructive to the apple, pear, cherry and plum.

FARCY. The horse with Farcy should be killed immediately it is apparent that it is acute. The pustules are malignant, and arise from blood poisoning as in Glanders. It should be needless to say, that if the human system becomes inoculated, with the virus, death is certain sooner or later. Fortunately the disease is rare, as is Glanders. Charlatans indeed have cures both for Farcy and Glanders. So they will profess to cure spavin after the bones are quite anchylosed, or grown together. There is a form of Farcy called Chronic Farcy, not especially dangerous, and mild forms may be cured. The buds or buttons as in acute Farcy are arranged in groups about the inner and outer thighs, forearm, flanks, neck, and head. They are tender and painful, but do not ulcerate. They may also be felt, as hard, irregular knots along the course of the jugular vein. Rub the buds and knots with biniodide of mercury, or touch them with lunar caustic. If they break wash with a ten per cent. solution of carbolic acid. Keep up the strength of the animal with nourishing food. Give twice a day, in a pint of water, five grains of arsenic and one drachm nux vomica. The proper proceeding however, if Farcy or Glanders is suspected, is to consult, or describe symptoms to, a competent veterinary surgeon, or in case the symptoms are pronounced to kill and bury deeply at once, and disinfect the stable promptly.

FARINA. The flour or meal of grain. *Farinaceous* is a derivative.

FARM ACCOUNTS. One of the most curious facts, in agricultural economy, is, that probably not one farmer in ten ever keeps a correct book account of debit and credit on the farm. Consequently his only means of knowing which crops pay best, or in fact which pay at all, is to guess at it and take the chances. One reason is the prevalent idea that there is some mystery in keeping books or something requiring a special order of talent. One of the excuses made is, that it takes a large amount of time. Book-keeping may be made as simple as any other labor of the farm, and the little time occupied in keeping the books in order every evening, may very economically be taken from some other less important work. There is another class, who shirk this duty from an unwillingness to undertake anything that savors of intellectual labor. The larger class, however, do not keep a correct account of what pertains to the farm, because they consider it unimportant. A merchant or manufacturer who goes upon such a presumption most assuredly bankrupts himself. The farmer who goes upon this presumption loses enough yearly to pay for doing the work ten times over. The only way to get into the habit of keeping farm accounts is to begin. It is not necessary to keep an account of the cost of every animal from the time it is born; an approximation can be had, for instance, on the feeding of a lot of calves, a bunch of steers, or the time and money spent on a field of grain, etc., can be had with but little trouble. Some time since Mr. John H. Borne, of Massachusetts, presented a simple and concise plan for doing this, from which we extract, for one reason especially, that some portions of it apply to farms where manure is a considerable item. Where this is not the case, of course it will become one of the minor items. In relation to this matter, Mr. Borne says: Sometimes we see accounts, even in agricultural reports, in which everything a farmer raises is set down at the market value. For instance, credit is given for the number of tons of hay, the number of bushels of corn and potatoes, and everything that is raised, without a corresponding debit of what is used in keeping the stock through the year—making it appear as if the net income was very large, when, in reality, nearly all is used upon the place. A farmer may, perhaps, plow large fields that have been previously manured, and, without applying any fertilizer, obtain a good crop, which, when sold, brings in a large sum of money. He may decide that his profits are large; but a system of book-keeping that estimates the value of the land of each field, each year, would oblige him to appraise the fields from which his large crops were taken as of less value than before. This would show him that the profits were not really as large as he at first supposed. Another might spend a good deal of time and money in making improvements, which, for the present, bring in no profit, and it might seem that nothing was made by farming; yet an account of what his improvements cost, and of all that the land (on which the improvements were made) produced for several years would change his opinion. Thus, by carrying out a system of book-keeping which, not only applies to the farm as a whole, but also to each operation in detail, a very large fund of practical knowledge would be obtained in a few years. If each farmer in our nation would thus estimate the expenses of his business our practical knowledge of the value of agricultural products would be much increased, and the amount of productions in the nation be vastly enlarged. Some charge no interest upon their cattle, tools, land, and buildings; others sell a large quantity of wood each year, which is all considered as profit, without regard to the diminished value of the lot; these all deceive themselves, thinking they have made a large profit by farming, when the profit, in reality, comes from some other source. The plan which I propose to present is so simple that a person whose education is very limited can adopt it. The productions raised, and the prices of both productions and labor, vary much in different localities; but the principles will apply, and a little practice will make the application comparatively easy. It will be better to use only one book; it may be of any size and shape, but containing about two hundred pages, made of ruled paper, and having two ruled lines on the right hand, up and down the page, for dollars and cents, and one on the left hand for the date of the transaction. Let the book be paged, writing the numbers plainly, and place an index at the commencement. Following, should be an inventory of the value of the farm, the stock and farming implements, leaving a few blank leaves for inventories in future years. Next, may follow what may be called a memorandum or journal, in which should be noted all transactions important enough to be remembered. This will require no debit or credit, but is simply a history;

important for reference, and will serve to prove the time and nature of any transaction. At one-third the distance from the beginning should commence the cash book or farm account, in which every sale is credited to the farm, and every expense is debited. Commencing with the last quarter of the book may be kept the account with different fields, hired men, and every person with whom an account is kept. As the season begins in April, I would commence the year with that month—as less produce is on hand, and it is easier to take an inventory, (or account of stock, as merchants call it,) which should always be done. It will require some judgment to rightly estimate how much more, or less, each animal is worth than one year before; whether your buildings and fences are in as good repair; whether your land has improved or lessened in value; whether the new tools purchased are equal in value to the loss by use of the old; whether you have more hay, grain, or vegetables on hand than at the commencement of the previous year, all of which should be correctly ascertained, being appraised at the market value. If an inventory is not taken, however accurate the account of the receipts and expenditures may have been, the real income or loss of the farm will not be known; and the more accurately the estimate is made, the nearer correct will be the figures that show the gain or loss for the year. The farm to which the following figures apply is one upon which a mixed system of husbandry is employed, and its poverty of soil and distance from a market may, in part, account for the small net income of the year. The following will assist in understanding the plan to be pursued. It would, perhaps, be better to name and appraise each animal and each wagon separately, as, in case of losses or sales, the loss or cash could be set against it more readily.

INVENTORY OF FARM STOCK, TOOLS, ETC., APR. 1.

Farm of about one hundred acres, upland and meadow, in a poor state of cultivation, with a house, two small barns, and other out-buildings, which would probably bring at auction.	$2,550 00
One horse	100 00
Six oxen	620 00
Three cows	185 00
One heifer	35 00
Three turkeys	6 50
Ninety hens, at 75 cents each	67 50
Two swine	80 00
One express and one riding wagon	100 00
Ox wagon and ox cart	50 00
Harnesses	25 00
Truck harness.	5 00
Yokes	5 00
Plows and cultivator	20 00
Ox sled and chains	9 00
Spades, shovels, and forks	10 00
Corn sheller and harrow	10 00
Hoes, rakes, and other tools	30 00
Horse rake	8 00
Hand threshing machine	15 00
Grindstone	5 00
Baskets	4 00
Corn	15 00
Rye	5 00
Potatoes	30 00
Wheat	5 00
Three tons English hay	75 00
Two tons salt hay	20 00
Family stores	155 00
Amount of inventory on which interest is to be reckoned for one year	4,244 00

JOURNAL.

To go through the year would occupy too much space. Thus we give a memorandum of only one week every two months. It is not necessary to note every sale in the journal, only the more important, and such transactions as one wishes to remember; nevertheless we advise that the journal be sufficiently full so that it may become in a measure a reference from which the memory may be refreshed in relation to the principal business data of the farm and household.

April 1, 1865.—Have this day taken inventory of farm and what is on it, all of which are worth at the market value about $4,244.

Engaged two men to work for the season; Charles Gross, at $25 per month, and William Aiken at $23.

April 3.—Plowed for grain and grass seed.

April 4.—Plowed for onions, and purchased onion, grass and garden seeds, oil meal for feeding, and tools for summer use.

April 5.—Gave the onion ground thorough preparation for the seed, harrowing in fine manure, and working out all lumps and stones, making it mellow and level.

April 6.—Sowed onion seed, and finished sowing grass-seed.

[Omitting till first week in June.]

June 1.—Planted cabbages, putting hen manure, mixed with loam, in the hills.

June 2.—Sold one yoke of oxen for $197, which cost $105 last fall. They have done considerable work, and have had good keeping of hay and meal. The only way I know in which anything can be made in keeping cattle is to feed liberally.

June 3.—Hoed potatoes and corn, and planted squashes and melons.

June 5.—Bought one yoke of oxen for $135, which are in thin flesh, but will probably gain during the coming summer.

June 6.—Hired another man, Patrick Murphy, for the remainder of the season, to be paid $24 a month. I believe in hiring an abundant supply of help, and that more is lost by not having help enough than by having too much.

[Omitting till August.]

August 1.—Men employed in hoeing cabbages and turnips.

August 2.—Went to market, carrying potatoes, cabbages, eggs, etc. Purchased one fine Cotswold buck lamb for $—.

August 3.—Employed the men in filling low, swamp land for mowing. Last year the best grass on the farm was upon land so reclaimed.

August 4.—Mowed salt grass.

August 5 —At work filling swamp land.

[Omitting till first week in October.]

October 2.—Men at work digging muck. Went to market.

October 3.—Gathered onions; a small crop, owing to a very dry summer. Purchased oxen and steers for $—.

October 4 and 5.—Digging potatoes; very good crop; better than was expected.

October 7.—Drawing sea manure.

[Omitting till first week in December.]

December 1.—The time of the men being out, only one is to be employed during the winter; the others are paid.

December 2.—Spending time in making everything snug for winter. The barn and hog yards are now filled with muck, bedding is secured, and part of it is housed, and the remainder stacked, so that it can be kept dry; and everything is done to keep the stock warm and comfortable.

December 4.—Sold two fat hogs and eight pigs for $—.

[Omitting till first week in February.]

February 1, 1866.—Employed in laying plans for the coming year. In looking back over the failures of the past year, find that they have generally arisen from two causes: first, poverty of soil or lack of manure; and, second, not having men enough to perform all the work at the right time. In addition may be added one beyond the control of man, which was, long and severe drought.

February 5.—Man employed in getting wood for the year.

CASH BOOK.

In this book everything spent for the benefit of the farm is charged to as debtor, and everything sold, being the produce of the farm, is credited to it instead of using the owner's name. Reference to the journal must show how and why the expenditure was made.

Each debtor page to be headed as the following:

DR.

Date.		Farm.	Amount.
1865.			
April	4	To 4 lbs. onion-seed, at $2.25	$ 9 00
		" 30 lbs. clover-seed, at 15 cents	4 50
		" 1 bag red-top	4 00
		" ½ bush. Herd's grass	2 00
		" ½ bush. orchard grass	2 25
		" garden seeds	3 50
		" 500 lbs. oil meal, at 2½ cents	12 50
		" 2 shovels, at $1.25	2 50
		" 2 hoes, at 85 cents	1 70
		[Omitting until 1st week in June.]	
June	5	To 1 yoke of oxen	135 00
		[Omitting until 1st week in August.]	
Aug.	2	To 1 buck lamb	10 00
Aug.	3	" Wm. Aiken	8 00
Aug.	4	" Taxes	86 55
		[Omitting until first week in Oct'r.]	
Oct.	3.	To 1 yoke oxen	160 00
		" 5 steers	225 00
Oct.	5	" Patrick Murphy	24 00
		Omitting until 1st week in Dec'r.]	
Dec.	1	To Patrick Murphy, (in full)	43 25
		" Charles Gross, (in full)	175 00
		[Omitting until 1st week in Febr'y.]	
Feb.	1	To linseed meal	24 00
		Blacksmithing	7 50

Each creditor page to be headed as the following:

CR.

Date.		Farm.	Amount.
1865.			
April	7	By 2 pigs	$ 15 00
		[Omitting until 1st week in June.]	
June	2	By 1 yoke of oxen	197 00
June	7	" 1 calf	11 00
		" 15 bushels of potatoes, at 60 cents	9 00
		[Omitting until 1st week in August.]	
Aug.	2	By 8 bush. potatoes, at $1.50	12 00
		" cabbages	8 40
		" 12 doz. eggs, at 30 cents	3 60
		" 30 bunches onions, at 5 cents	1 50
		" 15 bunches turnips, at 5 cents	75
		" 20 dozen green corn, at 15 cents	3 00
Aug.	5	" 12 lbs. butter, at 40 cents	4 80
		[Omitting until 1st week in October.]	
Oct.	2	By 5 bbls. onions, at $2.25	11 25
		" cabbages	5 25
		" 15 doz. eggs, at 30 cents	4 50
		" melons	4 30
Oct.	6	" 15 bbls. onions, at $2.25	33 75
		" 4 bbls. apples, at $4	16 00
		" chickens	15 40
		[Omitting until 1st week in Dec'r.]	
Dec.	2	By 50 lbs butter, at 45 cents	22 50
		" 940 lbs. pork, at 16 cents	150 40
		" 8 pigs, at $4	32 00
Dec.	4	" ¼ beef, 156 lbs., at 13 cents	20 28
Dec.	5	" 92 lbs. hide, at 8½ cents	7 82
		[Omitting until 1st week in Febr'y.]	
1866.			
Feb.	1	By 25 bush. potatoes, at 60 cents	15 00
		" 8 bush turnips at 60 cents	4 80
Feb.	5	" 15 doz. eggs, at 35 cents	5 25
Feb.	6	" 4 steers	250 00

The above (being only detached parts, comprising merely six weeks of the year) will serve as a specimen to assist in understanding the manner in which each sale and expense is recorded. The debit side, or expenses, should be on the left hand page, and the credit, or sales, on the opposite (right) hand page, and when either page is filled, both should be added up, and the amounts placed at the bottom, when new charges and credits should be commenced on the next two pages. In like manner go through the year, and then the amounts can be drawn off and used in the final settlement. The inventory at the end of the year will be omitted to save room, but the amount must be used in the settlement. To find the gain or loss for the year, take—

The inventory April 1, 1865	$4,244 00
Interest on that amount for one year	244 64
Grocer's account for the year	175 85
Butcher's account for the year	85 40
Expenses of farm for the year, being the amount of all the debt pages of cash book	1,681 29
	6,441 18

The inventory April 1, 1866	$4,123 50
Amount of sales for the year	2,545 84
	6,669 34
Take expenses, value of farm, etc., April, 1865	6,441 18
Net income	228 16

This amount is received for services of owner and family, besides that portion of their board and clothing furnished by the farm. It allows for the additional or decreased value of the farm buildings and fences. The last quarter of the book being devoted to separate fields, poultry, cattle, grocer's account, butcher's account, etc., a few items will be given to show the method in which they are kept. These individual accounts are of prime importance. They may be made to show not only what every field costs and returns, but what each crop in a field costs, and, in fact, what each and every individual portion of a crop costs, as manure, seed, plowing, sowing or drilling, cultivating, weeding, harvesting, threshing and marketing. Thus, at a glance, the farmer may readily discover which crops pay best, the quantity of manure needed for special crops to produce the most remunerative returns, besides much other valuable information, by referring back from year to year. As a case in point: In the east where manure is an important and costly necessity in farming, where both commercial and domestic manures are used, the farmer can tell at a glance the relative economy of each, from their cost, including hauling and spreading, upon each and every crop to which they have been applied. So upon crops, the profits on which depend on the manure applied to previous crops, and the preceding crops themselves, as in the case of sugar beets, or other saccharine producing crops. An examination of the books will easily show the character of the soil as to constituents and condition for the crops in question. A correct and minute system of book-keeping becomes absolutely necessary on all large estates, and in all agricultural transactions, where the farm and factory go hand in hand, as in dairying, sugar-making, etc. It is quite as necessary, however small the farm or simple the operation, since any business requires correct data.

CORN FIELD, (TWO ACRES SWARD LAND.)

Dr.

May 1,	To 12 cords of manure, at $5	$ 60 00
“ 1,- 2,	“ getting ont and spreading	12 00
“ 3,- 4,	“ plowing	13 00
“ 8,	“ harrowing	3 50
“ 9,	“ furrowing one way, 3½ feet apart	2 00
“ 10,	“ seed corn	1 00
“ 10,	“ planting	3 00
June 3,	“ cultivating and hoeing	6 50
“ 20,	“ “ “	6 50
July 1,	“ “ “	6 50
Aug. 25,	“ cutting and curing top stalks	8 00
Oct. 3,- 4,	“ harvesting	15 00
	“ interest on land and taxes	6 50
		143 50

Cr.

By 128 bushels corn, at $1 10	$140 80
“ 3 tons top stalks, at $10	30 00
“ 4 tons butt stalks, at $8.	32 00
Value received	202 80
Cost of crop	143 50
Net income on two acres	59 30

CARROTS, (ONE-FOURTH OF AN ACRE.)

Dr.

May 12,	To 2 cords manure, at $5	$ 10 00
	“ drawing manure	2 50
“ 13,	“ plowing and preparing land	3 00
“ 20,	“ seed and sowing	1 50
June 20,	“ hoeing and weeding	10 00
Nov. 10,	“ harvesting	4 00
	“ interest on land and taxes	2 50
		33 50

Cr.

By 8,450 pounds carrots, at ½ cent per pound, or $10 per ton	$ 42 25
“ value of tops	2 25
Value received	44 50
Cost of crop	33 50
Net income	11 00

ONIONS, (ONE-HALF ACRE.)

Dr.

April 4,	To 4 cords of manure, at $5	$ 20 00
	“ drawing and spreading	3 00
“ 5,	“ plowing	2 00
	“ cultivating, harrowing and raking	4 00
“ 6,	“ seed and sowing	12 00
June 6,	“ hoeing	28 00
Oct. 3,	“ harvesting and topping	12 00
Nov. 6,	“ drawing to packet and freight	25 00
	“ barrels	21 00
	“ interest on land and taxes	5 00
		132 00

Cr.

By 95 barrels onions, at $2	$190 00
Cost of crop	132 00
Net income	58 00

BEEF ACCOUNT.

Dr.

To 4 steers, at $45	$180 00
“ 3 tons salt hay, at $10	30 00
“ ½ ton English hay	10 00
“ 30 bushels meal, at $1 10, (2 qts. each per day)	33 00
	253 00

Cr.

Cost of 4 steers	$253 00
By 4 steers	250 00
Loss besides the care of feeding	3 00

MEM.—Yet it is better to feed the hay upon the place, if as much can be obtained for it as it would bring if sold, even if little is received for the labor of feeding out. The manure thus made should be estimated as part of the credit.

COST OF RAISING "DAISY," A HEIFER TWO YEARS OLD, AND NEAR CALVING.

Dr.

To value when 4 weeks old as veal	$ 12 00
“ 6 quarts of milk per day for 3 weeks	3 78
“ 4 quarts of milk per day for next 3 weeks	2 52
“ 2 quarts of milk per day for next 3 weeks	1 26
“ meal and grass to November 1	1 25
“ 1 pint of meal per day to May 1	4 00
“ hay to May 1	4 00
“ care the first year	8 00
“ pasture till November 1	3 00
“ hay and grain to April 1	15 00
“ care the second year	5 00
	59 81

MEM.—Not having calved, she is yet to be proved, although indications are that she will be worth all she cost. When she has been proved, her value may be entered beneath her cost stated above.

GROCER'S ACCOUNT.

April 1,	Sugar	$2 15
	Kerosene	1 40
	Molasses	2 00
3,	2 lbs. tea	2 50
3,	Crackers	25
6,	Flour	12 50

BUTCHER'S ACCOUNT.

April 1,	6 lbs. steak, at 20c	$1 20
6,	8 lbs. beef, at 14c	1 12
7,	15 lbs. fish, at 3c	45

[So keep account to the end of the year.]

A similar account of dry goods and of general household furnishing should be kept; also, of all marketing sold. It is said that farmers are more slack in their payments than most other business men. It is true they generally pay in time; but they are often short of money and get trusted for what they buy, thus keeping always in debt. This ought not so to be, and a little system in keeping an account of the income and expenses will have a favorable influence in assisting them to keep out of debt. In order that every record may be accurate, it is necessary that it be attended to each night, while fresh in the mind. A small book in the pocket, or a slate and pencil hanging in some convenient place, may assist in retaining the principal facts and figures until they can be transferred to their appropriate places. The foregoing is not given as an indication of expenses or prices. These will vary with the locality; for instance, in the West, the manure account will be light, and so will be the labor account, in comparison with the New England States, on the other hand the price at which products are sold will be less than in the East, not so much less than years ago, when there were few railways to give cheap transportation, yet the principle will hold good now as then. With this showing we must leave the subject only adding that the most successful farmers are those who keep a strict debit and credit account, and who are not afraid to look expenses in the face.

FARM BUILDINGS. The importance and necessity of convenient farm buildings is early seen in the settlement of new countries. For the first few years the buildings must necessarily be of the crudest character, but, as wealth increases, among the first efforts of the farmer is to improve his dwelling house and other farm buildings. These will be found treated of under the titles architecture, barns, dairy, and other buildings, which see.

FARMERS' CLUBS. (See Fairs.)

FARMING. To those who can look back to the days when the labors of the farm were the merest drudgery; when a one-horse and a two-horse plow, a harrow, the crudest hoes, rakes, scythes, and reaping cradles constituted the working implements of the farm, and compare those of to-day, when plows of every conceivable pattern, with and without wheels, harrows, and scarifiers, for a great variety of purposes, rollers, grain drills, gang hoes, reapers and mowers, horse-rakes, threshers, hay-tedders, hay-sweeps, horse forks and carriers, horse corn and cotton planters, cultivators, corn harvesters, huskers, stalk cutters, seed planters of every kind, nearly all of which may be operated without the driver being obliged to walk. To those, we say, who have witnessed all this, and, moreover, steam harnessed to the plow and threshers, and made to do the work of twenty horses at once, the change is surprising indeed. The power machinery of every half section farm now often represents more money than the entire value of a good farm forty years ago. In other words, the application of science to agriculture has increased our productions ten-fold, and enabled the farmer to feel that his calling is not all mere drudgery. Not only has great progress been made in the application of machinery to the farm, but the investigations and labor of countless experimenters has given us improved varieties of grain, vegetables, fruits and flowers, and farm animals so improved, that the farmer who died half a century ago, if he could come back, would not recognize his country nor even the earth upon which he once had lived. In these days, especially in the West, it is the capital invested in implements, machinery, and stock, that gives the measure of success in farming. It enables the farmer to accomplish high farming at the lowest possible cost. It enables him to make a complete crop of corn, ready for husking, at less than one-and-one-quarter days' labor of a man and team per acre, and in favorable seasons he may accomplish sixty-five acres to the man and team employed. Modern improvement has enabled the farmer to raise crops of wheat at an outlay of $5 per acre, including cost of seed and harvesting. So, with all other crops, the intelligent use and care of machinery has not only increased the acreage, per man, six-fold, but has increased the average yield as well. This is all there is to high farming—the raising of maximum crops at a minimum cost. Mr. T. S. Gold, one of the best farmers in Connecticut, and Secretary of the State Board of Agriculture, and a close observer, has this to say about farming in New England: It is true that little judgment was used in first settling the country, and that many farms, or even larger districts, were cleared from the forests that should have been allowed to remain, to furnish timber for manufacturing and building, and shelter for fruits and crops. The introduction of agricultural machinery is rendering the culture of these rough portions and the gathering of the hay relatively more expensive than upon smoother land, and there is no doubt that some entire farms thus circumstanced fail to return to their owners a fair equivalent for the labor and capital employed, and that many other farms have some portions which are a drag upon their better parts, a sinking-fund to swallow up the profits derived from successful culture elsewhere. I do not refer to those expensive labors in clearing rocky land, or draining wet land, or reclaiming sandy land by ashes and lime or green crops, but to the continued culture of rough and impoverished lands, the gathering of hay from rough meadows, still mowed because they were once productive, and other like practices followed because under other circumstances they were profitable. Lands so situated that they cannot profitably be manured or even cultivated, because they are so difficult of access, must be classed here as not paying for the labor required. Wherever we find farmers laying aside these old-time ways, concentrating their energies upon their better lands, adapting their farming to the changing conditions of the times in stock, crops, and improved implements and machinery, we find them thrifty, enjoying the comforts and luxuries of life, with means to support society, to educate their children, laying up a comfortable competency for old age, and to give their children a better start in life than they themselves enjoyed. Again, if farming does not pay, how is it that all the cultivators of the soil live? They always get their living by their occupation, not by dependence upon other callings. The agricultural laborer always has his sustenance and always secures his wages. The failure of a farmer to meet his obligations, unless he becomes involved by some outside venture, is a rarity so great that it may be said never to occur, while every community can show examples of ruined fortunes, involving many other parties, in the more enticing walks of trade and manufactures. Agriculture absorbs and employs all men who fail in other avocations either from physical disability or other causes. The disjointed parts of lives spent in other callings, which absorb their mental powers and their physical training in periods of rest, are mostly spent in the culture of the earth. Agriculture has to feed all these and their families. Adventurers of every kind take rest and find renewed strength on the farm for new enterprises, and come back again often with blasted hopes and shattered health and fortunes. As showing the advantage of capital in farming, in England, and the rule will hold good everywhere, the capital being expended judiciously, Mr. Mechi, the well known and successful English farmer, who went into farming because he thought it would pay better than any other sure business, stated that for his farm of one hundred and seventy acres he paid £23 per acre, and invested nearly as much more in buildings, drainage, roads, clearances, and machinery. These outlays he regarded as constituting his invested capital as landlord, claiming in return, as yearly rent, £2 per acre, or about four and one-half per cent. Further outlay considered as capital invested by him in his capacity of tenant farmer, averaged per acre as follows: December 31, 1868, live stock, £6 10*s.*; farm houses, £1 1*s.*; tillages, manure, etc., £3 15*s.* 6*d.*; implements and machinery, £2 10*s.*; hay, corn, etc., unsold, £2 5*s.*;—total per acre, £16 1*s.* 6*d.* With this tenant's capital of £16 per acre, he has for several years obtained from the farm an annual surplus of more than £600 available for rent and profit, after paying all expenses. The statement carried out for the one hundred and seventy acres shows a landlord's capital of about £7,800, giving a rent income of nearly four and one-half per cent.; and a tenant's capital of £2,720, giving a profit of over £260, or nearly ten per cent., after payment of rent and expenses. Mr. Mechi states, however, that his average annual profit as tenant for a course of years has been twelve and one-half per cent. His large outlay for live stock, which he feeds mostly on purchased food, is the key to his frequent and extraordinary crops and large profits; for through this means he is enabled to apply great quantities of rich manure to his deeply cultivated land. Such a system accounts for his production of forty tons of mangels per acre in 1869, and for his frequent production of forty-eight to sixty-four bushels of wheat per acre. Yet the soil of his farm was naturally poor, needing more outlay to keep it in condition than would be required on better land; and experience had convinced him that he could have done better with a tenant's capital of £20 to £25 per acre. Many farmers in Norfolk and Lincolnshire employ a capital of £20 to £30 per acre to advantage. It is beyond question that a difficulty with many farmers, is, they farm in a haphazard way. They fail to understand that to the plants to be grown, the soil, climate, rainfall and other conditions must be adapted. Thus they lose much valuable time and money in trying crops neither adapted to the soil or climate. A case in point, undertaken by the French government, and later, still another by the United States, in tea and coffee culture, will illustrate the point: M. Naudin illustrates the losses of time and money which arise from inattention to the meteorology of acclimation by the attempt made many years ago to introduce tea culture into France. The experiment, made at a large expense, failed for the reason that the temperature and the degree of atmospheric moisture necessary for the profitable culture of the plant did not exist in that country. The costly trial was undertaken without a proper preliminary investigation. The success which has attended the recent enterprise of the English government in the cultivation of the cinchona in India, was the consequence of a careful study of the conditions, climate, etc., of the South American habitat of the tree, and a selection of localities in which those conditions could be sufficiently approximated.

FARMS AND CROPS. The animus of the present age is toward the concentration of capital in gigantic enterprises. Thus within the last fifty years immense establishments have grown up for the extensive manufacture of almost every article required, either for ornament or use. Agricultural enterprises, as a matter of course, can not be carried out in the same direction except in a limited sense, as in the manufacture of butter, cheese, the artificial feeding of stock in large numbers, and the carrying forward of the systematic raising of crops on a large scale, under the direction of the master and by means of a large outlay of capital. This however can scarcely succeed, except occasionally in the production of special crops, and while the land is new; for, it may be set down as a fact incontrovertible, that the larger the estate, worked by direct hiring, the smaller the average profits. So far, the history of these gigantic farms is that in the end the result has been failure; the only exceptions being when bodies of wild land have been secured at a very low price, sown to wheat, and the land disposed of at a profit at the end of a few years, or when the surrounding country had become densely enough settled so as to add many times in value to the original cost of the land. Hence in the settlement of new districts of a country, it always holds good, that, as the inhabitants increase, farms are divided up, and become smaller and smaller in acreage, and that in proportion to the diminished size of the farms, the system of cultivation improves. A case in point showing the effects of thorough cultivation in the South will suffice to illustrate: In 1874, at the semi-annual convention of the Georgia State Agricultural Society, a Mr. R. A. Hardaway gave a detailed statement and comparison of his farming on fifteen acres, as against the average as indicated by the tax returns of the State. The total cash receipts from his fifteen acres, for the years named below, were as follows:

1866	6 acres of corn and 9 acres of cotton.....	$1,127 18
1867	5 acres of corn and 10 acres of cotton....	1,185 80
1868	15 acres of cotton........................	1,721 44
1869	15 acres of cotton........................	1,614 02
1870	15 acres of cotton........................	1,316 41
1871	2 acres oats, 6 acres cotton, 4 acres corn, 1 acre potatoes, 2 acres rice..........	926 75
1872	4 acres corn, 4 acres cotton, 7 acres oats.	951 60
1873	3 acres corn, 5 acres oats, 1 acre potatoes, 6 acres rested........................	634 00
	Total value of crops for eight years	9,477 20

Mr. Hardaway gives the cost of labor for the cultivation of these fifteen acres at $100 per annum, and adds to cash received from products of the farm, premiums amounting to $575; making his total cash receipts $10,052.20 for the eight years, with but $800 deducted for labor. The returns of the tax-receivers of the State, made under oath, gives the following average yield of the three crops named, for the year 1873: Corn, five and one-half bushels per acre; oats, four and one-half bushels; and one bale of cotton to three and one-half acres of land. Comparing these results with the crops made on the farm mentioned, the comparison is as follows:

1866.—The two hundred and fourteen bushels of corn produced by me on six acres would require forty-one acres, and the seven bales of cotton made by me on nine acres would require twenty-four acres. Here, then, would be sixty-five acres against fifteen acres, and an additional expense of $392.45 for cultivating the extra fifty acres.

1867.—The one hundred and sixty-nine bushels of corn produced by me on five acres would require thirty-three acres, and the nine bales of cotton which I made on ten acres would require thirty-one acres. The case stands thus, for this year: Sixty-four acres against fifteen acres—forty-nine acres less, and $392.45 of extra expense saved in cultivation.

1868.—Fourteen bales of cotton produced on fifteen acres, the amount of my crop for this year, would require forty-nine acres, with the extra amount for cultivation.

1869.—Fifteen bales of cotton on fifteen acres, against the same amount on fifty-three acres; a difference of thirty-eight acres and $392.45 of extra expense in cultivation.

1870.—I this year made eighteen bales of cotton on fifteen acres. Taking the State average, it would have required sixty-three acres to have produced this crop—a saving of forty-eight acres and the difference in the expense of cultivation.

1871.—This year I made 168 bushels of oats on two acres against thirty-seven; five bales of cotton on six acres against seventeen; 168 bushels of corn on four acres against thirty-two, a saving of seventy-four acres with the additional expense of cultivation.

1872.—My crop on fifteen acres was as follows this year: Two hundred and eighty bushels of corn on four acres, against forty acres required for the same amount by the State average; four bales of cotton on four acres, against fourteen acres; three hundred and fifty-nine bushels of oats on seven acres, against eighty acres; making, in all, one hundred and thirty-four acres, against fifteen—a saving of one hundred and nineteen acres with its extra expense of cultivation.

1873.—On three acres I made three hundred and four bushels of corn, against fifty-eight acres required by the State average; on five acres, three hundred and thirty bushels of oats, against seventy-three acres; making, in all, one hundred and thirty-one acres against eight. In the eight years I have saved in cultivation an average of sixty-seven acres annually, with its additional expense of $392.45 for cultivation, aggregating a total of $2,339.60.

It must not be inferred from this that it would be advisable to reduce all farms to small areas. Until a country becomes densely settled, it is not practicable to work a few acres. On cheap lands the profit is in working large areas, by means of machinery and horse power; nevertheless it is the fact, as a country is settled up, large bodies of land continue to be cultivated to special crops, without division, until they become exhausted. No better exemplification of this fact can be given than in the large areas of waste land in the South, that years ago were utterly run down under the exhaustive system then practiced. We see the same thing to-day in some sections of the West, in a limited sense. Yet in the West there is a constant tide of emigration pouring in, and the lands are subdivided and eagerly bought up by the new comers, in small areas of forty acres and upward, and, before they have seriously deteriorated. Hon. J. R. Dodge, in an address before the National Agricultural Congress in 1874, stated some curious facts in relation to areas of particular crops, from which we extract as follows: When we consider that less than a third of the area of the States, and less than a fifth of the entire domain of the United States, is mapped into farms, and remember that of this farm-area only one-fourth is tilled or mowed; and when we further reflect that the average yield per acre could be doubled if the many could be brought up to the plane of the few in the practice of intensive culture, then we begin to realize what numbers our country is capable of feeding, and what waste of toil and effort comes from neglect of the economical lessons taught by the statistics of scientific agriculture. We now know that our wheat occupies an area less than the surface of South Carolina and, if the yield should equal that of England, half of that acreage would suffice. We know of our natural crop, maize, that it covers a territory not larger than the Old Dominion, and might produce its amplest stores within narrower limits than the present boundaries of Virginia. The potato crop could grow in the area of Delaware, though yielding less than a hundred bushels per acre; the barley for our brewing requires less than the area of a half-dozen counties; and tobacco enough to glut our own and European markets, is grown on an area twenty miles square. The following tables are important, not only as being brought down to the latest corrected statistics, but also as serving as a continued basis upon which to found values of farm products. The synopsis of total numbers of live stock, and total values which follow are also important. The first table shows the average cash value per acre of the principal crops of the farm, taken together, for the year 1879.

States.	Average value per acre.
Maine	$13 51
New Hampshire	13 56
Vermont	11 69
Massachusetts	26 71
Rhode Island	29 32
Connecticut	16 82
New York	14 15
New Jersey	18 05
Pennsylvania	17 68
Delaware	15 80
Maryland	17 82
Virginia	10 91
North Carolina	10 79
South Carolina	10 09
Georgia	10 35
Florida	8 52
Alabama	13 49
Mississippi	14 76
Louisiana	22 40
Texas	14 69
Arkansas	20 40
Tennessee	12 39
West Virginia	12 74
Kentucky	13 58
Ohio	15 58
Michigan	18 96
Indiana	14 66
Illinois	12 47
Wisconsin	13 80
Minnesota	10 29
Iowa	8 88
Missouri	10 78
Kansas	9 11
Nebraska	8 60
California	17 18
Oregon	17 11
Nevada, Colorado, and the Territories	16 13

Table showing the average yield and cash value per acre, and price per bushel, pound, or ton, of farm products for the year 1879.

Products.		Average yield per acre.	Average price.	Average value per acre.
Indian corn	bushels.	29.2 —	$0 37.5+	$10 93
Wheat	"	13.8 —	1 10.8—	15 27
Rye	"	14.5 +	65.6—	9 54
Oats	"	28.7 —	33.1+	9 50
Barley	"	24.0 —	58.9—	14 11
Buckwheat	"	20.5 +	59.8—	12 28
Potatoes	"	98.9 —	43.6—	43 09
Tobacco	pounds.	795.1 +	5.8+	46 18
Hay	tons.	1.29+	9 32 0+	12 04
Cotton	pounds.	188.0 —	10.2+	19 22

Table showing the average cash value per acre of farm products in the United States for the year 1879.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Tobacco.	Hay.	Cotton.
Maine	$22 80	$23 04	$17 28	$12 90	$20 00	$17 70	$56 70	....	$10 51	....
New Hampshire	25 35	17 55	11 52	16 80	16 38	14 52	55 68	....	9 71	....
Vermont	26 28	21 13	9 48	13 20	21 06	13 34	58 00	....	9 06	....
Massachusetts	28 08	27 00	11 18	15 50	16 80	7 92	58 24	$165 00	24 96	....
Rhode Island	24 00	....	11 05	10 56	17 10	....	62 00	....	27 65	....
Connecticut	21 46	27 00	14 08	9 89	14 96	10 64	51 94	168 00	13 65	....
New York	20 13	21 00	9 75	12 40	18 00	10 80	37 44	157 80	11 36	....
New Jersey	19 72	16 97	7 50	12 80	....	19 32	52 51	....	16 06	....
Pennsylvania	18 90	20 20	8 16	11 16	18 26	13 20	38 48	131 31	17 26	....
Delaware	14 85	17 94	11 05	7 70	....	....	49 80	....	15 60	....
Maryland	15 91	20 45	9 60	9 20	....	14 20	36 40	31 65	17 40	....
Virginia	9 31	11 68	5 67	4 56	....	11 16	38 64	38 15	14 76	....
North Carolina	8 70	8 96	6 40	7 20	....	....	57 96	38 92	15 60	$17 16
South Carolina	5 62	13 19	6 10	10 20	....	....	84 28	....	7 81	15 73
Georgia	6 51	11 34	....	8 55	....	....	71 04	....	22 76	15 60
Florida	6 88	....	....	13 28	....	....	....	....	....	10 50
Alabama	8 58	11 09	....	11 05	....	....	98 00	....	21 29	18 70
Mississippi	9 92	9 79	....	7 08	....	....	68 73	....	25 51	18 60
Louisiana	11 40	....	....	9 38	....	......	....	....	....	20 20
Texas	13 39	8 74	12 00	15 50	....	....	60 63	....	12 57	17 50
Arkansas	13 92	8 56	10 01	10 67	....	....	79 98	....	19 03	27 50
Tennessee	9 25	8 72	7 10	6 30	....	12 24	65 00	40 00	14 99	26 80
West Virginia	14 26	14 04	6 22	7 14	8 00	12 81	34 04	39 48	10 92	....
Kentucky	11 84	15 12	9 78	6 05	22 68	....	33 66	39 65	14 58	....
Ohio	13 65	23 40	12 70	8 97	25 08	14 25	37 41	40 26	12 46	....
Michigan	16 65	22 46	8 32	11 27	18 46	10 08	46 33	....	15 32	....
Indiana	11 22	23 75	12 42	7 92	21 06	14 00	27 88	42 00	11 91	....
Illinois	10 85	20 01	10 98	8 64	13 57	12 92	44 00	39 00	11 36	....
Wisconsin	15 21	13 10	9 45	11 70	16 47	11 90	33 66	123 96	12 36	....
Minnesota	9 45	11 56	10 78	8 05	12 47	12 40	34 50	....	7 44	....
Iowa	9 12	9 38	8 42	8 28	9 90	12 42	27 52	....	6 99	....
Missouri	9 25	14 14	10 37	6 40	....	12 60	43 68	33 15	10 00	....
Kansas	8 91	9 79	10 20	6 50	6 45	15 47	63 20	....	6 70	....
Nebraska	8 61	9 49	6 72	7 36	7 40	17 00	29 16	....	5 91	....
California	22 12	17 22	20 71	22 11	12 88	....	69 55	....	16 19	....
Oregon	29 76	15 68	22 00	15 84	19 20	....	51 66	....	22 68	....
Nevada, Colorado, and the Territories	27 00	13 78	....	16 50	....	....	110 40	60 62	16 00	23 75

A general summary showing the estimated quantities, for the United States, number of acres, and aggregate value of the principal crops of the farm in 1879.

Products.	Quantities.	Number of acres.	Value.
Indian Corn, bush.	1,547,901,790	53,085,450	$580,486,217
Wheat....... "	448,756,630	32,545,950	497,030,142
Rye .... "	23,639,460	1,625,450	15,507,481
Oats......... "	363,761,320	12,683,500	120,533,294
Barley....... "	40,283,100	1,680,700	23,714,444
Buckwheat .. "	13,140,000	639,900	7,856,191
Potatoes..... "	181,626,400	1,836,800	79,153,673
Total	2,619,108,700	104,097,750	1,324,281,392
Tobacco..pounds.	391,278,350	492,100	22,727,524
Hay. ......tons.	35,493,000	27,484,991	330,804,494
Cotton......bales.	5,261,202	12,595,500	242,140,987
Grand total	....	144,670,341	1,919,954,397

The live stock of the United States for 1880, as to number and total value, and average prices, foots up as follows: Of horses, there were in the United States and territories in 1880, 11,201,800 head, valued at $613,296,611, the average price being $54.75; mules, number, 1,729,500, value, $105,948,319, average price, $61.26; milch cows, number, 12,027,000, value, $279,899,420, average price, $23 27; oxen and other cattle, number, 21,231,000, value, $341,761,154, average price, $16.10; sheep, number, 40,765,900, average price, $2.21; swine, number, 34,034,100, value, $145,781,515, average price $4.28. In Europe the governments are fully alive to the importance of statistical information. In the United States, until within a few years, the statistics, especially agricultural statistics, have been meagre and unreliable; later they have become more full. Many State Boards of Agriculture have moved in the matter, and our statistics are now respectable at least. The average yield per acre in Great Britain for 1878, was wheat, 30 bushels; oats, 50 bushels; barley, 36 bushels; potatoes, 166 bushels; hay, 2 tons. The agricultural statistics of France, as published in 1876, are as follows: Total area, 130,910,000 acres; cultivated area, 101,200,000 acres; area in cereals, 37,050,000 acres. The table below shows the principal crops, acres, bushels, and bushels per acre, in France:

Crop.	Acres.	Bushels.	Bushels per acre.
Wheat	16,942,861	271,049,123	16
Spelt	1,168,315	20,239,058	17.32
Rye	4,539.596	75,221,677	16.57
Barley	2,665,977	52.713 848	19.77
Buckwheat	1,630,318	16,768,396	10.28
Corn	1,632,946	20,151,166	12.34
Oats	8,647,512	209,461,607	24.22
Potatoes	3,035,620	332,054.473	107.61

In Great Britain the agricultural statistics are very thorough. The following summary and comparisons for 1878—the latest received—will be interesting, especially as showing (their population being to the United States as thirty-six to fifty) the true basis upon which the United States rests, in the elements of real national wealth, as the following tables will show, this foundation being universally accorded to be the diversified wealth which a country may have for use and export:

Great Britain, 1876.		United States, 1878.	
Total acreage in crops, fallow, and hay......	47,327,000	Total acreage in crops, fallow, and hay......	179,000,000
Wheat (acres)............................	3,382,000	Wheat (acres)............................	32,000,000
Oats (acres)............................	4,124,000	Oats (acres)............................	13,176,000
Barley (acres)............................	2,723,000	Barley (acres)............................	1,790,000
Total in all cereals, including peas and beans..................................	11,030,000	Total of cereals, including corn.............	97,960,000
Potatoes..................................	1,365,000	Potatoes..................................	1.776,000
Turnips and other green crops..............	3,400,000	Cotton, sugar, and tobacco.................	13,000,000

LIVE STOCK.

Horses..................................	1,927,000	Horses..................................	10,611,000
Cattle..................................	9,761,000	Cattle..................................	31,850.000
Sheep..................................	32,571,000	Sheep..................................	36,575.000
Hogs..................................	3,768,000	Hogs..................................	33,134,000
Total live stock..........................	48,027,000	Total live stock..........................	112,170,000

It will be seen from the foregoing that the United States rests for her prosperity essentially upon an agricultural basis, and that our averages compare favorably with that of two of the greatest agricultural countries of Europe. This is undoubtedly due to our improved processes of cultivation and improved implements. Within the last few years a system of tile draining has been adopted in many sections, especially in the West, which has added materially in lengthening the growing season, and in materially increasing the average of crops per acre.

FARRIER. One who shoes horses, or treats their diseases; the latter department is now coming into the hands of educated men, called veterinary surgeons.

FARROW. A litter of pigs.

FASCICULUS, OR FASCICLE. In botany, an inflorescence in which the flower-stalks of various lengths form a summit somewhat level, and the uppermost buds expand first, as in the Sweet William.

FASCID. In anatomy, a tendinous expansion lying between muscles.

FAT. An unctuous, solid substance, or, more properly, a concrete oil, deposited in little membranous cells in various parts of animal bodies. It is generally white or yellowish, with little taste or smell, and varies in consistency according to the relative quantities of stearine and oleine, which it contains. Goats' fat, besides these principles, contains also hircine; to which it owes its peculiar smell. Different kinds of fat liquefy at different temperatures. Lard is softer than tallow, melts at 97°; but the fat extracted from meat by boiling requires a heat of 127°. The ultimate elements of animal fat are the same as those of vegetable oils. According to the analysis of Chevreul, 100 parts of human fat are composed of 79.0 carbon, 11.4 hydrogen, and 9.6 oxygen. Hog's lard and mutton suet are very similarly constituted. Fat is insoluble in water, alcohol, and ether. The strong acids dissolve, and gradually decompose it. With the alkalies it combines and forms soap; hard with soda, and soft with potassa. Fat serves to defend the muscles and bones against cold, to temper the acids of aliments, and to invigorate and support the whole frame.

FATHOM. A measure of six feet.

FATTENING STOCK. (See Feeding.)

FAUCES. The part of the throat at the root of the tongue.

FAULT. In geology, an interruption in the continuation of a stratum, the bed having been broken up by an earthquake and separated. The crevice between the parts is often filled with clay, which forms an impervious barrier to drainage.

FAUNA. The animals of a country.

FAUX. The opening or throat of monopetalous flowers, like the snap-dragon, sage, etc.

FAVOSUS. Marked like a honey-comb.

FEATHER-BOARDING. Weather-boarding, the edges of the boards overlapping.

FEATHER-GRASS. *Stipa pennata.* A very inferior grass.

FEATHERS. The covering of birds, answering the purpose and being of the same composition as the hair and fur of animals. Goose-feathers for beds are, in Europe, plucked in the spring, midsummer, and September, each parcel being dried in an oven. If they become foul, it may be remedied by boiling them, enclosed in bags, in an abundance of water for a few minutes. The quill is prepared by dipping in a quantity of sand heated to 150° Fahrenheit, and afterward rubbing it strongly with flannel until it becomes clear.

FEBRIFUGE. Any medicine which allays the heat and violence of fevers, as lemonade, Seidlitz powders, tartar emetic, etc.

FECES. Excrements, dregs.

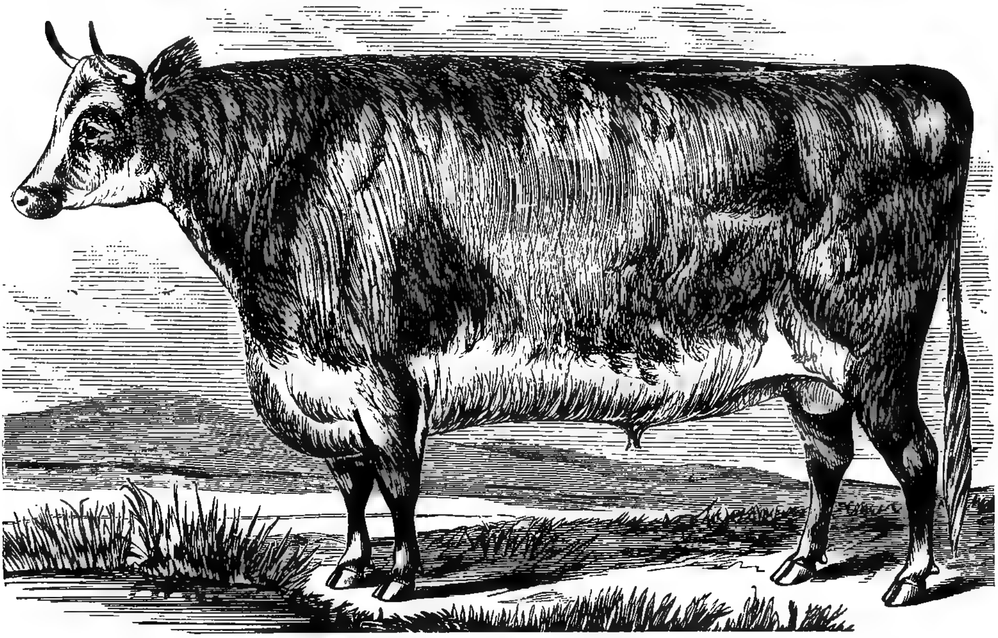
FECULA. Starchy matter.

FECUNDATION. In horticulture, the art of sprinkling the yellow powder (*pollen*) of the stamens of one flower upon the stigma or female organ of another, to produce new varieties of seed, is called artificial fecundation or impregnation. Experimenters and propagators have obtained in this way many choice fruits. Varieties of plants, especially melons, are frequently injured and lost by planting them near each other, from fecundation arising from the pollen of one kind being carried to another by insects or the wind. Hence annuals of the same species set out for seed should be placed far apart.

FEEDING. The proper and economical feeding of live stock has always attracted the close study of intelligent stock-growers. The time has long since passed when it is considered true economy to allow young stock to shift for themselves without the intelligent care of the master, and proper feeding. It is no longer thought economical to raise animals on only sufficient food in winter to keep life in them, or until the succeeding spring shall again start them on the new grass. The most successful feeders of to-day feed all stock liberally, and such as are destined for human food, are fed fully from birth, and until ready for the butcher's block. But the system of forcing is carefully avoided with all stock intended for either labor, or breeding. The object here is to develop strong constitutions and ample bone and muscle, that a long and useful life may result. Hence a different class of foods are used from those intended for mere fattening. In this, again, the question of the proper foods to be used becomes important. To reach the best results, feeding must be carried out systematically. The mere feeding of an animal constantly full, with rich food, will not necessarily cause it to fatten kindly. The food must be perfect food; that is adapted to the special requirements of the animal. Young animals; those required for labor; those to be used for fast driving, and those ready for feeding ripe (fully fat) each require different food, and, indeed, different care. Here again comes in the question of temperature. In some countries, and this is especially true in the West, stock require perfect artificial means of keeping warm in winter. In some countries where fuel is cheap and food dear, it has been found economical to use fire-heat in the stables, and also the use of cooked food. In the United States, adding to the food ration, with good shelter is as a rule most economical. In the fattening of animals, the sooner they can be brought up to a fully fat weight, the greater will be the profit; a weight of say 1,500 pounds for cattle, 300 pounds for the large breeds of swine, 200 pounds for the small breeds, and from 100 to 150 pounds for sheep, according to the breed. To do this they must be pressed forward from birth, by means of the food best adapted to the animal, and marketed before they become fully grown. In summer a pasture containing a variety of good grasses will furnish this perfect food. If anything is needed more, it may measurably be found, for fattening, in Indian corn, or meal as a supplementary food, to be given at night. For young animals, working, and, fast driving stock, oats are proper. The two first, however, may have any kind of mill stuff, with profit, if cheaper than oats. In the winter all stock in addition to good, sweet hay, should receive daily such grain as will best answer the end, except that corn meal, or corn may constitute a part of the daily ration for all classes of stock, since more fat is required for the animal waste than in summer. For dairy stock the young animals should be fed identically as for working stock, but not forced, since sufficient frame-work for continued usefulness must be provided. Milking stock may receive largely of corn meal, in winter, and ground rye, oats, barley, or mill feed, according to relative prices. Dr. Thompson, of the University of Glasgow, Scotland, gives the following data in experimental researches of the food of animals, and the fattening of cattle, from which we extract to show the correctness of the opinions here stated: The importance of attention to the proper equilibrium of the constituents of the food is clearly pointed out in the following table, from which it is evident, food containing the greatest amount of starch or sugar does not produce the largest quantity of butter, although these substances are supposed to supply the butter; but the best product of milk and butter is yielded by those species of food which seem to restore the equilibrium of the animals most efficiently. The first column in the table represents the food used by two cows; the second column gives the mean milk of the two animals for five days; the third, the butter during periods of five days; while the fourth contains the amount of nitrogen in the food taken by both animals during the same periods:—

Food Rations.	Milk in five Days.	Butter in five Days.	Nitrogen in Food in five Days.
	lbs.	lbs.	lbs.
Grass...	114	3·50	2·32
Barley and hay........	107	3·43	3·89
Malt and hay..........	102	3·20	3·34
Barley, molasses, hay..	106	3·44	3·82
Barley, linseed, and hay	108	3·48	4·14
Beans and hay.........	108	3·72	5·27

Our author says, we may infer, from these results, that grass affords the best products, because the nutritive and calorifient constituents are combined in this form of food, in the most advantageous relations. The other kinds of food have been subjected to certain artificial conditions, by which their equilibrium may have been disturbed. In the process of hay-making, for example, the coloring matter of the grass is either removed or altered; a portion of the sugar is washed out or destroyed by fermentation, while certain of the soluble salts are removed by every shower of rain which falls during the curing of the hay. Perhaps similar observations are more or less applicable to the other species of food enumerated In relation to this experiment, the grains mentioned may have substituted for them, oats and Indian corn, equal parts. This will, with good hay, constitute approximately a perfect food. Many analyses collated, compared and brought together have given the following average of equivalents in the principal foods, used in feeding stock: The following are considered equivalent to 100 pounds of best meadow hay: 383 parts of oat straw, 460 parts of barley straw, 479 parts of rye straw, 460 parts of wheat straw, 390 parts of potatoes, 382 parts of carrots, 676 parts of turnips, 70 parts of Indian corn, 65 parts of barley, 60 parts of oats, 27 parts of peas, 23 parts of beans, 22 parts of cotton seed or linseed meal. It will be seen that it is neither practicable to feed on straw alone, or on turnips alone. They could not eat enough straw to support life in winter, that is to say, 120 pounds per day; so the turnips would be too watery, but by combining the different substances named, as Indian corn, with straw, hay and carrots, or straw, hay and corn, we may make a perfect food representing 100, and that will keep the animal in thrift, and at the same time consume straw, otherwise of little value. There is one other important point in the feeding of stock that deserves special notice. They are more creatures of habit than is generally supposed. Hence the imperative necessity of feeding at strictly regular hours. Another important matter is the necessity of changing their diet. Animals will live on one particular food. They will even thrive for a time; but the best results, economically considered, have always been gained by varying the food, according to the appetite of the animal. The power of animals to accommodate themselves to new forms of food, is extraordinary. Grass-eating animals may be transformed into grain-eating animals, but, here again, grain is one of the natural foods of the genus *bos* (ox) and *equus* (horse). The dog however, in a wild state, is strictly a carnivorous animal, but in a state of domesticity, they may be kept in good health without a particle of meat; but, here again, the food must be highly nitrogenous, and the carbon must be in the form of oil rather than of starch. Icelandic cows are said to be fed partially on dried fish. Horses in Central Asia are recorded to be fed on raw meats, and both horses and cattle have been fed on beef tea and soups to restore them from a debilitated to a stronger condition. Yet this change in sustenance was not brought about suddenly. It was accomplished gradually, year by year, generation by generation. The change from green to dry, and dry to green food should be measurably so. It is as necessary as that they be not confined exclusively to one diet. Dr. Wolff, a competent German authority, found that thirty pounds of best young clover hay per day, would keep a cow in good milk. This contains of dry substance, twenty-three pounds, of this, the albuminoids, 3.21; the carbohydrates, 11.28, and the fat, 0.63, or 15.12 of the twenty-three parts was digested. The richest and best meadow hay, he found to contain, in thirty pounds, 23.2 pounds of organic substance, of this the following are digestible: Albuminoids, 2.49 pounds; carbohydrates, 12.75 pounds, and fat, 0.42 pounds; or in the 23.2 parts, 15.66 parts are digestible. Hay in the West is one of the most expensive of the stock foods raised in all that great region known as the corn belt. In the more central portions of the corn zone, a ton of corn and fodder can be produced for less money than a ton of the best meadow hay. Hence, feeders use as largely of corn as possible, and when finishing off cattle fat, it is given almost exclusively, or with only enough rough fodder to properly divide it. Regularity in the amount of the ration fed is of particular importance. All animals should be fed at exactly regular hours, and just what they will eat clean. If any is left, it should be removed and given to other hungrier animals. As to the time of feeding three times a day is sufficient for all except the horse. The horse should have three or four feeds of grain per day, according to the nature of his work, and also hay in his manger at all times. In the horse, unlike the ox and sheep, the stomach is small, and requires filling often. The same is measurably true of swine. The best results with fattening swine will be found to be to give them what they will eat clean, four times a day. Whatever the food used in fattening animals, the object of the feeder should be to get the greatest quantity of food eaten daily that the animal may be capable of digesting. There will always be some animals that will be delicate and indifferent feeders. These should always be separated from the hearty ones and given special care and food. Get rid of them at the first possible opportunity; certainly as soon at they are in passably salable condition. There is no money either in trying to raise or fatten such. When cattle are kept in a stable there should be a room, frost proof, where the morning's food may be prepared over night, if mixed food or wet food is given. If meal or other grain food is given without mixing with hay or straw—and in our opinion this is better for cattle—it should be given only moist enough so it will not be dry. A little experience will soon enable the feeder to so prepare the meal for the whole stock over night, that it will be in proper condition in the morning. If it be mixed with cut food, use clear bright oat straw if possible, and not cut shorter than two inches. Experience has proved the inutility of feeding hard, cut fodder, to cattle, and especially that cut short. Feed just what they will eat clean night and morning. Supplement this through the day with what good hay they will eat. What is left from day to day may be taken from the mangers and given to the stock cattle in the yards. Whatever the bedding used, it should be soft and plentiful. Many good feeders, however, prefer a hard smooth floor. Our own experience is not averse to this. If the passage ways to the urine conduits are properly made, animals may thus be kept both clean and comfortable. In the West and South, comparatively few cattle are fed in stables, Where food is plenty and cheap and labor scarce and high, the feeder will figure very closely as between enhanced weights in fattening, and the cost of putting on the flesh. Hay is often a scarce commodity. Corn to be fed must be husked, shelled and ground. When it is fed in the ear, we prefer it snapped with the husk on. Under any system of feeding whole grain, much is lost for the want of proper digestion, when swine are not used as gleaners of the droppings. Careful experiments made some years since at the Illinois Industrial University, as between feeding in stables with ground and unground corn, showed a decided profit in the latter way of feeding. This we have also found to be the case. Under this system of feeding, whether the stock are fed snapped corn,—that is, corn pulled from the standing stalks with so much of the husk as will adhere, or fed with husked corn, very little is lost. The cattle are fed plentifully. What they leave and that which passes undigested is picked up by swine, two of each being usually allowed to each steer to be fattened, and at the end of the day the hogs are given some corn additional, if they need it. Thus, except in very inclement weather, steers may be made fat on about fifty bushels of corn in about three to four months feeding, and the shoats require but little additional food to bring them up to heavy weights. The illustration, page 334, shows a Short Horn steer from flush pasture, and fattened in the field. The best plan we have ever tried for out-door fattening is to feed corn cut at the roots and shocked. This is hauled daily on truck wagons, when the ground is hard, or on sleds when there is snow, and fed, corn and fodder together. The cattle are not expected to eat the fodder clean, but usually they may be expected to consume the blades, which with the ears are the valuable part. The feeding is twice a day, in feeding lots—a lot for the morning feed and one for the evening feed. The cattle being about done with the ears, hogs are turned in to glean the scattered corn and droppings. Thus, whatever the system of feeding, if cattle have shelter from stormy and inclement weather, they may be made very fat, and healthfully so, and, where labor is scarce and corn cheap, at a minimum expense. We could give tables of foods without number. It is hardly necessary; certainly not in the West, the South, and Southwest, where corn is found in plenty, and the feeding can not be carried on scientifically, with profit, on account of the cheapness of food. The feeder must be guided almost solely by the relative prices of commodities. Corn, either in its natural state or ground, will be the chief reliance for fattening. When this is the case, and it is deemed necessary, the following will be found to be a good condiment for special feeding, to be given one pound with each feed of meal: Twenty-five pounds ground linseed oil-cake, ten pounds ground flaxseed, forty pounds cornmeal, twenty-four ounces ground turmeric root, two ounces ginger, two ounces carraway seed, eight ounces gentian, two ounces cream of tartar, one pound sulphur, one pound common salt and ten ounces coriander seed. Mix the whole together, and when fed use a quarter of a pound of molasses to each feed, the molasses to be used in the water for wetting the food in which the condiment is given. Where sorghum molasses is made this will not be found to be expensive. So much has been said by theorists about perfect foods, and the danger from feeding corn, that many persons have been brought to believe that corn is almost a dangerous food for growing animals; that, thus fed, they will lack bone and muscle, and cannot be expected to grow up healthy. If an animal were to be raised exclusively on corn this might be true, but the same would be true of other grain. Neither horses, cattle, or sheep can be properly raised exclusively on grain. Oats are undoubtedly the best grain that can be fed to growing stock in connection with hay. Oats, however, cannot be afforded. Good hay is a perfect food, so far as the distension of the stomach is concerned. The animal cannot eat enough to fatten upon. Our pastures make a perfect food, so far as muscular development is concerned. For cattle, whole corn, that is, the ears, husks, and leaves, forms a perfect food either for growing or fattening stock in winter, so soon as they get strength of jaw sufficient to crush the corn. Therefore, no breeder need be afraid that cattle from calfhood up will fail to develop, with plenty of good hay and corn, or corn meal in winter, and plenty of good, flush pasture in summer, with pure water at all times. In conclusion, it is only necessary to add that he who feeds best has the best stock and makes the most money.



SHORT HORN OX, FIELD FATTENED.

FEELERS. The antennæ of insects, or, according to entomologists, organs used for prehension.

FELDSPAR. A mineral abounding in granite and transition rocks; it is crystalline, of a pearly lustre, and of various colors, usually yellowish or reddish. Silicate of potash and alumina, contains from eleven to fourteen per cent. of potash, and furnishes, by slow decay in the soil, that important alkali to plants. Albite is a variety containing soda. An abundance of decaying vegetable matter in the soil, or the addition of heavy dressings of lime, assists the disengagement of the potash. No soil which contains much feldspathic sand can be deficient in potash.

FELINE ANIMALS. Carnivorous animals, furnished with sharp incisor teeth and retractile claws, as the domestic cat, panther, lion, tiger, etc.

FELLOES. The curved pieces of wood which form the circumference of wheels. The best felloes are now bent in one piece.

FELON OR FETLOW. In farriery, a term for a sort of inflammation in animals similar to that of whitlow in the human subject. It is cured by poulticing to a head and lancing.

FEMUR. The thigh bone; hence femoral.

FENCE. Any barrier of whatever kind to restrain trespass, either of animals or man. They are of rails, posts and rails, posts and boards, planks, embankments, wire, logs or brush. (See Fences and Fencing.)

FENCE LAWS. In nearly or quite every State in the Union there are laws defining what legal fences shall be. In some of the States, as in Illinois, the law leaves it for towns, villages, counties, and communities to define what the fence shall be, or whether there may be no fences. A synopsis of the laws relating to fences and farm stock is thus defined in one of the Reports of the Department of Agriculture, Washington: In the older States the laws regulating fences are substantially alike. As to height, a legal fence is generally four and a half feet, if constructed of rails or timber. Ditches, brooks, ponds, creeks, rivers, etc., sufficient to turn stock, are deemed equivalents for a fence. In case a stream or other body of water is considered inadequate to the turning of stock, the facts are investigated by officers known as fence-viewers, who will designate the side of the water upon which a fence shall be erected, if the fence be deemed necessary, the cost to be eqally borne by the parties whose lands are divided. Occupants of adjoining lands which are being improved are required to maintain partition fences in equal shares. Neglect to build or to keep in repair such fences subjects the negligent party to damages, as well as double, and in some States treble, the cost of building or repairing, to the aggrieved party. A person ceasing to improve land can not remove his fence unless others interested refuse to purchase within a reasonable time. A provision in the laws of several of these States, which is well calculated to serve the interests of neighbors, saving the expense of fence building, is one permitting persons owning adjoining lots or lands to fence them in one common field, and for the greater advantage of all, allowing them to form an association, and to adopt binding rules and regulations for the management of their common concerns, and such equitable modes of improvements as are required by their common interest; but in all other respects each proprietor may, at his own expense, inclose, manage, and improve his own land as he thinks best, maintaining his own proportion of the general inclosure. The laws regulating fences in the New England States differ only in a few particulars. The required height of a fence in Maine, Massachusetts, and New Hampshire, is four feet; in Vermont, four and a half feet; in Rhode Island a hedge with a ditch is required to be three feet high upon the bank of the ditch, well staked, at the distance of two and a half feet, bound together at the top, and sufficiently filled to prevent small stock from creeping through, and the bank of the ditch not to be less than one foot above the surface of the ground. A hedge without ditch to be four feet high, staked, bound, and filled; post-and-rail fence on the bank of a ditch to be four rails high, each well set in post, and not less than four and a half feet high. A stone-wall fence is required to be four feet high, with a flat stone over the top, or surmounted by a good rail or pole; a stone wall without such flat stone, rail or post on top to be four and a half feet high. In each of the New England States there are plain provisions in regard to keeping up division fences on equal shares, and penalties for refusal to build them, and when built for neglect to keep them in repair. Fence-viewers in the respective towns settle all disputes as to division fences. Owners of adjoining fields are allowed to make their own rules and regulations concerning their management as commons. No one not choosing to inclose uncultivated land can be compelled to bear any of the expense of a division fence, but afterward electing to cultivate, he must pay for one-half the fence erected on his line. Similar provisions for the maintenance of division fences exist in New York; whenever a division fence has been injured by flood or other casualty, each party interested is required to replace or repair his proportion within ten days after notification. When electors in any town have made rules or regulations prescribing what shall be deemed a sufficient fence, persons neglecting to comply are precluded from recovering compensation for damages done by stock lawfully going at large on the highways, that may enter on their lands. The sufficiency of a fence is presumed until the contrary is established; assessors and commissioners of highways perform the duties of fence-viewers. In Pennsylvania towns and counties secure special legislation as to the running of stock or other cattle at large. Fences in New Jersey are required to be four feet two inches in height, if of posts and rails, timber, boards, brick or stone; other fences must be four and a half feet, and close and strong enough to prevent horses and neat cattle from going through or under. Partition fences must be proof against sheep. Ditches and drains made in or through salt marshes and meadows for fencing and draining the same, being five feet wide and three feet deep, and all ditches or drains made in or through other meadows being nine feet wide at the surface and four and a half feet wide at the bottom, three feet deep, and lying on mud or miry bottom, are considered lawful fences. Division fences must be equally maintained. If one party ceases improving he can not take away his fence without first having given twelve months' notice. Hedge-growing is encourged by law. In Delaware, a good structure of wood or stone, or well-set thorn, four and a half feet high, or four feet with a ditch within two feet, is a lawful fence; in Sussex county four feet is the height required. Fence-viewers are appointed by the Court of General Sessions in each "hundred." Partition fences are provided for as in other States. There is no general law in Maryland regulating fences, the law being local and applicable to particular counties. In Virginia a lawful fence is five feet in height, including the mound to the bottom of the ditch, if the fence is built on a mound. Certain water courses are specified as equivalent to fences. Four feet is the height of a legal fence in West Virginia, and five feet in North Carolina. In the latter State persons neglecting to keep their fences in order during the season of crops are deemed guilty of misdemeanor, and are also liable to damages. Certain rivers are declared sufficient fences. In South Carolina fences are required to be six feet high around provisions. All fences strongly and closely made of rails, boards, or post and rails, or of an embankment of earth capped with rails, or timber of any sort, or live hedges five feet in height, measured from the level or surfaces of the earth, are deemed lawful; and every planter is bound to keep such lawful fence around his cultivated grounds, except where a navigable stream or deep water-course may be a boundary. No stakes or canes that might injure horses or cattle are allowed in an inclosure. The laws of Georgia provide that all fences, or inclosures commonly called worm fences, shall be five feet high, and from the ground to the height of three feet the rails must not be more than four inches apart. All paling fences are required to be five feet from the ground, and the poles not more than two inches apart. Any inclosure made by means of a ditch or trench must be three feet wide and two feet deep, and if made of both fence and ditch, the latter must be four feet wide and the fence five feet high from the bottom of the ditch. All water-courses that are or have been navigable are deemed legal fences as far up the stream as navigation has ever extended, whenever, by reason of freshets or otherwise, fences can not be kept, and are subject to the rules applicable to other fences. The fences in Florida are required to be five feet in height, but where there is a ditch four feet wide the five feet may be measured from the bottom of the ditch. If the fence is not strictly according to law, no action for trespass or damages by stock, will lie. In Alabama all inclosures and fences must be at least five feet high, and, if made of rails, be well staked and ridered, or otherwise sufficiently locked; and from the ground to the height of three feet the rails must be not more than four inches apart: if made of palings, the poles must be not more than three inches apart; or if made with a ditch, four feet wide at the top; the fence, of whatever material composed, must be five feet high from the bottom of the ditch and three feet from the top of the bank, and close enough to prevent stock of any kind from getting through. No suit for damages can be maintained if the fence is not a legal one. For placing in an enclosure any stakes, poles, poison, or anything which may kill or injure stock, a penalty of $50 is provided. Partition fences must be equally maintained. Fences in Mississippi are required to be five feet high, substantially and closely built with plank, pickets, hedges, or other substantial materials, or by raising the ground into a ridge two and a half feet high, and erecting thereon a fence of common rails or other material two and a half feet in height. Owners of adjoining lands, or lessees thereof for more than two years, are required to contribute equally to the erection of fences, if the lands are in cultivation or used for pasturing. No owner is bound to contribute to the erection of a dividing fence when preparing to erect a fence of his own, and to leave a lane on his own land between himself and the adjoining owner; but the failure to erect such fence for sixty days is deemed an abandonment of intention to do so, and determination to adopt the fence already built. In Texas every gardener, farmer, or planter is required to maintain a fence around his cultivated lands at least five feet high and sufficiently close to prevent hogs from passing through it, not leaving a space of more than six inches in any one place within three feet of the ground. Fences in Arkansas must be five feet high. In all disputed cases the sufficiency of a fence is to be determined by three disinterested householders, appointed by a justice of the peace. Division fences are provided for as in the majority of the other States. In Tennessee every planter is required to make a fence around his cultivated land at least five feet high. When any trespass occurs a justice of the peace will appoint two freeholders to view the fence as to its sufficiency, and to ascertain damages. If a person, whose fence is insufficient, should injure any animal which may come upon his lands, he is responsible in damages. In case of dispute between parties as to a division fence, a justice of the peace will appoint three disinterested freeholders to determine the portion to be maintained by each. No owner, whose fence is exclusively on his own land, can be compelled to allow his neighbor to join it. In Kentucky all sound and strong fences of rails, plank, or iron, five feet high, and so close that cattle or other stock can not creep through, or made of stone or brick four and a half feet high, are deemed legal fences. Division fences can not be removed without consent of the party on adjoining land, except between November 1 and March 1 in any year, six months' notice having been given. In Missouri all fields must be inclosed by hedge or fence. Hedges must be five feet high; fences of posts and rails, posts and palings, posts and plank, or palisades, four and a half feet; turf, four feet, with trenches on either side three feet wide at top and three feet deep ; worm fence at least five feet high to top of rider, or, if not ridered, five feet to top rail, and corner locked with strong rails, poles, or stakes. Double damage may be recovered from any person maiming or killing animals within his inclosure if adjudged insufficient. In Illinois fences must be five feet. [But counties may legislate to have no fences if they choose.—Ed.] The laws regulating division fences are similar to those of the New England States. In cases of dispute three disinterested householders decide as to the sufficiency of any fence. Proprietors of commons may make their own regulations. Line fences are protected on public highways. In Indiana any structure or hedge, or ditch, in the nature of a fence, used for purposes of inclosure, which shall, on the testimony of skillful men, appear to be sufficient, is a lawful fence. The laws of Ohio provide that whenever a fence is erected by any person on the line of his land, and the person owning the land adjoining shall make an inclosure on the opposite side, the latter shall pay one-half the value of the fence as far as it answers the purpose of a division fence, to be adjudged by the township trustees. A legal fence in Wisconsin is four and a half feet high if of rails, timber, boards, or stone walls or their combinations, or other things which shall be deemed equivalent thereto in the judgment of the fence-viewers. While adjoining parties cultivate lands they must keep up fences in equal shares; double value of building or repairing may be recovered from delinquents. The law regulating division fences is similar in most particulars to those of the New England States and Illinois. Overseers of highways perform the duties of fence-viewers. Fences in Michigan must be four and a half feet high, and in good repair; consisting of rails, timber, boards, or stone walls, or any combination of these materials. Rivers, brooks, ponds, ditches, hedges, etc., deemed by the fence-viewers equivalent to a fence, are held to be legal inclosures. No damages for trespass are recoverable if the fence is not of the required height. Partition fences must be equally maintained as long as parties improve their lands. When lands owned in severalty have been occupied in common, any occupants may have lands divided. Fences extending into the water must be made in equal shares, unless otherwise agreed by parties interested. If any person determines not to improve any portion of his lands adjoining a partition fence, he must give six months' notice to all the adjoining occupants, after which he will not be required to keep up any part of the fence. Overseers of highways act as fence-viewers. In Minnesota four and a half feet is the legal height. Partition fences are to be kept in good repair in equal shares. In case of neglect, complaint may be made by the aggrieved party to the town supervisors, who will proceed to examine the matter, and if they determine that the fence is insufficient, notice will be given to the delinquent occupant of land; and if he fails to build or repair within a reasonable time, the complainant may build or repair, and may recover double the expense, with interest at the rate of one per cent. per month, in a civil action. No part of a division fence can be removed if the owner or occupant of adjoining land will, within two months, pay the appraised value. When any uninclosed grounds are afterward inclosed, the owner or occupant is required to pay for one-half of each partition fence; the value thereof to be determined by a majority of the town supervisors. If a party to a division fence discontinues the improvement of his land, and gives six months' notice thereof to the occupants of adjoining lands, he is not required to keep up any part of such fence during the time his lands are unimproved, and he may remove his portion if the adjoining owner or occupant will not pay therefor. County commissioners are the fence-viewers in counties not divided into towns. A legal fence in Iowa is four and a half feet high, constructed of strong materials, put up in a good, substantial manner. In all counties where, by a vote of the legal voters, or by an act of the general assembly, it is determined that hogs and sheep shall not run at large, a fence made of three rails of good, substantial material, or three boards not less than six inches wide and three-fourths of an inch thick, such rails or boards to be fastened in or to good, substantial posts, not more than ten feet apart where rails are used; or any other fence which, in the opinion of the fence-viewers, shall be equivalent thereto, is deemed a lawful fence, provided that the lowest or bottom rail shall not be more than twenty nor less than sixteen inches from the ground, and that the fence shall be fifty-four inches in height. The respective owners of inclosed lands must keep up fences equally as long as they improve. In case of neglect to repair or rebuild, the adjoining owner may do so, and the work being adjudged sufficient by the fence-viewers, and the value determined, the complainant may recover the amount, with interest at the rate of one per cent. per month. If an owner desires to throw his field open, he shall give the adjoining parties six months' notice, or such shorter notice as may be directed by the fence-viewers. In Kansas fences may be of posts and rails, posts and palings, or posts and planks, at least four and a half feet high; of turf, four feet, and staked and ridered, with a ditch on either side at least three feet wide at top and three feet deep; a worm fence must be at least four feet and a half high to top of rider, or if not ridered, four and a half feet high to top rail, the corners to be locked with strong rails, posts, or stakes. The bottom rail, board or plank in any fence must not be more than two feet from the ground in any township, and in those townships where hogs are not prohibited from running at large it must not be more than six inches from the ground. All such fences must be substantially built and sufficiently close to prevent stock from going through. Stone fences are required to be four feet high, eighteen inches wide at the bottom, and twelve at the top. All hedges must be of sufficient height and thickness to protect the field or inclosure. A wire fence must consist of posts of ordinary size for fencing purposes, set in the ground at least two feet deep and not more than twelve feet apart, with holes through posts, or staples on the side, not more than fifteen inches apart, and four separate lines of fence wire, not smaller than No. 9, to be provided with rollers and levers at suitable distances, to strain and hold the wires straight and firm. Owners of adjoining lands must maintain fences equally. In case of neglect of one party to build or repair, another party may do so and recover the amount expended, with interest at the rate of one per cent. per month. A person not improving his land is not required to keep up any portion of a division fence. The trustee, clerk, and treasurer in each township act as fence-viewers, to adjust all disputes concerning fences. A legal fence in Nebraska is described as any structure, or hedge, or ditch in the nature of a fence, used for the purpose of enclosure, which is such as good husbandmen generally keep. Division fences must be equally maintained. A party may remove his portion of division fence by giving sixty days' notice. If removed without such notice the party so doing is liable for full damages. Where a fence is injured or destroyed by fire or flood it must be repaired within ten days after notice by interested persons. Justices of the peace are *ex officio* fence-viewers. Legal fences in California are described with great particularity. Wire fences must consist of posts not less than twelve inches in circumference, set in the ground not less than eighteen inches, and not less than eight feet apart, with not less than three horizontal wires, each one-fourth of an inch in diameter, the first to be eighteen inches from the ground, the other two above at intervals of one foot, all well stretched and securely fastened from post to post, with one rail, slat, pole, or plank, of suitable size and strength, securely fastened to the post, not less than four and a half feet from the ground. Post and rail fence must be made with posts of the same size and at the same distances apart and the same depth in the ground as above required, with three rails, slats, or planks of suitable size and strength, the top one to be four and a half feet from the ground, the other two at equal distances between the first and the ground, all securely fastened to the post. Picket fences must be of the same height as above, made of pickets not less than six inches in circumference, placed not more than six inches apart, driven in the ground not less than ten inches, all well secured at the top by slats or caps. Ditch and pole fence—the ditch must not be less than four feet wide on the top and three feet deep, with embankment thrown up inside of ditch, with substantial posts set in the embankment not more than eight feet apart, and a plank, pole, rail, or slat securely fastened to posts at least five feet high from the bottom of the ditch. Pole fence must be four and a half feet high, with stakes not less than three inches in diameter, set in the ground not less than eighteen inches, and when the stakes are placed seven feet apart there must not be less than six horizontal poles well secured to the stakes; if the stakes are six feet apart, five poles; if three or four feet, four poles; if two feet apart three poles, and the stakes need not be less than two inches in diameter; if one foot apart, one pole, and the stakes need not be more than two inches in diameter. The above is a lawful fence so long as the stakes and poles are securely fastened and in a fair state of preservation. Hedge fence is considered lawful when by reliable evidence it shall be proved equal in strength and as well suited to the protection of inclosed lands as the other fences described. Brush fence must be four and a half feet high and at least twelve inches wide, with stakes not less than two inches in diameter, set in the ground not less than eighteen inches, and on each side, every eight feet, tied together at the top, with horizontal pole tied to the outside stake five feet from the ground. In the case of partition fences, if one party refuse or neglect to build or maintain his share the other may do so and recover the value. Three days' notice to repair is sufficient. The sufficiency of a fence is to be determined by three disinterested householders.

FENCES AND FENCING. The fences of the country are estimated to be worth more, as to cost of making and repairing, than are all the buildings erected. So onerous is the cost of fences that in all districts, where timber is scarce embankments protected by barriers of various kinds have been used. Hedging has been extensively employed, and would be almost universally so were it not for the cost of pruning them, and otherwise keeping them in condition. Indeed, in widely extended districts no fences whatever are used, it having been found cheaper to herd stock than to fence them in. When we come to consider the large portion of the year when stock may run on the farm without injury to crops, it is an open question whether this system, or a modification of it, might not be more generally adopted than it is. As to the cost of fences the Secretary of the Wisconsin Board of Agriculture, gives interesting data in relation to fencing in that State, and urges the importance, as an economical measure, of the immediate planting of live fences. He gives the first cost of the perishable fences of the State at $40,000,000, reckoning the cost at 85 cents per rod. Basing the assertion upon long experience and observation, he says that these fences must be renewed every twelve years, costing in the course of half a century to the people of the State an expense of $160,000,000. He is of the opinion that one-half or three-fourths of this sum can be saved by the immediate planting and rearing of hedge fences. The yellow-willow, white or soft maple, box-elder or ash-leafed maple, Lombardy poplar, cottonwood, and acacia or honey-locust, are all recommended as suitable for live fences. These, he says, are all hardy, and will thrive vigorously in any part of the State. So far as hedges and the planting is concerned, we would impress upon our readers that they should always be placed upon a raised surface not less than eight feet wide. This may be cheaply thrown up with a two, or better, three horse plow, by repeated plowings, after which the center may be levelled by a revolving harrow, or by running a horse hoe once or twice along the crown, and then going over the ground with a plank and team. If the hedge is to be set on sod land, two thin furrows are thrown out, the sod removed, and this space is mellowed as deeply as possible. Then commence turning down a thin strip of sod, following with a trench plow as deeply as possible. Thus you may get a tolerably mellow surface of earth by repeated harrowings. A simple and good way to set hedge plants is, to stretch a line marked with red, at such intervals as the plants are intended to be placed. Have the plants in a bucket containing a little water, carried by a boy. A sharp, clean spade thrust in the soil as deeply as possible, and then the handle thrown forward, makes the place for the plant, which is thrust therein by the boy; withdraw the spade, and press the earth firmly about the plant with the foot. If the spade is thrust in such direction as comes natural to the workman, the plants will lean a little—no objection, if they all lean one way and in the direction of the hedge row. A man and boy will thus set 100 rods per day. The cultivation the first year is with the ordinary corn cultivator. Thereafter it is done with the plow by throwing light furrows, always to the hedge. We have advised eight feet as the least possible distance for the width of the plowed surface for hedges. Eighteen to twenty feet will be ultimately required, and in practice it will be found that crops will not succeed nearer than within ten feet of Osage Orange, or within twenty feet of willow or other live fence. The following are the reasons for our advice as given for Osage Orange, but which will apply to any hedge. In relation to ridging, the necessity arises from the generally observed fact, that the natural drainage of the larger portion of the vast prairies is poor and ineffective, the soil in many localities being so overcharged with moisture, particularly in rainy seasons, as to materially check the growth of farm crops; and, as is well understood, the yield of corn and small grain is much reduced from this cause. The same is true of considerable districts of several of the better timbered States, where other fencing material is growing scarce. The height of the ridges should be as great as can be made by twice plowing, or gathering up the soil. In spongy or low, wet places, three gatherings with the plow will not raise the ridge too high. Among the advantages of ridging may be named the following: 1. The hedge will be more likely to escape winter killing, the exemption being due to the fact that the roots are above the level of saturation. 2. Operations can be commenced and completed from ten days to two weeks earlier, in all localities where the natural drainage is inefficient, and the plants can be set before the buds open. 3. The roots of young plants will strike down obliquely in ridged ground, instead of extending out horizontally just beneath the surface soil, and attain a growth corresponding with the increase of available soil. 4. The young plants make a more uniform growth when ridged, in consequence of the more uniform condition of the soil as to moisture, and will generally be exempt from the gaps and thin places, resulting from partial winter killing. 5. When a ridge is properly prepared for the hedge, the roots of the hedge row will form a more fibrous growth, which will be made chiefly in central parts of the ridge soil, instead of the roots growing long and straggling. If, in the course of years, however, straggling roots should be found to require pruning at a distance of eight or ten feet from the hedge row, they will present less obstruction on a ridge than when grown upon level ground. 6. When a hedge becomes strong enough to turn stock, it is desirable to check its growth, which can be done by cutting off the ends of the roots on the sides of the ridge with a pruning plow, or with a revolving colter, and this without endangering the life of the hedge, the large amount of root growth in the deeper, central parts of the ridge being sufficient for the plant. 7. A ridge eighteen to twenty-four inches above the level will add thirty to forty per cent. to the effective height of the hedge; and, in combination with the latter, will form a barrier that will turn stock, thus constituting an effective fence from one to two years sooner than when planted on low, level ground; and, at the same time, equally contributing toward the effectiveness of the hedge in its incidental capacity as a wind-break. A plow colter, such as is used for cutting off the extremities of apple tree roots to induce early bearing, may serve a similar purpose in pruning hedge roots when extending beyond their prescribed limits. As in the case of shortening back to induce the growth of fruit spurs in the apple tree, the effect of trimming osage thorn hedges is to cause some thickening at the bottom, but the growth is chiefly in the upper part of the branches, or in the emission of numerous small side shoots, or lateral branches. Inexperienced writers recommend this mode of training to produce thick-bottomed, permanent growth. Thick side growth may, for a limited time, result from such management, as repeated cutting back leaves the plants, in their struggle for existence, the only alternative of the slow, feeble, lateral growth, to be seen in hedges that are not allowed to extend their growth vertically. Low-trained hedges may be necessary where land is limited in area, and high in price, as in the case of gardens, small lawns, and other ornamental grounds; but in such situations plants of less vigorous growth than the osage thorn would seem to be more suitable, for this reason—low evergreens or shrubs may be formed, trimmed, and low-trained a long time without plashing. With the vigorously growing thorn, however, the case is different, and laying down and plashing is now generally adopted. It has been established by experience in Great Britain, and to a limited extent in this country, that hedges sooner or later become so thinned at the bottom that renewed or young bottom growths are essential to maintain their efficiency as fences; and this necessity can not be evaded in the case of the osage thorn. The sap tends so much towards the top that the lower part will become thin by self-pruning, which will be succeeded by holes and gaps. This result may be expected in both trimmed and untrimmed hedges. These gaps and holes may be temporarily mended, however, by inserting detached branches cut from thicker parts of the fence. Layering has been suggested, but in the shade and in dry soil, in which the layer must grow, if at all, their growth will be so slow as not to become available against animals in any reasonable length of time, and it is probable that but few layers would survive. Osage Orange hedges may grow to a height of twelve to twenty feet before they require layering. Layering reduces the height of the fence two-thirds or three-fourths, or more, causing the new growth to be made near the ground, and here, accordingly, multitudes of vigorous shoots are sent up, growing up in like manner, at successive layering. Single-row hedges can not well be renewed by layering, without stakes. But double rows may not only be laid or plashed without stakes, but, when laid down in a proper manner, the hedges will constitute a very strong fence. Two-row hedges are believed to be much the best adapted to resist the stress of gales of wind, the attempts of rampant animals to break over them, and for any contingencies requiring great strength in a fence. In the accompanying illustrations Fig. 1, represents a section of the horizontal form of laying the brush of each of the rows backward and obliquely over to the opposite side. The stems are plashed, one from each side or row, alternately, each branch being brought down from the opposite side, and laid in such a manner that each stem crosses the last one laid, about midway of its length; and in the center between the hedge

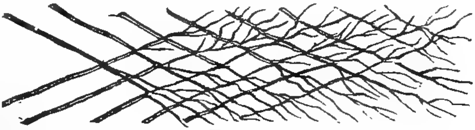


Fig. 1.

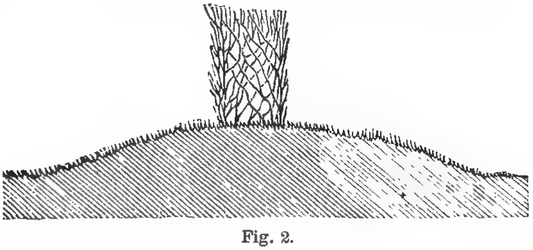


Fig. 2.

rows, the angle formed between the saplings and the ground being about thirty degrees. In Fig. 2 is shown the embankment heretofore mentioned, and also a double line hedge five feet high. In ordinary cases the hedge composed of a single line of plants, if well grown, is amply sufficient to turn ordinary stock, even breachy horses and swine; but, whether the hedge be single or double the embankment will be found labor well spent, even on dry soils. The tools most used in hedging, as shown below, are, the press pole, Fig. 3, used for pressing the branches to the ground in plashing. Weights are sometimes placed on the plashed hedge to hold it down. Fig. 4, is a bill hook, or plashing knife, which may be used in a variety of ways for rough trimming about the farm.

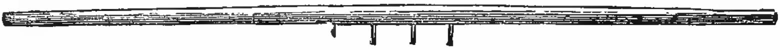


Fig. 3.

Fig. 5, shows a straight trimming blade, a heavy sharp knife; such as is used for cutting up Indian corn, is in general use. Fig. 6, is a trimming hook. Here again a strong, sharp grass sickle will answer every purpose for the trimming of green or succulent annual branches. The more common plants used for hedging, in the United States are, in the North and West, Osage Orange; the Honey Locust, (*Gleditschia triacanthos*), and the Buck-thorn, (*Rhamnus catharticus*), are also planted, the latter to a limited extent. In Great Britain the Hawthorn, (*Cratægus oxyacantha*), has been used for centuries. Of late years English hedges have been in process of extermination, it being found that the land is too valuable to be cumbered with their growth.

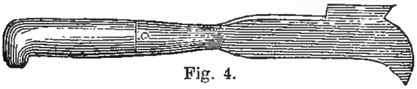


Fig. 4.

In the West, the growth of weeds in hedge rows, the cost of keeping them, and the land they occupy has become a serious objection to the planting and renewal, and the cheap, substantial, and amply protecting wire fence is now largely superseding its use. In the South the Cherokee rose is largely employed as an ornamental hedge, and where it will stand, it makes an admirable barrier. In relation to village, yard, lawn, and other places requiring ornamental hedges, there is nothing finer than a well kept Privet (*Ligustrum vulgare*) hedge. It is hardy East, as far north as New York, and Massachusetts, and in the West to about the northern boundary of Illinois, or say latitude forty-three degrees.

Fig. 5.

Whatever materials may be used for outside fences, they should be strong and substantial. Inside fences for such purposes as that of separating the lawn from the vegetable garden may be of lighter construction; especially if a fence crosses a lawn, as seen from the house with an open view beyond, it should be as light and elegant as is consistent with strength and durability. In such cases it is often desired to conceal the fence, as an intrusive object in the landscape, by adopting the sunken fence. This may be described as a ditch-like excavation four or five feet in depth, finished by a perpendicular wall on the lawn side, and the ground flatly sloped on the opposite. The propriety of persistently concealing the fence in such positions may be questioned. Utility is a strong element of the beautiful, and if no visible barrier intervenes between the pleasure ground and a grazing field, we at once condemn the incongruity. We can not distinguish where the flower garden ends or the grazing meadow begins, and must suppose that the cattle can perambulate the flower garden if they choose; we can imagine the result, and we feel that a fence becomes a necessity to separate objects that can not well be united without injury to one or both. Wire fences are well adapted for this purpose, as they are so light as not materially to interrupt the view; and if properly constructed, are sufficiently strong and permanent. It has been claimed that the highest degree of rural beauty is a village without fences, or any other distinctive marks to properties. But it has been replied: As well might it be claimed that the best arrangement in a picture gallery will be produced by taking the paintings out of the frames and nailing the canvass to the walls. The love of exclusive possession is a mainstay of society. Well-defined boundary lines to property greatly enhance its enjoyment, especially when applied to lawns and gardens. Hedges are useful as shelter to gardens, rendering them earlier, more productive, and greatly exempt from casualties of climate and locality. In the growth of all kinds of small fruits, as well as those of larger orchard growth, shelter is always of the greatest benefit. In grounds of very limited dimensions, where the boundary lines are at no great distance from the house, an evergreen hedge set inside the fence will afford great relief to the eye and form a background, as it were, to the shrubbery and flower borders.

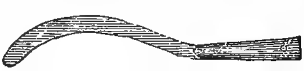


Fig. 6.

In relation to farm fences, whatever the material, whether posts and rails, posts and boards, worm or Virginia fence, sod fence, wire fence, etc., they should be made in the most substantial manner. It is poor economy to slight, in any respect, a barrier that is expected to last from ten to fifteen years, the life of good oak posts, or to scant the material, thus offering a premium to make animals unruly. In forest regions, timber fences are cheapest. Where timber is scarce, wire and posts are cheapest, and the modern barbed wire, of two twisted strands, will be found cheap, effectual, and not seriously to expand or contract in length by heat and cold. As showing something of the growth of barbed wire fencing within the last ten years, the production in the United States was fully six hundred tons in 1880. The objection that it injures stock, is hardly worth considering, and even this may be entirely obviated by placing a pole on top from post to post, which stock can easily see.

FENESTRATE. In entomology, the appearance produced by the transparent spots on the wings of some insects. In botany, the absence of tissue between the veins of a leaf.

FENNEL, SWEET. *Fœniculum dulce.* This species of fennel is an annual plant, a native of Italy and Portugal, where it is cultivated as a pot-herb, as well as for the seeds and the oil which these afford. It is a smaller plant than the common fennel. The stem is somewhat compressed at the base. The fruit is much longer than that of the common fennel, being nearly five lines long, less compressed, somewhat curved, and paler, with a greenish tinge.

FENUGREEK. *Trigonella fœnum-grœcum.* A species of trefoil, cultivated for its seed, having a strong, disagreeable smell, and an unctuous, farinaceous and somewhat bitter taste. The seeds are useful in cataplasms and fomentations.

FERMENTATION. Fermentation is that decomposition or decay which apparently acts spontaneously on animal and vegetable substances, involving heat and a rapid evolution of gas. The primary cause of fermentation is from microscopic fungi, acting as a ferment. Thus any organic body, not living, in the presence of moisture and heat will ferment, since the germs are floating everywhere, and may even find lodgment in the pores of wood. The act of fermentation is taken advantage of by gardeners, in preparing hot beds, in composting, and in a variety of ways; in the first place to produce, with manure, bottom heat for the propagation of plants (see Hot-beds); also by brewers, wine makers, distillers, etc.. in the preparation of their products; by the housewife in making bread, vinegar, etc., and the process is constantly going on naturally, entirely unknown by the ordinary observer. This process once begun, oxygen is set free, which, again uniting with the elements of the body, accelerates and facilitates the progress of the phenomenon Salt retards fermentation, if present in considerable quantity; consequently it is used in preserving meat. Applied in small quantities to the compost heap it retards fermentation and combustion, and prevents fire fanging. Fermentation is of three stages--the vinous, producing alcohol; the acetous, producing vinegar; and putrefactive, producing decay of all the parts. Vinous fermentation is produced by oidium. The second, as in the souring of milk, by penicillium, and the third is supposed to be from the action of infusoria. A fourth ferment is denominated panary, but it is not generally recognized by chemists. Panary fermentation is what was stated to take place in the fermentation of dough in making bread, but this is precisely the same, without doubt, and may be referred to the vinous and the acetous. Fermentation must not be confounded with effervescence. Fermentation is confined to animal and vegetable substances, effervescence to minerals. Fermentation is spontaneous, effervescence the result of the intimate mixture of two bodies, as an alkali and an acid. Cider, beer, wine, etc., ferment; soda-water effervesces. One causes active decay, the other a neutralization of two bodies, acting one on the other. A single illustration will suffice: The simplest case is the fermentation of the must or expressed juice of grapes which, when exposed either in close or open vessels to a temperature of about 70°, soon begins to give off carbonic acid, and to become turbid and frothy; after a time a scum collects upon the surface, and a sediment is deposited; the liquid which had grown warm gradually cools and clears, loses its sweet taste, and is converted into wine. The chief component parts of must are water, sugar, mucilage, gluten, and tartar (bitartrate of potassa). During the fermentation carbonic acid escapes, the sugar disappears, and with it the greater part of the mucilage; the gluten chiefly forms the scum and a portion of the sediment; and the tartar originally in solution is thrown down in the form of a colored deposit. Sugar and water alone will not ferment; the ingredient requisite to the commencement of the change is the gluten, which absorbs in the first instance a little oxygen from the air, becomes insoluble, and induces the subsequent changes. The reason why grapes never ferment till the juice is expressed, seems to depend upon the exclusion of air by the husk or membranes. In beer the alcohol is derived from the sugar in the malt. When wine is exposed to air and a due temperature, a second fermentation ensues, which is called the acetous fermentation, and which terminates in the production of vinegar. During this process oxygen is absorbed, and more or less carbonic acid is evolved; but the apparent cause of the formation of vinegar is the abstraction of hydrogen from the alcohol, so as to leave the remaining elements in such proportions as to constitute acetic acid. Thus alcohol has been theoretically and quaintly stated as constituted of charcoal, water and hydrogen, and acetic acid of water and charcoal only; the oxygen of the air, therefore, converts the hydrogen of the alcohol into water, and so effects the change into vinegar.

FERNS. *Filices.* Flowerless plants, with beautifully developed leaves, bearing their seed-vessels on the lower side.

FERRET. *Putorius fœtidus.* The Ferret belongs to the weasel family, and has long been domesticated and applied to the destruction of rats, rabbits, hares and other destructive burrowing animals. It is extremely sensitive to cold, and consequently care must be taken to keep it in a warm, dry place. As a curious fact in instinct, the manner of killing its prey by the ferret is interesting. It does not suck the blood, but kills by a single bite, by which the canine teeth pierce the spinal cord between the first vertebra of the neck and skull thus killing instantly. The length of the ferret is twelve to fourteen inches from the nose to the base of the tail, the latter being five inches in length. The natural color of the ferret is a mixture of black and yellow. The fur long and fine, with an undergrowth of woolly cinereous hair. They also breed white with pink eyes. Those most yellow being more addicted to albinism than the darker. It is also an error to suppose the ferret to be dangerous to handle. They must however be handled gently and by one to whom they are accustomed, and when used for hunting vermin, must be muzzled, the object being that they drive rats, etc., from their burrows, rather than that they kill them.

FERROCYANATE OF POTASH. A yellow, crystalline salt, also called Prussiate of potash, the solution of which is used as a test for peroxide of iron in solution, with which it strikes a beautiful blue, being, indeed, Prussian blue. It is also used in the laboratory as a test for copper and other metals, and to form various compounds of cyanogen.

FERRUGINOUS. Containing iron, or of the color of rust. Ferruginous waters are also called chalybeates, and much esteemed as tonics. Ferruginous soils, when friable, are frequently very fertile and open to improvement.

FERTILIZERS. The necessity of fertilizers for worn land is generally acknowledged even by the most ignorant; but very many—otherwise good farmers—fail to appreciate the advantage of applying manure while yet the soil is in a state of vigorous fertility, in order to keep it so, and also to still further improve its producing quality. They fail to appreciate the fact that it costs no more to cultivate an acre of land in the highest state of fertility, than it does a poor acre. Nay, it costs less, for the vigorous growth will soon tend to smother out the weeds and keep them down. The question of ordinary manures will be treated under the head of Manures, the term fertilizers being now, by common consent, applied to special manures and, particularly, to those known as commercial fertilizers. These are of six principal classes: 1, those manufactured directly from dead animal products, as offal, flesh. blood, fish, etc.; 2, superphosphate, made from bones; 3, guano, or the deposit of marine birds; 4, poudrette, manufactured from night soil, the contents of privies; 5, the mineral manures as lime, gypsum, salt, kainit, etc.; and 6, ashes, the important constituent of which is potash. Among all these guano has been found to be the best source of nitrogen, (ammonia); and phosphoric acid, and bone preparation, the best source of superphosphate, or soluble phosphate of lime. The most glaring and shameful adulterations of these substances rendered it necessary for those States where fertilizers were principally sold, to pass the most stringent laws for the protection of purchasers. In relation to the supply of Peruvian guano, a report made by the British consul at Callao says that the whole amount of exportable guano possessed by Peru would not, by fair estimate, reach 3,000,000 tons, a quantity which would supply the demand only for a very few years. Information obtained through careful inquiries at the Guanape and Macabee Islands, up to November, 1872, placed the available quantity at these localities at about 500,000 tons and 750,000 tons respectively. He is assured that the guano on the Lobos Islands does not exceed 750,000 tons in quantity. This has since been verified not only by a diminished supply, but by the fact that the guano question has led to serious wars between Peru and neighboring States. In relation to the supposed values of commercial fertilizers, chiefly occasioned by the specious advertisements of those engaged in the manufacture and sale, Prof. S. W. Johnston, in a paper to the Connecticut Board of Agriculture, as long ago as 1869, from analyses made to determine the commercial value as compared to the selling price, the samples tested being taken directly from the sacks and other packages in the dealers' stores, of sixteen samples tested, says· Of these sixteen samples, one, a home-made superphosphate, has no selling price affixed. Another fertilizer shows a currency value of $61.52 per ton, against a selling price of $56 per ton. In contrast to this a poudrette exhibited a currency value of only $3.03 per ton, against a selling price of $28 per ton; and another of similar brand a value of only $3.16 per ton, against a selling price of $2.50 per barrel. The point is, any person buying commercial fertilizers, of any kind, if in States having laws relating to adulteration, should see that the value of the fertilizer has been regularly verified. Then the buyer has redress through the courts, if fraud be practiced, not easily obtained otherwise. Guanos, and other special fertilizers, may be made at home. Pigeon dung is fully equal to the best Peruvian guano, and the dry dung of fowls better than guano, as usually guaranteed and sold. Prof. Johnson recommends the following as an excellent combination for fertilizing purposes· Mix one bushel of salt with two bushels of dry lime, under cover, and allow the mixture to decompose gradually, thus forming an intimate chemical union of the two materials. For this purpose the mixture should lie at least six weeks before use, or, still better, two or three months, the heap mentioned being turned over occasionally. This salt and lime mixture, when applied at the rate of twenty to thirty bushels per acre, forms an excellent top-dressing for many crops. It acts powerfully on the vegetable matter of soils. Fifty bushels applied to a turnip field have produced as large a crop as twenty loads of barnyard manure. It is also very destructive to insects and grubs in the soil. Like salt, it attracts moisture from the air, and has been found useful against drought. Its decomposing power is remarkable; and, if three or four bushels of it are mixed with a cord of swamp muck, the latter will soon be reduced to powder. Coarse manure is in a similar manner decomposed and made fine. Sour, wet muck, thus treated and composted with barn-yard manure, constitutes a fertilizer almost as valuable as the unmixed manure of the barnyard. An excellent substitute for commercial fertilizers, such as superphosphates, etc., may be made as follows: Take one barrel of pure, raw, finely-ground bones, and one barrel of the best wood-ashes; mix them on a floor, and add gradually three pailfuls of water, mixing thoroughly with the hoe. Use in small quantities in about the same manner as the superphosphates. If the ashes cannot be procured, dissolve twelve pounds of potash in ten gallons of hot water, and with this solution saturate the bone-flour thoroughly; a barrel of dried peat or good loam, without stones, may be added. The mixture should not be sticky, neither too moist nor too dry. In applying it avoid direct contact with the seed; for instance, when applied in the hill, scatter a little earth over it before dropping the seed. A very early visible effect should not be anticipated, but the good results will manifest themselves as the season advances. The Dr. Valentine's guano contains the following constituents in a ton, and is made as follows, the manufacture to be carried on in a dry place: Take twenty bushels of dried peat, three bushels of wood-ashes, and five bushels of bone-dust, and mix them together; then take forty pounds nitrate of soda, twenty pounds of sal ammonia, eleven pounds of carbonate of ammonia, twenty pounds sulphate of soda, ten pounds sulphate of magnesia, and ten pounds common salt, mix these ingredients in sufficient water to dissolve them—say four or five pailfuls. Add this solution to the three articles first named, and mix as in making mortar. When thoroughly intermixed, add three bushels of calcined plaster, which will absorb the superabundant liquid, and bring the composition into a dry condition. Pack so as to exclude air. If occasion requires, garden mold or clean virgin soil may be substituted for the peat. The editor of the Boston *Journal of Chemistry* recommends increasing the bone-dust to four or five bushels, and to substitute nitrate of potash for the nitrate of soda, and that the rate of application on ordinary northern soils be from a half ton to a ton per acre. The cost of the ingredients will depend on circumstances of locality, etc., but may be approximately stated at $20 per ton, not including the peat. Kainit, an article lately brought into commercial notice, is a rock containing from twenty-eight to thirty-two per cent. of sulphate of potassa, in combination with sulphate of magnesia, chloride of magnesium, sulphate of lime, and chloride of sodium. Its potash constituents give it its value. It is mined at Strassfurth, Germany, where the bed lays from 500 to 800 feet below the surface. In relation to this fertilizer, Dr. Voelcker thinks it more likely to be remunerative on sandy and gravelly than on clayey soils, and especially for roots, clover, and other leguminous crops, and potatoes. For the latter, designed for market, it may also be of use on heavier soils. In moderate applications it may be beneficial to grass land which does not receive sufficient dung, and which is annually cropped in hay, with the aid of such nitrogenous manures as ammonia salts or nitrate of soda. But he does not anticipate much benefit from a general use of kainit in agriculture. In South Carolina a phosphate rock is largely mined, and its use is increasing every year. Among its valuable constituents are 26.28 per cent. of phosphoric acid; 39.78 lime; and, insoluble silicious matter, and soluble silica 15.31 per cent. The following table will show, from Dr. Emil Wolff, Germany, the average composition of the principal commercial fertilizers, these being the average results of numerous analyses, lately revised. They will be found approximately correct.

Fertilizers. (In one hundred parts.)	Water.	Organic Substance.	Ash.	Nitrogen.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.	Sulphuric Acid.	Silica and Sand.	Chlorine and Florine.
	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.	pr. ct.
Peruvian Guano	14.8	51.4	33.8	13.0	2.3	1.4	11.0	1.2	13.0	1.0	1.7	1.3
Norway Fish-Guano	12.6	53.4	34.0	9.0	0.3	0.9	15.4	0.6	13.5	0.3	1.6	1.1
Poudrette	24.0	27.0	49.0	2.0	0.9	1.0	18.6	0.5	2.1	1.0	5.4	1.5
Pulverized Dead Animals	5.7	56.9	37.4	6.5	0.3	0.8	18.2	0.4	13.9	1.0	1.7	0.2
Flesh-Meal	27.8	56.6	15.6	9.7	......	......	7.0	0.3	6.3	0.1	1.1	...
Dried Blood	14.0	79.0	7.0	11.7	0.7	0.6	0.7	0.1	1.0	0.4	2.1	0.4
Horn Meal and Shavings	8.5	68.5	25.0	10.2	......	......	6.6	0.3	5.5	0.9	11.0	......
Bone-Meal	6.0	33.3	60.7	3.8	0.2	0.3	31.3	1.0	23.2	0.1	3.5	0.3
Bone-Meal, solid parts	5.0	31.5	63.5	3.5	0.1	0.2	33.0	1.0	25.2	0.1	3.0	0.2
Bone-Meal, soft parts	7.0	37.3	55.7	4.0	0.2	0.3	29.0	1.0	20.0	0.1	3.5	0.2
Bone-black, pure	6.0	10.0	84.0	1.0	0.1	0.3	43 0	1.1	32 0	0.4	5.0	......
Bone-black, spent	10.0	6.0	84.0	0.5	0.1	0.2	37.0	1.1	26.0	0.4	15.0	......
Bone ash	6.0	3.0	91.0	......	0.3	0.6	46.0	1.2	35.4	0.4	6.5	......
Baker Guano	10.0	9.2	81.0	0.5	0.2	1.2	41.5	1.5	34.8	1.5	0.8	0.3
Jarvis Guano	11.8	8.2	80.0	0.4	0.4	0.3	39.1	0.5	20.6	18.0	0.5	0.2
Estremadura Apatite	0.6	......	....	......	0.7	0.3	48.1	0.1	37.6	0.2	9.0	1.5
Sombrero Phosphate	8 5	......	91.5	0.1	......	0.8	43.5	0.6	35.0	0.5	1.0	0.6
Navassa Phosphate	2.6	5.4	92.0	0.1	......	... ..	37.5	0.6	33.2	0.5	5.0	0.1
Nassau Phosphorite, rich	2.6	......	97.4	......	0.8	0.4	45.1	0.2	33.0	0.3	5.5	3.1
Nassau Phosphorite, medium	2.5	......	97.5	......	0.7	0.4	40.1	0.2	24.1	......	20.8	1.5
Westphalian Phosphorite	6.5	1.6	91.8	......	......	......	21.8	0.9	19.7	1.0	22.0	1.6
Hanover Phospuorite	2 0	3.5	94.5	......	......	......	37.2	0.2	29.2	0.5	3.3	1.5
Coprolites	4.3	......	95.7	......	1.0	0.5	45.4	1.0	26.4	0.8	7.5	0.1
Sulphate of Ammonia	4.0	... ..	.. ..	20.0	......	......	0.5	......	....	58.0	3.0	1.4
Nitrate of Soda	2.6	....	......	15 5	......	35.0	0.2	... ..	......	0.7	1.5	1.7
Wool-dust and offal	10.0	56.0	34.0	5 2	0.3	0.1	1.4	0·3	1.3	0.5	29.0	0.2
Lime-cake	6.5	47.0	46.5	3.1	......	......	20.5	2.4	3.0	......	8.0	......
Whale-oil refuse	23.0	68.4	8.6	5.7	......	......	3.0	0.2	2.3	......	3.0	......
Common Salt	5.0	......	95.0	......	......	44.3	1.2	0.2	......	1.4	2.0	48.2
Gypsum or Plaster	20.0	......	80.8	......	......	......	31.0	0.1	......	44.0	4.0	.....
Gas-lime	7.0	1.3	91.7	0.4	0.2	......	64 5	1.5	......	12.5	3.0	......
Sugar-House Scum	34.5	24.5	41.0	1.2	0.2	0.6	20.7	0.3	1.5	0.3	9.1	0.1
Leached wood ashes	20.0	5.0	75.0	......	2.5	1.3	24.5	2.5	6.0	0·3	20 0	.....
Wood-soot	5.0	71.8	23.2	1.3	2.4	0.5	10.0	1.5	0.4	0.3	4.0	......
Coal-soot	5.0	70.2	24.8	2.5	0.1	......	4.0	1.5	......	1.7	16.0	......
Ashes from Deciduous trees	5.0	5.0	90.0	......	10.0	2.5	30.0	5.0	6.5	1.6	18.0	0.3
Ashes from Evergreen trees	5.0	5.0	90.0	......	6.0	2.0	35.0	6.0	4 5	1.6	18.0	0.2
Peat-ashes	5.0	......	95.0	......	1.5	0 8	?	1.5	0.6	1.3	?	0.2
Bituminous coal-ashes	5.0	... ..	95.0	......	0.5	0.4	?	3.2	0.2	8.5	?	......
Anthracite coal-ashes	5.0	5.0	90.0	......	0.1	0.1	?.	3.0	0.1	5.0	?	......
Superphosphate, from												
Peruvian Guano	16.0	41.9	42.1	10.0	2.0	1.2	9.5	1.0	10.5	15.0	1.5	1.1
Estremadura Apatite	15.0	.....	85.0	......	0.4	0.2	28.2	0.1	22.1	28.5	5.3	0.9
Sombrero Phosphate	15.0	......	85.0	......	.....	0.5	26.4	0.4	20.2	25.5	0.6	0.4
Navassa Phosphate	15.0	2.5	82.5	......	......	?	17.0	0.3	15.4	19.5	2.3	?
Nassau Phosphorite, rich	15.0	......	85.0	......	0.5	0.2	26.5	0.1	19.4	25.5	3.2	1.8
Nassau Phosphorite, medium	12.0	......	88.0	......	0.3	0.1	24.2	0.1	16.6	19.5	13.5	1.3
Bone-black	15.0	8.0	77.0	0.3	.....	0.1	25.0	0.7	16.2	21.0	9.3	.....
Bone-Meal	13.0	23.8	63.2	2.0	0.1	0.2	22.4	0.7	16.6	19.5	2.5	0.2
Phospho-guano (manufactured)	15.5	13.0	80.3	3.3	0.3	0.4	24.0	......	20.5	28 8	3.0	0.9

In relation to the application of most commercial fertilizers and concentrated manures, if applied directly to the seed, or the plants they will kill. They should always be intimately mixed with the earth or applied dissolved in water, or mixed with other material. For information relating to ordinary fertilizers see article Manures.

FESCUE GRASSES. The genus *Festuca*, containing several valuable, permanent grasses, of which the *F. pratensis*, meadow fescue, and *F. duriuscula*, hard fescue, are well known. (See Grasses.)

FETLOCK. The part of the leg where the tuft of hair grows behind the pastern joint of horses. The fetlock joint is a very complicated one, and from the stress which is laid on it, and its being the principal seat of motion below the knee, it is particularly subject to injury. Fomentations, which see, are specific remedies for inflammations of the joints or integuments, to be followed, if necessary, with mild blisters. (See Blistering.)

FEVER. Fever is that state of the animal system, or symptoms formed by acceleration of the pulse, chills followed by heat, thirst, and a general exhibition of lassitude and uneasiness; specific names being applied to the various types it assumes. Fevers generally begin with languor of body and mind; chilliness, amounting to shivering, though the skin often, at the same time, feels hot; the pulse is quicker than it should be; respiration hurried or labored; pains are complained of in various parts, especially about the head, back and loins; the appetite falls off, or there is nausea and vomiting; the mouth is dry; the bowels generally constipated, and the urine small in quantity and deep in color. These, which constitute the first stage, or ordinary febrile symptoms, are succeeded by alternate flushings, a quicker and fuller pulse, rapid alternations of shivering and burning heat, and by mental anxiety and wandering, which, under a great variety of aspects and modifications, constitute the second stage; they are succeeded by the third stage, in which the leading appearances are a cleaner tongue, a more natural pulse, a moist skin, calm mind, and the urine becomes more copious in quantity, and deposits a sediment as it cools. The symptoms of fever generally undergo an increase every evening, which is called an exacerbation; and this fluctuation often takes place more than once in the twenty-four hours, the violence of the attacks increasing with their occurrence, and forming what is called a continued fever.

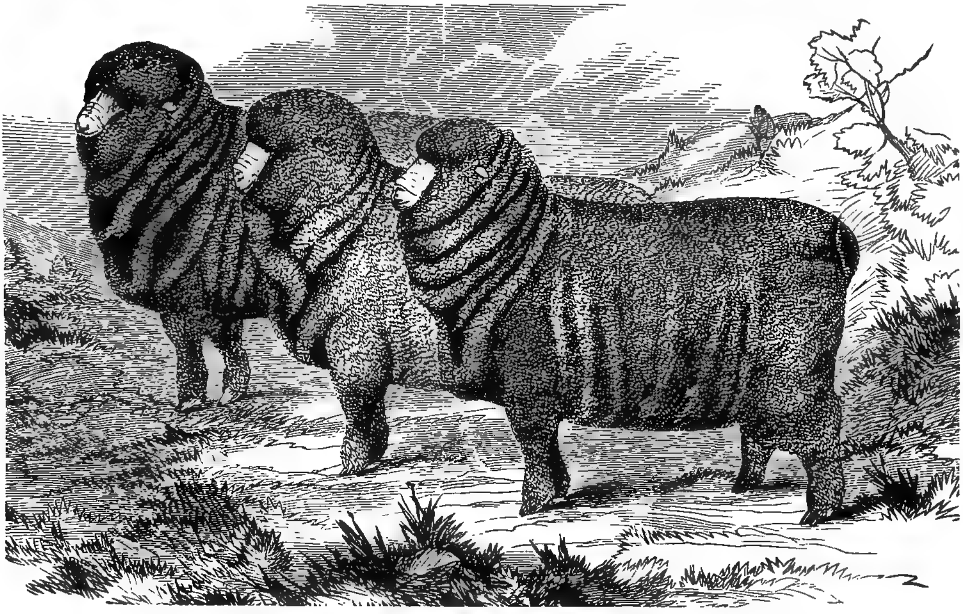
FEVERFEW. *Pyrethrum;* from *pyr*, fire, the roots being hot to the taste. Of this interesting European genus of plants, the *Matricaria* of Linnæus, three species only are indigneous to England. The common feverfew, (*P. parthenium*), a biennial which grows in waste grounds, hedges, and walls, flowering in June or July. Root tapering, small, and white; stem erect, branched, leafy, round, many flowered, about two feet high; leaves stalked, of a hoary green, pinnatifid. Flowers numerous, like daisies, white or yellowish, in a corymbose panicle, sometimes compound, on long naked stalks, erect, about half an inch broad. The whole plant has a strong disagreeable smell, a bitter taste, and yields a volatile oil by distillation. It was formerly reckoned tonic, stimulating, and antihysterical, and the oil is still regarded as such. It contains much tannic acid; and in Germany it has been usefully employed in tanning and currying leather. Corn Feverfew, or scentless Mayweed, (*P. inodorum*), is very common in cultivated fields, and by waysides, on gravelly soils. Root tapering, rather large, annual, flowering in August or September. Sea Feverfew (*P. maritima*), a perennial, flowering in July or August, is found on the sea coast in sandy or stony ground. The thick, woody, long-enduring root runs deep into the ground, producing a number of hollow stems, spreading circularly on the ground, often tinged with purple. The common wild chamomile (*Matricaria chamomilla*), was formerly classed as a feverfew. The greenhouse varieties of feverfew are, some of them, handsome. They grow in any rich, light soil, and young cuttings root readily when planted under a glass. Any common soil suits the hardy kinds, which are increased by divisions or seeds. It possesses the properties of the real chamomile in a marked degree, and might be substituted for it as a medicinal agent. In the United States the only indigenous species are *M. parthenium* and *M. discoidea*, the latter a native of Oregon.

FEVER, IN THE FEET. (See Founder.)

FIBER. This is a term used to designate the filaments or slender threads that constitute the substance of the bones, cartilages, ligaments, membranes, nerves, veins, arteries and muscles, and the slender threads composing the structure of plants, and found also in minerals, is termed fiber. Any fine, slender root, thread or filament is a fiber. Fibrin is a peculiar organic compound substance, solid, tough, elastic, and composed of threads, fibers, and found in animals and vegetables. When pure it is whitish, inodorous, and insoluble in water Fibrin, both in animals and vegetables, is nearly identical, as the following analyses will show:

Fibrin.	Animal.	Vegetable.
Carbon	52.8	53.2
Hydrogen	7.0	7.0
Oxygen	23.7	23.4
Nitrogen	16.5	16.4
	100.0	100.0

Fiber abstrusely considered is one of the most important productions in nature. Among the families of plants producing valuable fiber for manufacturing purposes are the mallow family, noted in all parts of the world for the excellent fiber of its bark. Cotton belongs to the fiber plants. In this plant, however, it is the woolly envelope of the seeds that is the valuable part. The nettle family, in all its subdivisions, is noted for the abundance and excellence of its fiber. The hemp sub-family contains not only the hemp plant but the hop. The bread fruit sub-family; includes not only the different species of mulberry, but also the paper mulberry, the last probably the most useful of the whole. The nettle family proper, in all parts of the world, produces valuable fiber plants. The famous china grass, (*Bœhmeria nivia*), is stronger than hemp, and belongs to what are denominated stingless nettles. The Dog-bane family, (*Apocynum,*) is represented by plants remarkable for their fineness. *A. cannabinum*, or Indian hemp, is one of these. The milkweed family, (*Asclepias*,) is another family remarkable for its valuable fibers. Lately, it is asserted, that some members of this family produce a gum analogous to India rubber and that it may be produced, by cultivation, in paying quantities. Among the fiber plants in most common cultivation in various parts of the world, and representing an enormous rural and manufacturing industry are flax, hemp, jute, manilla "grass," the latter obtained from a species of plantain, (*Musa textilis*). All the plantain and banana tribe abound in fiber. Cocoanut fiber is the product of the tree, (*Cocos nucifera*). The pineapple tribe furnishes fiber from which most exquisite fabrics are made. Esparte, or Esparto, (*Stipa tenacissima*), is a fiber grass of great value. Sandals, mats, ropes, baskets, nets, and paper are produced from it, and it has even been used in Spain for hurdles in which to pen sheep. Cotton is without doubt the most valuable fiber plant known, next comes flax, then hemp, and next manilla grass.



GROUP OF PAULAR MERINO EWES.

FIBRIN. The principal constituents of muscles; it also exists in blood and some vegetables. When pure, it is white, inodorous, and insoluble, and, if properly dry can be kept for any time, but when moist it putrefies rapidly.

FIBROUS PLANTS. (See Fiber.)

FIBULA. The outer thin bone of the foreleg.

FICOIDEÆ. Tropical plants resembling the cactuses, inhabiting sandy plains.

FICUS. The generic name of the fig; hence ficaria, resembling the fig. (See Fig.)

FIERY HANG-BIRD. (See Oriole.)

FIG. (*Ficus carica.*) The fig is one of the most ancient fruits recorded in history; a diœcious plant, the sexes occurring in different trees. Wherever it will withstand the winter it is generally cultivated; in Europe up to the latitude of Southern Germany, and in the United States up to the latitude of Tennessee. It is even cultivated successfully in some parts of Ohio, and in the southern portions of the Michigan lake shore region with protection in winter. If, however, the wood is frozen it is killed. In its proper climate the fig is a moderately large tree, indigenous to the countries bordering on the Mediterranean sea, and in Syria, Persia, Asia Minor, and North Africa. It is said only to have been found wild near Urfa, and on the banks of the Northern Euphrates. Cortes first carried the fig to America in the year 1560.

FILARIA. A genus of intestinal worms resembling a thread in appearance.

FILIFORM. Thread-like.

FILLY. The young female of the horse kind.

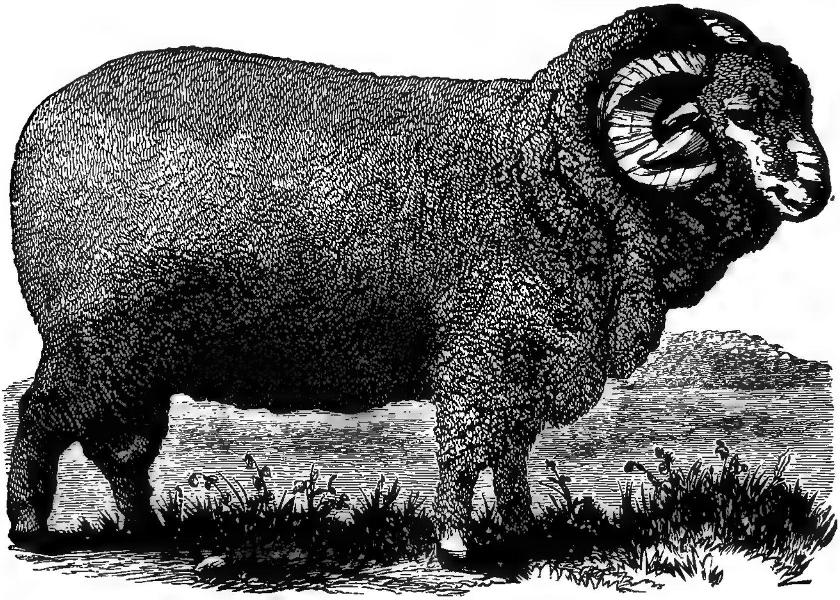
FILTRATION. The separation of the clear portions of a solution or mixture from the precipitate or dregs, by passing through a close tissue For chemical purposes, white blotting paper, called filtering paper, is used, folded into a conical form, and placed on a funnel. The fluid which runs through is called the filtrate. In quantitative analysis the filters are weighed before use, and when properly dried with the precipitate, and reweighed, give the amount of the latter with the best results. Sometimes the paper is burned with the precipitate, the known weight of its ashes being deducted from the whole weight. For common purposes, stout cotton cloth or porous earthenware are used.

FIMBRIATE. Any long, fringe-like margin to animal or vegetable organs.

FINE WOOLED SHEEP. The introduction of fine wooled sheep into the United States dates from early in the century, through importations of the best individuals to be obtained from Spanish flocks, and later, of French Merinos, Saxon, and Silesian. Judicious breeding for many years has resulted in what is now known as American Merinos, larger, better wooled, and better adapted to take on flesh than any of the original breeds. In fact, the crosses made from time to time with Saxony, French, and Silesian sheep, resulted in disappointment. The leading strains from careful breeding and selection, during many years, resulted in what were known as the Atwood, the Rich, and the Hammond Merinos, from the names of the respective breeders. They are now almost universally disseminated over the country, under the name of American Merinos and, all things considered, are without doubt the best breed of fine wooled sheep in the world, not excepting those of Australia, in which country the breeding of fine wooled sheep has been carried to great perfection, as an examination of their varied and superior fine wooled fleeces at the American Centennial Exhibition at Philadelphia amply attested. The fine wooled sheep are represented by the improved Paulars, and the improved Infantados. The other American breed is a cross of French Merino ewes with American rams. A quarter of French blood with three-quarters of American blood, increases the size, but the French Merinos always were tender, and not good feeders. The French Merinos were a mongrel race, the worst of them gaunt, flat sided, hard feeders, and the best of them never carried the wool the American Merinos do. We doubt much if a flock of true French Merinos can now be found in the United States, and their extinction here, if not already accomplished, will surely follow. The Saxons are delicate, but with wool of exceeding fineness. Nevertheless they were found to be not adapted to the United States. The flocks of Australia, many of them, received a large infusion of Saxony blood. In the United States they have almost entirely disappeared, and for the reason that the American Merinos were found to be second to none for the production of fine wool of most excellent quality. The Silesian sheep as known in the United States, are larger than any American Merino, with longer and thinner necks in proportion to their size, and with longer legs. Their wool is of very superior quality, and is carried compactly and evenly over the carcass, but so far they have not held their own with our well established American Merinos, of the two principal families of the original Spanish stock of the country. As illustrating French Merinos of the last century and also of the present day, the accompanying cuts will give the reader a good idea of their characteristics. Dr. Randall, than whom there is no better authority, in the United States, describes the improved Infantados, and Paulars as follows: The improved Infantados are a fourth if not a third larger than their Spanish ancestors, and are the largest family of American Merinos. Full-grown ewes, in their prime, weigh about 100 pounds, and some of them 120 and 130 pounds. They are much rounder in the rib, broader, fuller in the quarters, shorter proportionally in the limbs, and stronger in the bone than were the Spanish sheep. They are indeed models of compactness and of beauty when judged by fine-wool standards. Their hardiness in respect to locomotion, or, in other words, their ability to travel, is not probably as great as it was sixty years ago; for, having no necessity to drive his sheep eight hundred miles a year, as did the Spaniards, the American breeder, in the place of that useless ability to travel, has developed those qualities which increase aptitude to take on flesh and produce wool. The improved American Infantados appear to be quite as hardy in other particulars as their ancestors, are more prolific and better nurses, and when properly fed, resist other vicissitudes equally well, and endure cold even better; but probably demand better keeping. They will thrive, however, where none of the mutton breeds above described would find sufficient subsistence. Choice Infantado flocks with the usual number of sheep of different ages, yield from nine to ten pounds of wool per head. The fleece is longer, thicker, and covers the different parts of the animal far better than it did on the Spanish sheep. The quality is probably as good. The improved American Paulars bear the same relation, in several particulars, to the preceding, that the Devons do to the Short Horns among cattle. They are smaller, consume less food, and perhaps can better endure deprivation of it. Accordingly they are the sheep for cold, meagre soils; for the scanty herbage of mountain districts, and for plains subject to periodical droughts. They have about the same general improved points of form as the Infantados, but are shorter bodied. As breeders and nurses they are equal. Their fleeces are of equal quality,

RAMBOUILLET RAM OF THE YEAR 1787.

but are a pound or two lighter to the head. For that reason, and on account of the greater size of the former, there is, at the present time, a prevailing inclination to cross the Paular flocks with Infantado rams. This produces an admirable result for the wants of many farmers, but it would be very unfortunate if the present mania for great fleeces should lead to the loss, in its essential family purity, of a class of sheep so well adapted to extensive regions of our country. Mr. W. R. Sandford, of Vermont, went to Europe, in 1851, in the interest of himself and some other gentlemen, including Mr. Hammond, and with the view of importing valuable animals if those could be found better than at home. This gentleman visited the best flocks of France, Saxony and Silesia, and purchased representatives of some of the best French and Silesian sheep, not with a view of breeding them himself, for he was satisfied that they were inferior to those at home, but to reimburse the expenses of the journey. Nevertheless, they did make the experiment, but it resulted unsatisfactorily and it is well known that those who crossed the Saxony sheep upon their Spanish flocks, in an early day when the Saxon fever raged, did incalculable injury. A Vermont correspondent of the Department of Agriculture at Washington, writing of Merinos in New England, in 1869, says, the heaviest fleeces shown by Mr. Atwood, of Connecticut, twenty-five years since, were five pounds from ewes, and from five to eight pounds from rams. Now eighteen pounds are taken from best ewes, and twenty-six to thirty from the best rams, the growth of twelve months. The Child Brothers, bred several years from a ram that sheared as follows: First fleece, sixteen pounds; live weight after shearing, sixty-four pounds; second fleece, twenty-four pounds; live weight ninety-nine pounds; third fleece, twenty-six pounds; live weight 107 pounds. Although these fleeces are very heavy they do not injure the vitality of the sheep, and the keep that will fix a wether nicely for market will keep the Merino in fine condition. Of course fleeces of the above weight will shrink in cleansing far more than the long wools; yet no other breed of sheep has probably been produced that, in proportion to live weight, will produce as much cleansed wool per head as the Merino. Between eight and nine pounds have been realized in numerous instances from a single fleece. We may add, that, as good results have been reached with sheep by our best breeders West; and, for the reason that, while they have brought as high intelligence to the art of breeding as anywhere else in the world, profiting by the experience of others, they have spared no expense in obtaining the best sheep possible. The result may be seen yearly at our principal fairs. The illustration, page 345, of a group of American Paular Merino ewe Tegs, (sheep in their second year), illustrates the perfection of breeding of the last twenty years and extending to the present time. As showing something of fine wooled sheep breeding in various parts of the country, the following statements to the Department of Agriculture, Washington, gathered some ten years ago, will furnish a good basis from which the young breeder can calculate. E. D. Battles, of Ohio, makes the following statement: That for eight years, including 1862 and 1869, he kept 300 to 400 of the long stapled Spanish Merino sheep. The average weight of fleece for eight years was four and three-quarters pounds. The wool was sold annually at an average price of sixty cents per pound. The increase of the flock over and above the loss was twenty-five per cent. After the flock was increased to 400 (commenced with 300) it was kept at that number by selling the three years' old wethers, dry ewes, and drafting from the remainder of the flock such as were



RAMBOUILLET RAM OF TO-DAY.

thought to be of the least profit to keep. The sheep that were sold brought, on an average, $3 per head. The annual proceeds of each 100 sheep were:

From wool	$285 00
From increase	75 00
Total	360 00

The average annual expense of 100 sheep, for eight years was as follows:

Hay consumed in 125 days, ten tons	$100 00
For 240 days pasturing, at three cents per head per week	103 00
For grain	30 00
Washing, shearing, and marketing wool	20 00
Summer and winter care, including salt	30 00
Total	283 00

Profits on 100 sheep, over and above all expenses, $77.

The following statement shows the cost and profits in keeping seventy ewes, twenty lambs, and twenty rams, the Merino flock of C. A. Miller, a wool grower of Michigan:

Fifteen tons of hay, at $8	$120 00	
Labor in feeding	20 00	
Pasture	67 00	
Washing and shearing	10 80	
Salt and summer care	8 00	
Total		$225 80
Wool of ewes, 652 pounds	$253 28	
Wool of rams, 285 pounds	46 95	
Letting of rams	100 00	
Thirty lambs sold, at $3	90 00	
Twenty choice lambs kept	60 00	
Manure	50 00	
Total		603 23
Profit		404 43

A wool-grower in Livingston county, Mo., makes report of a flock of 500 Merinos, purchased at $780, which at the end of the year he sold for the same amount, after selling their wool for $500 and keeping a handsome young flock from the increase. The mountain districts of the South have the finest sheep ranges, almost entirely unoccupied, on which grass sufficient for millions of sheep annually decays, of no immediate advantage, and of no remote benefit except as a fertilizer of the soil. Merino sheep would thrive upon this herbage, and wherever the experiment has been fairly tried great profit has resulted. They also do well upon the lowlands of the South, if they escape the ravages of dogs and vagrants. It is worthy of record that the South is moving in preventing the killing of sheep by dogs, and in some sections sheep are now fairly protected. As an example: In Pulaski county, Ga., a farmer bought 800 head of sheep, in 1868, of which the following statement is made of debit and credit:

Dr.		
Cost	$750 00	
Cost of one hand to care for them	180 00	
Salting and incidental expenses	20 00	
		$950 00
Cr.		
2,000 pounds wool, at thirty cents	600 00	
Increase, 225 lambs at $1	225 00	
Fifteen acres of land well manured, at $10 per acre	150 00	
700 sheep on hand, $1.50 per head	1,050 00	
		2,025 00
Profit		1,075 00

A Texas correspondent sends the following tabulation, compiled with the aid of records from actual experience in wool-growing, with a flock of selected grade Merinos improved by thorough-bred Merino rams. The annual increase, allowing for losses of lambs, is placed at eighty per cent., half males, which are sold annually, and the ewes added to the flock.

Years.	Breeding ewes, number.	Annual increase ewe lambs.	Annual increase—ram lambs.	Yearlings transferred.	Yearling wethers sold.	Price per head sold.	Amount received for wethers.	Annual clip of wool in pounds.	Cash received for wool.	Annual expense labor.	Salt, tar, medicine, etc.
1	1,200	480	480	....	....	....	....	4,800	$1,200	$600	$60
2	1,200	480	480	480	480	$1 25	$600	8,640	2,160	900	90
3	1,680	672	672	480	480	1 25	600	10,560	2,640	1,200	120
4	2,160	864	864	672	672	1 25	840	14,016	3,504	1,500	150
5	2,832	1,132	1,132	864	864	1 25	1,080	18,240	4,560	1,800	180

At the close of the fifth year the value of the flock is estimated:

Breeding ewes, 2,832, at $4	$11,328 00
Lambs, ewes and rams, 2,264, at $1	2,264 00
	13,592 09
Stock rams, eighty-six head, at $25 per head	2,150 00
Total value of entire stock	$15,742 00

In 1879 there were 38,123,800 sheep in the United States, the value of which was $79,023,984. The great bulk of these were American Merinos, their grades and crosses. The average value of these sheep was $2.07 each. Of the number as stated, the States having 1,000,000 or over was as follows: California, 6,889,000; Texas, 4,500,000; Ohio, 4,040,000; New York, 2,121,000; Michigan, 1,820,000; Pennsylvania, 1,666,000; Wisconsin, 1,313,000; Missouri, 1,296,400; Oregon, 1,160,600; Illinois, 1,089,000; Indiana, 1,039,500; Kentucky, 1,020,000; Nevada, Colorado and the Territories had 3,435,600. Thus it will be seen that the fine wool interest of the United States is one of immense importance, both in the annual clip of wool and in the sale of lambs and mutton sheep. In 1840 there were 19,311,346 sheep in the United States. The average number of pounds of wool is given at 2.5. At that time, the average for France, a country of fine wool, was 2.4. In 1860, the average in the United States is stated at four pounds. The returns for 1870 showed 28,477,951 sheep, shearing 100,102,387 pounds of wool, a fraction less than four pounds per head average. In 1875 the 36,000,000 sheep of the United States sheared 155,000,000 pounds of wool, or 4.30 pounds per head average. For management and diseases the reader is referred to the article Sheep, and to the various diseases as treated of.

FIORIN. *Agrostis stolonifera.* A creeping, bent perennial grass. The genus contains some valuable varieties. (See Grasses.)

FIR. *Picea.* A group of trees of which the Silver fir and the Balsam fir are best known. The spruces, hemlocks and firs are often classed in the same genera. The older writers called the spruce, picea, and the fir, abies. Linnæus reversed these terms. Some botanists place the fir in the genera *Picea,* the hemlocks in the genera *Tsuga,* and the spruce in the genera *Abies.* The firs are found in Europe, Asia and North America, extending from the torrid to the arctic zone. They are remarkable for their formal conical growth, being perfect in outline and rich in color, as they are vigorous in growth. Specimens are found on our Northwest coast, from 150 to 200 feet high, and of immense proportions of trunk. The spruces are found most plentifully in America, but also in some of the colder portions of Europe and Asia. The Hemlock spruce was placed by Carrier in the separate genus *Tsuga.* The trees of this genus are all remarkably handsome and graceful, and should be planted wherever they will stand the climate. They are not killed by the cold, but are often injured by the winter sun, and the heat of summer, until they become well rooted and established. (See valuable species under their proper names.)

FIRE-DAMP. The inflammable gas of bituminous coal-mines. Carburet of hydrogen.

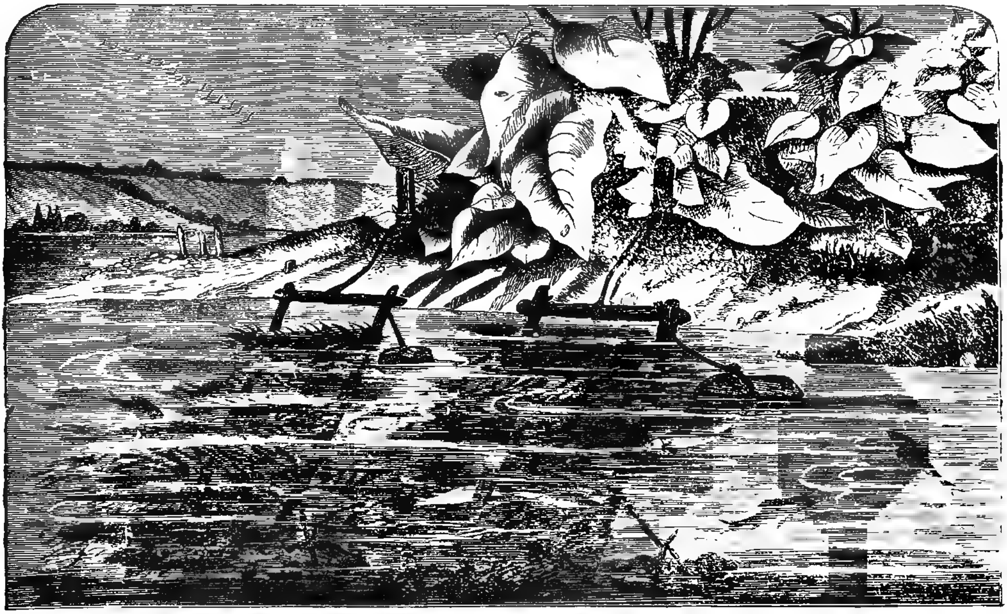
FIRE-FANGED. Dried up. When manure, or composts, in which heat is generated, become too hot, the parts assume a baked appearance and ashy color, and are said to be fire-fanged. This should never be allowed, since it thus loses ammonia.

FIRE-FLY. *Elater noctilucus.* An herbivorous insect of the Click or Spring Beetle genus.

FIRING. In farriery, the application of red-hot irons, practiced by ignorant and brutal men, for the removal of spavin and other blistering purposes. The hot iron should be used cautiously, and only under the advice of a veterinary surgeon.

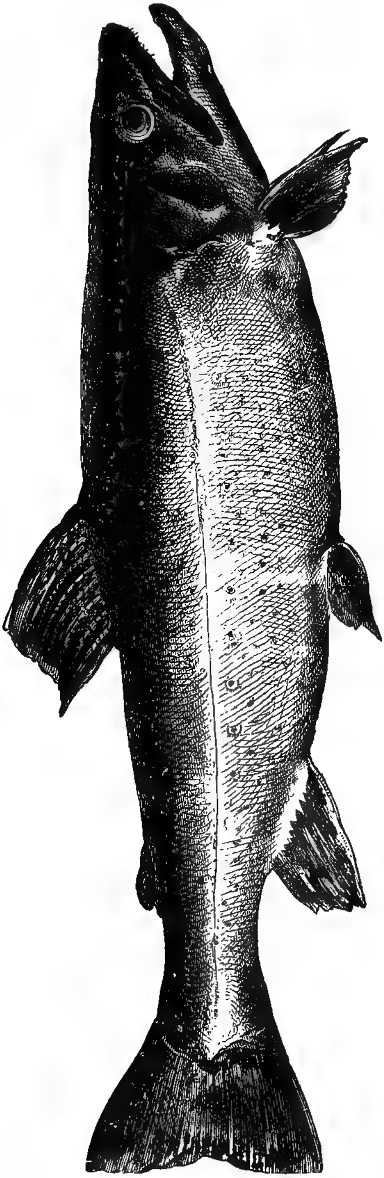
FIRKIN. A measure of 2,538 cubic inches, or 7½ imperial gallons, being the fourth part of a beer barrel. Butter is packed in barrels called firkins, but weighed, not measured.

FISH BREEDING. The subject of fish breeding has attracted increased attention from year to year, and as a productive industry it has assumed large proportions, especially since improved means of transportation for the eggs have been largely perfected. So between artificial fecundation and artificial spawning beds, the operator or breeder must decide for himself. The illustration we give will show a form well adapted for an artificial bed upon which fish may spawn. In relation to the use of these artificial beds, M. Blanchard, in his work on the fresh water fishes of France has the following: In view of the present condition of the rivers and canals of France, the idea of artificial spawning beds would appear to be a most happy one. M. Millet, before the Society of Acclimatization, has insisted, with great earnestness, on the preference to be given, in many cases, to artificial spawning beds over artificial fecundation. M. Coste has justly remarked that artificial fecundation is not all-sufficient, and yet a contrary opinion is generally prevalent. No one has forgotten the marvellous results which we were to obtain by means of artificial fecundation; fishes, left to themselves, could not thrive and have a numerous progeny. Their duties should be assumed by us, and the advantages would be incalculable. More than fifteen years have elapsed since these seductive announcements were made, without having yet furnished brilliant results. Among fishes, some, as the salmon, deposit their ova in slight excavations, in gravel, or in the interstices between stones; others, as the perches and cyprinids, (carp, bream, roach, etc.,) attach their ova, agglutinated together by means of a viscid matter, to aquatic plants, stones, or any bodies to which their eggs can be fixed. It is especially for the last that artificial spawning beds might sometimes be advantageously prepared. The construction of an artificial spawning bed is a very simple matter. A framework of sticks or laths should be made, and to such framework, boughs, furze, and aquatic plants should be fastened by cords, in such a way as to form irregular structures. It is also easy to give to structures of this kind a circular form, by taking hoops for frameworks. The form, and especially the size to be given to these spawning beds, would necessarily vary, according to the character or the size of the body of water in which they are to be immersed. They should be held to the bottom of the water by stones, and fastened to a stake or post on the bank. When kept in place in this way they can be easily drawn out of the water, if it becomes necessary to do so. These artificial spawning beds will be serviceable in those streams and water areas which are so clear as to be devoid of any natural spawning beds. For the salmonids, which spawn on a gravelly bottom, and whose ova remain free, artificial spawning places are very simple and readily prepared. It is only requisite to cover in certain places the beds of rather shallow and rapid streams, near the bank or the bottom of rivulets, with a thick layer of gravel or pebbles, and to prepare slight excavations or furrows, like those made by the salmon or trout, to deposit their eggs in. M. Millet also recommends that small heaps of pebbles should be raised at the edges of these furrows. By means of these contrivances, trout especially would often be attracted, and be content to stop and spawn in places which they would not otherwise frequent, and where it would be convenient to keep them. Natural spawning and fecundation, on artificial beds, supplemented with the artificial care of fish, has been practiced at Meredith village, N. H., for nearly fifteen years. In the illustrations as given, further on, are shown the hatching house, nursery, and pond; and another lower pond and fish-way. These ponds and hatchery are described as follows: The location is peculiar. A marshy area of three or four acres is nearly surrounded by an ampitheatre of high hills, from the base of which issue numerous springs of clear, cold water, which varies little in temperature during the year, and less, perhaps, in quality of water discharged in different seasons. These springs, uniting, form a brook of sufficient volume to support naturally a goodly number of the finny inhabitants, and a decided reputation as a trout stream, though it is little more than half a mile from its hundred heads to its single mouth, where it embouches into the Nashua. A dam, three or four feet in height, was thrown across the ravine, and a pond of an acre and a half obtained, five or six feet deep at points of least elevation, but quite shallow in a large portion of its area, and interspersed with growing trees, and shrubs, and ferns, and other forms of vegetation. So equable is the temperature of the water that there is noted a difference of only 8 ; 50° being the record in summer, and 42° in winter. In this pond were placed 500 trout; a hatching-house was erected just below, and 10,000 eggs were procured from Seth Green, and placed in the hatching-boxes for the first experiment, in November, 1867. The water, before entering the boxes, was filtered through six flannel strainers, (which were washed nearly every day) and every foreign substance, and every decaying egg was removed. The result was successful beyond the expectation of the amateur fish-hatchers. In March, 9,000 small fry appeared, or ninety per cent., from ova brought more than four hundred miles. While the eggs were being placed in the hatching-boxes the full grown trout in the pond above were seeking suitable spawning beds in shoal water in which they deposited their eggs, which were duly fertilized and left to hatch naturally. Early in the season large numbers were observed just from the egg, brisk and vigorous, the yolk sac unabsorbed, and growing to two or three inches in length by the following August. The older trout, fed two or three times a week with fresh liver, appeared to have doubled in weight during the year. The experiment warranted larger resources, and in 1868 a more spacious house was built, capable of hatching 100,000 in a single season. Small tanks or ponds adjacent to the hatching-house are excavated for rearing the small fry, or for keeping the spawners while ripening, by digging away a foot or two of bog earth at the base of the hills, exposing a bed of fine, gray sand, in which living springs bubble up, continually filling the excavation with clear, cold water. The dam has been raised to a height of five or six feet, thus increasing the area of the pond to three or four acres. Another pond below is also filled with trout, and the capacity is said to be now some hundreds of thousands of Brook Trout (*Salmo fontinalis*), see cut, trout. Near Elgin, Ill., are extensive private fish hatcheries, especially adapted to brook trout, cool, natural springs gushing in abundance from the hillsides, form the ponds, and of which enterprising citizens have availed themselves. At Geneva Lake, Wis., large quantities of fish are propagated, and now, in almost every State, the propagation, exchange, or the purchase of fish eggs is more or less extensively carried on, so that the artificial hatching of fish and stocking of waters, is now a large business, being prosecuted not only by private individuals, but in


ARTIFICIAL SPAWNING BED.

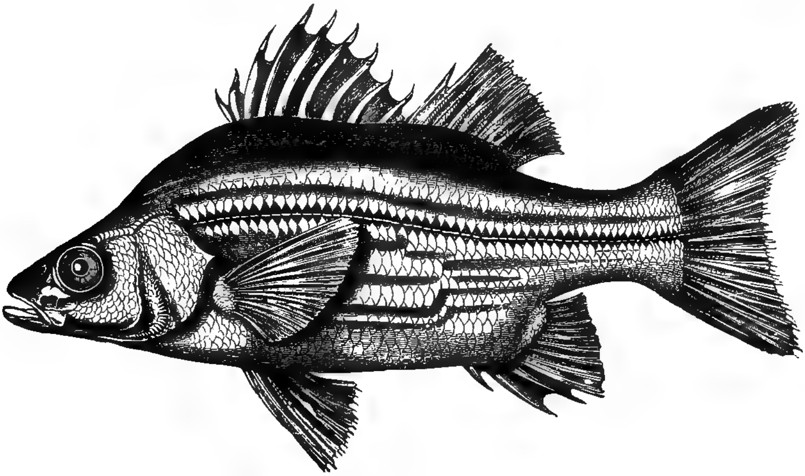
HATCHING HOUSE, NURSERY AND POND.

POND AND FISH-WAY.



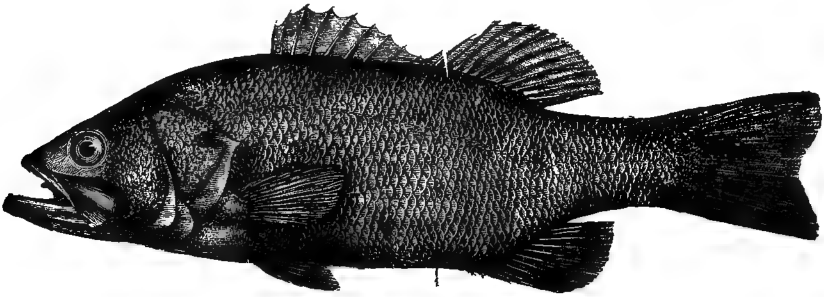
BROOK TROUT.

many of the States by officers or agents, paid by the legislature, under the name of fish commissioners. The legislatures of all the New England and Middle States, more than ten years ago, passed stringent laws for the protection of fish and fisheries; have voted liberal appropriations for buildings for hatching the fish, and have appointed commissioners to manage this new industry. Since that time, many of the Western States have followed their example. In the West, salmon, salmon trout, white fish and brook trout, are the species generally experimented with, and these, except white fish, and with the addition of shad and some other sea fish, are those usually hatched in the East. In the article Salmon (which see) will be found an illustration of the California species (*Salmo quinnat*), said to be remarkable for hardiness and freedom from disease. The late Mr. Klippart believed the following species as commonly found in Western waters, will be valuable. It must be remembered, however, that the perch family and the carp family, and the pike family, must not be in the same pond, unless they are expected to furnish food for the pike and pickerel. Perch family: Yellow perch, pickerel of the lakes, sunfish, rock bass, grass bass, black bass of the lake, and black bass of the Ohio river, (two distinct fish, though bearing the same name,) dwarf bass. Hog fish family: White perch of the Ohio river, sheep's head of the lake, hog fish, blenny-like hog fish, variegated hog fish. Carp family; Carp of the Ohio, mullet of the lake, Missouri sucker, white sucker, red-horse sucker, Buffalo sucker, brook sucker, spotted sucker, mud sucker, black sucker, rough-nosed dace, stone roller, silver shiner, large shiner, red-bellied shiner, red-bellied shiner of the lake, white and yellow-winged shiner, horned chub, red-sided chub, gold shiner, flat shiner, chub-nosed shiner, flat-headed chub, mud minnow. Pike family: Muskallonge pike, black pike. Catfish family: Blue catfish, yellow catfish, channel catfish, mud catfish, bullhead, yellow backtail. Salmon family: Mackinaw trout, speckled or brook trout, shad of the lake, white fish. Shad family: Gold shad, hickory shad, larger herring, lesser herring, moon-eyed herring. In addition to these we have several species of eels, sturgeon, and other fishes, which have not yet fallen under the notice of the naturalist, so as to be properly classified. Out of this list of nearly seventy-five species, according to Prof. Kirtland's catalogue, made nearly forty years ago, there certainly must be at least half a dozen species which are as much worthy our care and attention, and whose culture is certainly as profitable as some branches of farming in which millions of capital are invested. For the lake, the propagation of white fish, Mackinaw trout, and the lake perch, perhaps would pay the best. In the reservoirs and rivers the perch family would, in all probability, be the most advisable and profitable. It is possible that some species now unknown in our waters, more desirable than any of those enumerated above, may successfully be introduced and cultivated with profit. Further on we give cuts of the black bass (*Micropterans achigan*), and the brassy bass (*Morone interrupta*), two well known game fish of Western waters. In stocking ordinary shallow, or warm water ponds in the West, the carp family will be found best adapted to such places, although all the smaller catfish are equally well adapted. In fact, any fish usually found in ponds and sluggish streams may be used, but care must be taken not to introduce shovel-nose pike, or other predaceous fish of that character. In relation to the preservation of fish and stocking of waters, the report of the United States Fish Commissioners, in 1873, through Prof. Baird, says, in conclusion, that the decrease of fishes on the coasts that have been long and heavily drained by human demands, is probably dependent on the habits of most if not all fishes to return to the same spawning places year after year. Of late years the decrease has been more rapid on the coast here reported, because of the increased population to be supplied; the greater facilities by railways, and in the use of ice for packing, for extending sales into remote sections of the interior; the waste and even reckless destruction of spawn and of fish in endeavors to get the largest supply in the shortest time; the manufacture of oil and manure from fish; and the diminished supply as food for other fishes, thus compelling the feeders to seek other places for feeding. As a thorough investigation of all these and other points was necessary to a correct result, the inquiries took a wide range. In addition to the above-named causes of decrease, the commission examined into the effects of changes in the temperature of the waters and of pollution of waters by the waste of manufactories and the sewage of cities; the amount and condition of fish food; the habits of the fishes, and the diversion likely to be caused in those habits by the changes above noted, and the interference of inventions for fishing. And the products of some of these investigations were also used to add to the collections for the National Museum at Washington, and for other important museums elsewhere. The conclusions arrived at, as to the proper mode of preventing further decrease, and insuring an increased supply of food-fishes, the commissioner has embodied in an act (which has been submitted to, and amended and approved by, the best authorities among all parties most interested) which is to be made a law and enforced by the States of Massachusetts, Rhode Island, Connecticut and New York. This act is to provide for the prohibition of capturing fish in traps and pounds, from six p. m., on Friday until six a. m., on Monday—three nights and two days in each week—during the six weeks of the spawning season. This measure, all admit, will allow a gradual increase of the number, of all fishes, without material interference with the interests of any persons interested, except, perhaps, a few middle-men. Intelligent fishermen gave assurances that they would gladly welcome a law to that effect. To secure its easy and certain enforcement, all ponds and traps are to be licensed, and an infraction of the law is to work forfeiture to the State, and a transfer of the license to the informer. This will render official surveillance by the State nearly unnecessary—the law will almost enforce itself. Should these States neglect or refuse to enact such a law, it is then urged that Congress pass a law absolutely prohibiting the erection of any fixed apparatus for taking fish, after a period of one or two years, on the south side of New England and on the shores of Long Island, which constitute the spawning-grounds of the shore-fishes referred to. The one or two years would allow the present owners to wear out or use up their apparatus; and the absolute prohibition following, would restore the original abundance in much less time than the more gradual measure proposed for State action, while it would leave all fishing open to taking by hook and line, seines, and gill-nets exclusively. Thus the markets would be more regularly supplied, and the business and its profits be divided among a greater number of persons. Absolute prohibition by the United States is required, that it may be able easily to enforce the law. An occasional patrol along the coast by vessels of the revenue department, to confiscate all apparatus used in violating the law, would be all that is requisite. We now come to artificial spawning and hatching. Upon this subject we find the following data, which, with the accompanying illustrations, will be made plain: In the cut showing indoor hatching boxes, 1, is a frame work of glass rods; 2, tank with eggs resting on gravel; 3, catcher; 4, hand net. In the cut showing hatching-box, 1, is the reservoir; 2, short trough through which water is discharged; 3, trough in which the water falls before entering the box; 4, perforated zinc; 5, shoot to discharge water. (See explanation, Mr. Francis' plan) The next cut of hatching-boxes will illustrate a more extensive series of hatching-boxes. As explanatory of the illustrations still farther, in relation to artificial fecundation, and propagation, in an article prepared by Theodore Gill, M D., for the Department of Agriculture, he says: The fish should be firmly seized by the hand, and that the other should be passed over the abdomen gently, but firmly, and the ova and milt, if mature, will readily pour out. Only those fishes which are mature should be treated thus. If the ova or milt comes out with difficulty, and only under hard pressure, it is a sufficient indication that



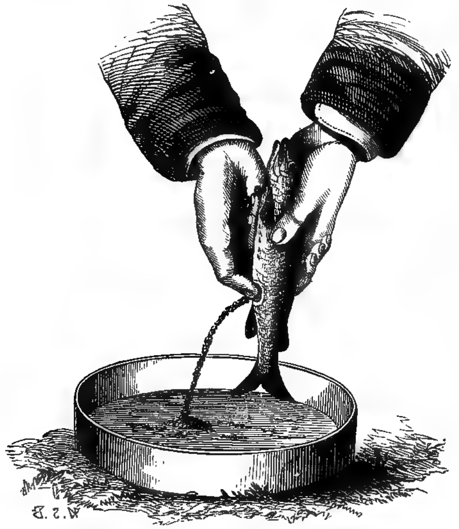
SHORT STRIPED OR BRASSY BASS.

they are not ripe, and it would not only injure the pregnant fish, but be useless as to results to anticipate the period of maturity. This uncertainty as to the period when the fish may be most advantageously manipulated, is one of the difficulties incidental to artificial fecundation. The fishes may be caught when they have apparently nearly reached their term, and be confined so as to be under the notice of the pisciculturist. When ripe they may be distinguished by their turgid sides, the pouting anus, and their uneasy movements. (See cut.) Having secured the eggs of certain fishes and fecundated them, these may be transferred to receptacles for hatching them; various patterns have been recommended, but the principles followed are essentially the same in all. A fountain of clear running water—a spring is preferable—from which a small stream flows, or may be led, is selected; and if there is a gradual fall or descent, so much the better. A series of boxes, through which the water will flow, are placed in the position to be fed by the stream, and the floor of each box is covered with gravel or pebbles, which may furnish a bed for the deposit of the spawn. In the details of the form and construction of these boxes, and the manner of regulating the flow of the stream, the variations chiefly consist, and may be illustrated by reference to two methods. One of these plans has been adopted by the Thames Angling Preservation Society, and was elaborated and introduced by Mr. Francis Francis. The chief object in view was to increase the stock of trout, and to introduce the grayling in the river Thames. A spring, from which a rill flowed, was first obtained; to use Mr. Francis' own words, there was a considerable fall in the run of the water, which was very advantageous; nevertheless, the plan here adopted can be applied more or less to any stream. We first bricked up the little rill so as to form a reservoir (1) and raise the water to a higher level; we covered the reservoir in with a large stone to keep out dirt and vermin, and placed at the lower end of it a zinc shoot, (2) over which the stream flowed. Immediately under this we placed our first box, a fac-simile of which is given. It was made of elm, four feet long, and fifteen inches wide in the clear, and ten inches deep. At the upper end of the box a projecting zinc trough (3) was fixed to catch the water, this trough being about three-quarters of the width of the box itself. At each end of every box a piece was cut out six or seven inches in width, and through these the water flowed into each box. (These openings were not carried all across the boxes, as the shoulders left made an eddy very favorable, as quiet resting places, to the young fry when first hatched. If the stream be at all strong, artificial eddies should be created by sticking small pieces of perforated zinc upright in the gravel at intervals along the sides and across the stream; behind these the helpless fry can be in safety.) The top cut, which first received the water, being secured from foes without by being covered with perforated zinc through which the water flowed, and the further end one having a zinc shoot to deliver the water, and also a perforated zinc face, not only to keep foes out, but the fish in. Fastened over the cut, in the lower end of the first box, was a short zinc shoot (5) to convey the water into the next box over the corresponding cut, so that no water should run to waste between the boxes. Thus, when No 1 was fairly placed on a brick foundation so as to receive the water in the zinc trough, all that was required was to insert the shoot at the other end of the box into the corresponding cut of No. 2 box, and slide No. 2 safely and closely up into its place, and so on with Nos. 3, 4, and 5, etc. These boxes were then partially filled with coarse gravel of the size of gooseberries, and some larger, even to the size of plums, for the more irregular their shape the better, as there will be more interstices between them in which the ova can be hidden, and the little fish when hatched can creep for safety. The gravel was at a level of about an inch below the cut which admitted the water, an inch depth of water being quite sufficient to cover them. Each box was furnished with a lid, comprising a wooden frame-work, and a perforated zinc center. This lid was made to fit closely by means of list being nailed on all around. It was padlocked down to keep out inquisitive eyes and fingers. Boxes in exposed places should always be covered in, if not with coarsely perforated zinc, yet with fine wire netting, or water mice will get in, and various birds, as moor-hens and dab-chicks, will pick out the spawn, while a kingfisher, should he discover them, will carry off the fry by wholesale. The stream was then turned on, and flowed steadily from box to box throughout the boxes, and finally discharged itself by the end shoot into the bed of the rill. It need not be imagined that a full stream is necessary, for a small amount of water is sufficient. Indeed, a flow of water, say through a half-inch pipe, would be enough, perhaps, though it is advisable while the ova are unhatched, to have more, so that there shall be more stream and movement in the water, and consequently less time for deposit to settle; so that we had on,

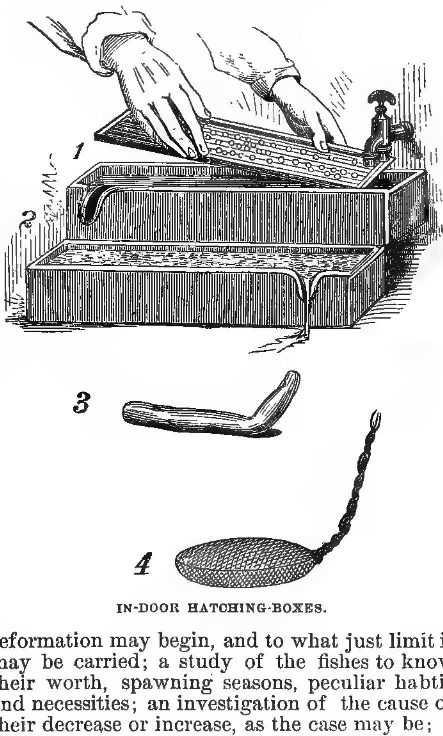


BLACK BASS.

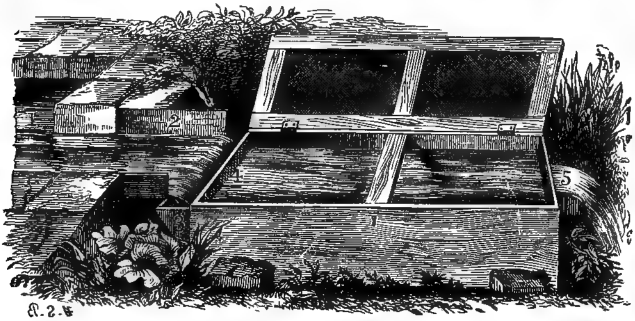
perhaps, as much as a stream of three-quarters of an inch in diameter. When the fish are hatched half that quantity would be preferable, as they are not well able to struggle against a stream, and would be carried down, perhaps, to the end box, and so against the perforated zinc face, where they would stop up the holes, and finally be smothered. The boxes were then properly steeped in water and seasoned, and being of elm, the joints drew closely together after a while, and the boxes held the water without material leakage. In each of the boxes thus constructed and arranged, about four or five thousand ova, or even more, are deposited; the gravelly bed in which they are spread is about one and a half or two inches below the cuts referred to in the preceding description. The ova are, by means of a spoon, regularly distributed, but from their numbers are quite close together; care is taken to have them among interstices of the gravel, such as are too prominent being carefully swept into some crevice by means of a fine brush. When thus cared for, a layer of gravel, composed of rather large flat stones an inch and a half or two inches square, is spread over the ova, heed being taken not to squeeze them. It may be remarked that the ova of the common yellow perch were hatched in these boxes. Another apparatus for the same purpose has been described by Mr. Frank Buckland as being employed by the Messrs. Ashworth, the proprietors of the Galway salmon fisheries, and by means of which many thousands of salmon have been hatched. The boxes in this case are six feet long, one foot wide, and seven inches deep. They have board covers with perforated zinc fitting their tops and attached by hinges; each box overlaps above the succeeding, so all are fed by the same stream of water, which falls from the outflow of the one into the inflow of the next. The inflow from the main stream must, of course, be regulated by a hatchway, (where the man is working with the fish kettle and net,) and be guarded by perforated zinc, etc. It may be also, if naturally not very clear, filtered through gravel, charcoal, etc. It is not necessary that the boxes should be placed on the side of a hill, as represented in the drawing, but still they should be placed one above the other in such a manner that there may be a fall from one to the other. Nor is it absolutely necessary that the end of the upper box should rest on that immediately below it. The water may be conducted from one to the other by means of a trough or plate (with the margins turned up) of common zinc. The pond at the end of the boxes will receive a fish, but they should not be allowed to escape there until the umbilical bag is gone. The pond must not be above three or four feet deep, or if it be naturally deep, the margins must be made to slope, as the young fish like shallow water to bask, feed, and play upon. They must be fed for a time when in this pond. The in-door is considered better than the out-door apparatus, principally because it may be better protected. As illustrating out-door apparatus, see cut of out-door hatching boxes. It is not absolutely necessary that there should be a distinct perpendicular fall from one box to the other, yet where this is practicable it will be found the better plan. We cannot better close this important subject than by giving an extract from a practical article by the Hon. George H. Jerome, Superintendent of the Michigan Fish Commission, in relation to fish farming. After stating the claims made by various authorities in relation to the importance of the subject, and also what is claimed for it in theory, our authority says: In scientific practice, it requires a study of waters to know at what point a reformation may begin, and to what just limit it may be carried; a study of the fishes to know their worth, spawning seasons, peculiar habtis and necessities; an investigation of the cause of their decrease or increase, as the case may be; a complete knowledge of one and all of those essentials that antedate birth, development, and



MODE OF DISCHARGING OVA.



IN-DOOR HATCHING-BOXES.



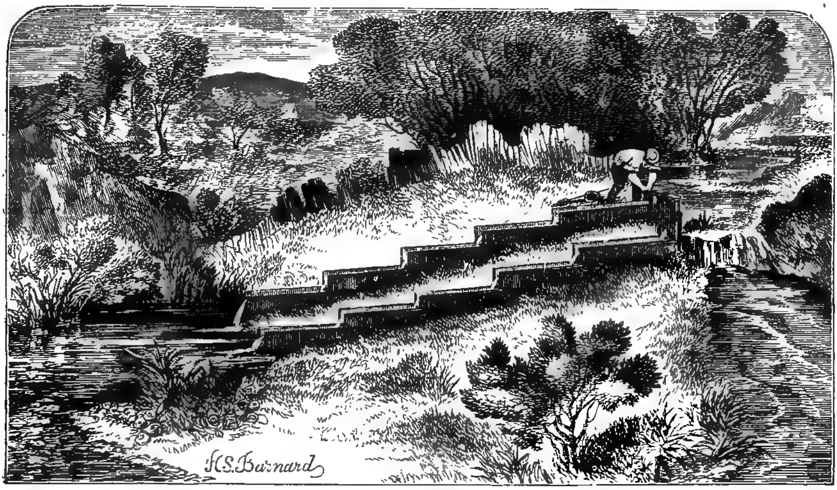
OUT-DOOR HATCHING-HOUSE.

the reproduction of valuable animal life. Then follows the manual work—the preparation of ponds, races, hatching-houses, supply troughs, hatching-boxes, egg trays, partition screens, egg nippers, pans, dippers, brushes, feathers, etc. The master workman, whatever his trade or occupation, will see to it that his chest of tools is full and in order. Next comes the procurement of the breeding-fish, male and female, to be obtained if possible without injury—healthy, vigorous parents always preferred. The fish obtained, the fish culturist, guided by observation and experience, will quite readily detect in the gravid fish those signs which precede and denote the mature spawner. Carefully noticing the premonitory indications, the porcelain or tin pan is brought to the place of operation, containing but very little water, the viscid fluid that accompanies the flow of the ova affording sufficient moisture. Formerly water was used, but is now generally discarded, it being thought to have the effect of drowning the spermatozoa or life principle of the milt. The spawner is then caught, gently seized and held (if small, one person is sufficient; if large, two or more persons are required) in an oblique-perpendicular position, the vent being directly over the pan. If ripe, which means a mature condition of the ova, the egg will often flow into the vessel by the mere force of gravity or muscular contraction, without any hand pressure or manipulation whatever; but if not so yielding up her spawn, a slight pressure with the thumb and fingers along the abdomen will cause the ova to be extruded. This process, once or twice repeated, in a majority of cases will secure the entire yield. The fish is now returned to the water in almost as good a condition as when taken from it, for the whole process has not occupied more than from twenty to forty seconds. The male fish or milter, as he is termed by pisciculturists, is now taken from the tub or trough near at hand, held in a similar position, and the manipulator, by a gentle pressure along the lower portion of the abdomen, will discover, provided the fish is ripe, an extension into the vessel containing the ova, a few drops of a creamy, whitish substance termed milt, spermatozoa, or fertilizing fluid. The fish is returned to the water, no pain or injury having resulted, a very little water is poured into the pan or porcelain vessel, and the contents stirred with a feather or tremulously shaken in a manner to give the ova a rotary motion, and very soon all or nearly all the eggs will have become impregnated, vitalized. The pan is now allowed to stand a few minutes. The eggs meanwhile are undergoing great changes; prior to the introduction of the milt or zo-osperms, they were in a manner agglutinated and in a flaccid condition; now they have become enlarged, are now translucent; each leg, no longer coherent, is an individuality, and by one of those mysterious processes by which Nature works, are become hard to the touch, so that they will roll about like shot on a smooth surface. Here now we have the vivified germ, the embryo fish. In this state they are taken, cleansed in one or two waters, and carefully placed upon a bed of gravel or upon wire cloth trays, and with a feather evenly distributed over the surface, the object of such spreading being to allow the clear, living water to come continually in contact with all the eggs—well-oxygenized water being as essential to a normal, healthy development of the embryo, as it is material to the life and growth of the fish in its subsequent stages. Now, with pure and perpetually running water, filtered if necessary by one or more flannel screens, with clean tools, clean surroundings and with clean hands, we enter upon the work of incubation, a labor lasting five, ten, twenty, forty, eighty, one hundred and twenty days, or even longer, depending upon species and upon quality and temperature of water. Dead eggs, easily distinguished, whenever discovered are to be at once removed, as they produce a byssus that sends out its clammy, fibrous arms, like Hugo's devil-fish, to destroy every living egg within their reach, and all sediment and substances of every sort, foreign to the before-named conditions of their health and growth, are to be sedulously guarded against. The eyes first appear, then a faint embryonic structure and soon after a dim outline of the coming fish may be seen, growing more and more visible each day, until some morning you see the wreck of a habitation floating down the current, and a tiny creation, most unmistakably alive, settled down amid the interstices of the gravelly bed, or meshes of the wire tray, a third, or a half, or perhaps three-fourths of an inch in length. About the most perceivable thing of this new birth, is a bag or sack attached to the belly of the fish. This sack, with the salmo quinnat, is of a rich, pinkish color, resembling one or two drops of blood incased in a semi transparent membranous bag. At birth it is larger than the fish itself, rendering all movements of the new comer exceedingly awkward and clumsy. This is the umbilical vesicle, or yolk sac—Nature's store-house for the supply and sustenance of the fish during its tender infancy. Until this sac is absorbed, the fish will eat nothing, seems to desire nothing but to be let alone, content with the pabulum stored in its little knapsack, from which it daily, hourly draws that nourishment, the provision and pottage of birthright. Day by day the sac becomes smaller, till it can scarcely be perceived with the naked eye; then the fish begins to move about, as if in quest of something to satisfy its hunger. This yolk sac, with the salmon and trout and some other species, lasts from thirty to forty days; with other varieties, not so long. During the existence of the umbilical vesicle the fish are known as alevins; afterward, up to certain periods of growth, minnows or fry. The sac being absorbed, the fry should be fed two or three times a day, or oftener, in limited quantities, will do no hurt. Various kinds of food are given—bonny-clabber, the yolk of an egg, boiled calf's or beef's heart, boiled hard and grated; liver of all kinds, (except hog's liver,) chopped or grated so fine as to become the consistence of thick blood, mixed with a little sweet cream, is used as food, while the fry is very young. Under proper care and feeding, the fish will come on rapidly, so that in a few days or weeks they will do to be removed from their hatching-troughs and planted in the lakes and rivers, there to grow and to bear testimony that fish culture is neither a myth nor a phantasm, but an ocular, tangible and gustible reality.

FISSIPAROUS GENERATION. That kind of generation which exists in polypes, hydras, etc., in which the parent throws out buds, or gemmules, which grow like itself and are finally detached.

FISSIROSTRALS. A tribe of perching birds with a deeply cleft bill (very wide gape), as the swallow.

FISTULA. This is a deep, narrow chronic abscess, reached by a pipe formed to the surface for the discharge of the matter constantly formed. They are formed from ulcerous or other wounds of long standing, as poll evil, quittor, fistula of the salivary glands, or wounds deep seated, which take on an unhealthy or chronic aspect. Poll evil is a fistulous ulcer situated just behind the ears of the horse, caused by a blow, or other bruise of the poll. In the early stage, if there is inflammation, keep the parts cool with cold water applications, or lay a cloth on the swelling and keep it constantly wet, with one quart each of strong vinegar and water mixed, to which is added, two ounces of the tincture of arnica. The inflammation reduced, if the poll remains hard, rub daily with an ointment made by working thoroughly together, one drachm of iodine and one ounce of lard. If the tumor suppurates, when the pus (matter) beneath can be felt by the finger, (a soft fluctuating feeling) open the abscess clear to the bottom, and keep the parts fomented with warm water. In old chronic cases where the pus has burrowed deep, involving the bone, the animal had better be killed at once. If not, but if a pipe has formed open it freely with the knife, wash thoroughly with warm water, and keep clean by injecting a solution formed of thirty grains chloride of zinc, to one quart of water; or a seton may be introduced along the opening to the bottom, and brought out upon the opposite side of the poll. When deep seated ulcers form, from wounds, ragged splinters or other cause, forming pipes to the surface, the proper course to pursue is to open the pipe to the bottom and syringe with the lotion as for poll evil. Fistula of the coronet of the hoof sometimes occurs from pricking in shoeing, calking, suppuration of corns, etc., forming pipes for the discharge of matter. This is sometimes called quittor. The direction of the pipe or pipes may be determined by means of a probe. Complete rest must be given. The shoe must be removed and the hoof examined to find if there may be an outlet at the sole, or for inflamed corns. The pipes should be injected every day, with the remedy advised for poll evil; or with one drachm of carbolic acid (pure) to one ounce of water. If this do not cause the fistula to heal, insert a guarded bistoury and cut the sides freely, and then use the wash of carbolic acid. As a last resort, place five grains of corrosive sublimate in tissue paper, and insert it as a plug in the pipe, holding it by means of a bandage, and the parts being eaten clean, proceed with the wash as before directed.



HATCHING BOXES.

FITS. (See Epilepsy.)

FIXED AIR. Carbonic acid. So called from its fixed condition in chalk, marble, etc.

FIXED OILS. Oils not volatile.

FLAGELLIFORM. A runner, or trailing stem.

FLAIL. A wooden implement for threshing grain, consisting of a handle, fastened by leather thongs to a movable stick or swiple. It is now seldom used except for beans, and other seeds which shell easily and which are rapidly beaten out.

FLAKE WHITE. Pure white lead.

FLAME. The burning gases or vapors given off from fuel.

FLAT-HEADED BORERS. (See Apple-tree Borer.)

FLAT-STALKED MEADOW GRASS. (See Blue Grass.)

FLATULENT COLIC. (See Colic.)

FLAX. Since the introduction of the cotton gin, cotton goods have largely supplanted the use of linen. Up to the period of the last war with Great Britain, flax, for manufacturing into goods for wear, was generally raised by farmers and spun by their families. The census of 1810 returned, 21,211,262 yards of flaxen cloths made in families, and a production of 23,925,746 yards of blended and unnamed stuffs, and 802,718 yards of tow cloth. Now, nearly all the linen goods manufactured in the country is from imported flax, it having been found that the cost of raising a crop for fine fiber, and its preparation, could not be undertaken on account of the scarcity and high price of labor, in this country, as compared with that of European countries, where cheap manual labor and that of cheaper women's labor came into competition. Nevertheless the cultivation of flax for its seed, and, as of secondary importance, the manufacture of the lint for coarse bagging, has become a great industry especially in the settlement of the Western lands, the seed being an article which in consequence of its high price would bear transportation long distances. As showing something of this, we find that the five States between the Ohio and the Mississippi reported in 1850, 238,265 bushels; in 1860, 375,107; 1870, 1,431,415. At these successive decennial periods Ohio reported 88,880 bushels, 242,420, and 631,-894; Indiana, 36,888, 119,420, and 401,931; Illinois, 10.787, 8,670, and 280,043. The States beyond the Mississippi reported in 1850, 15,976 bushels; 1860, 11,253; 1870, 143,930. The increase in the product of 1869 over that of 1859 was chiefly in Minnesota, Iowa, California, and Oregon. The State of Ohio furnishes definite local statistics, which illustrate the general upward tendency in the northern States east of the Mississippi, beginning with the stimulating effects of the war and continuing until those effects ceased to operate, followed by a gradual decline. From 1862 to 1875, inclusive, the annual acreage and production of seed and lint in Ohio were as follows:

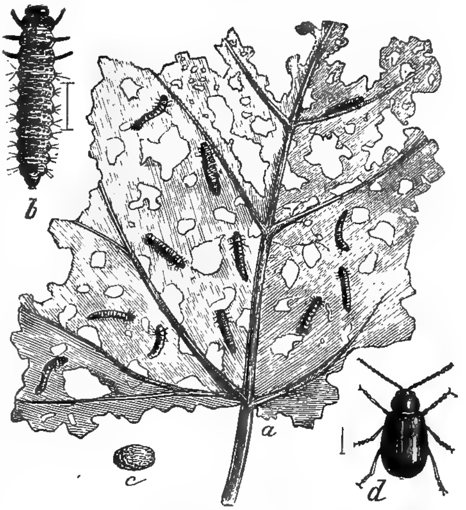
Year.	Acres.	Bushels.	Pounds.
1862	53,488	383,900	2,389,877
1863	95,170	624,224	3,582,170
1864	61,661	411,102	1,890,032
1865	47,875	245,659	3,150,488
1866	57,184	467,735	6,597,567
1867	98,822	726,517	10,523,876
1868	97,820	620,092	12,032,392
1869	88,989	610,758	18,722,776
1870	61,204	449,378	16,464,128
1871	85,863	733,384	24,447,361
1872	72,078	457,379	12,050,638
1873	43,650	238,510	5,070,788
1874	40,710	258,800	6,623,341
1875	33,862	223,653	5,285,417

In the younger States west of the Mississippi the upward tendency in production as yet shows no sign of declining, but seems to grow with accumulating force. Minnesota reported, for 1870, 18,635 bushels of seed, and 120,571 pounds of lint; 1872, 71,752 bushels, and 2,903,079 pounds; 1873, 100,853 bushels; for 1876 the official estimate was 125,932 bushels. Iowa, which reported for the census of 1870, 28,621 bushels, reported for the State census of 1875, 559,836 bushels. The report of the Kansas State board for 1879 gives over 37,000 acres in flax, yielding 424,770 bushels of seed, valued at $424,770,58. This gives an average yield of 11 48 bushels per acre, and an average value of $1.00 per bushel. In relation to the fiber, the report says, the amount returned for the census of 1850 was 7,709,676 pounds; 1860, 4,720,145; 1870, 27,133,034. In 1850 Kentucky held the first rank, reporting 2,100,116 pounds; Virginia the second, 1,000,450; New York the third, 940,577; and North Carolina excelled Ohio by 146,864 pounds, In 1860, New York had gained sixty-one per cent., and held the first rank; Ohio ninety-seven per cent., and was second; Kentucky had lost sixty-five per cent., and was third; Virginia fifty-one per cent., and was fourth. In 1870 Ohio had advanced 1,926.3 per cent., and ranked first; New York 141 per cent., and was second; while Kentucky had lost sixty-seven per cent., and was eighth; and Virginia, including West Virginia, fifty-six per cent., and was tenth. In New York, as in the Northwest, production which has been declining in recent years appears to have increased until after the close of the war; the product returned in 1869 (the census year) was 92,519 bushels of seed, and 3,670,818 pounds of fiber; in 1874, 130,318 bushels, and 3,927,914 pounds were returned. The cultivation of flax for seed and flax tow, requires that the soil be put in a fine state of tilth, that the seed be sown, one and a half bushels per acre, on freshly plowed ground, and lightly and evenly covered. When ripe, the crop is cut with a self-raking reaper, the gavels set up without binding, and leaning together so they will stand secure. When quite dry the seed is threshed by machines, and generally sold at once to agents of oil mills, or buyers in the villages. Formerly flax was thought to be an exhausting crop. From the prevalence of noxious seeds in the flax the land soon becomes foul. From these two objections has arisen the idea that flax is exhausting; yet, flax, except it be pulled and the seed and fiber carried away, is not particularly exhausting. As to the objection of foul seed, it is now obviated by means of modern fanning-mills, which clean the seed thoroughly. On the rich soils of the West farmers have taken advantage of these facts, and hence the large increase in production. If machinery could be invented for preparing the stems cheaply, the lint would be an added stimulus to its further production. So few persons understand the cultivation of flax for lint, (for where lint is the chief product, the seed is a secondary consideration,) we append the following, originally recommended by the Royal Society for the Promotion and Improvement of the Growth of Flax in Ireland, and revised by the special committee of the Northeast Agricultural Association of Ireland for Promoting the Growth of Irish Flax. They contain sufficient information for the cultivation of the plant, and to economize and reduce it to a proper state for breaking and scutching: By attention and careful cultivation good flax may be grown on various soils, but some are much better adapted for it than others. The best is a sound, dry, deep loam. It is almost essential that the land should be properly drained and subsoiled, as, when it is long saturated either with underground or surface water, a good crop need not be expected. The subsoiling should be executed upon a previous crop, so as to be completed at least two years before the flax is grown. The best rotation for lint is to grow after wheat on average soils; but in poor soils, where wheat does not succeed, it is often better to grow after potatoes. Flax should on no account be grown oftener than once in five years on the same ground, and once in seven is considered safer. Any departure from this system of rotation is likely to cause disappointment and loss. One of the points of the greatest importance in the culture of flax is by thorough draining and, by careful and repeated cleansing of the land from weeds, to place it in the finest, deepest, and cleanest state. This will make room for the roots to penetrate, which they will often do to a depth equal to one-half the length of the stem above ground. After wheat, one plowing may be sufficient if on light, friable loam, but two plowings would be better; on stiff soils three are advisable—one immediately after harvest, across the ridges, and two in spring, so as to be ready for sowing in the first or second week in April. Much will, of course, depend on the nature of the soil and the knowledge and experience of the farmer. The land should be so well drained and subsoiled that it can be sown in flats, which will give more even and much better crops. But until the system of thorough draining be general, it is advisable to plow early in autumn, to a depth of six or eight inches. Throw the land into ridges, that it may receive the frost and air, and make surface drains to carry off the rains of winter. Plow it again in spring three or four inches deep, so as to preserve the winter surface for the roots of the flax. The spring plowing should be given some time before sowing, to allow any seeds of weeds in the land to vegetate, and the harrowing in of the flax seed will likely kill them, and save a great deal of after-weeding. Following the last harrowing, it is necessary to roll, to give an even surface and consolidate the ground, breaking up this again with a short-tooth or seed harrow before sowing, which should be up and down, not across the ridges or angle-wise. These operations can be varied by any skillful farmer to suit peculiar soil or extraordinary seasons. The object is to have clean, fine soil, as like as possible to what a garden soil should be. In buying seed select it plump, shining and heavy. Sift it clear of all the seeds of weeds, which will save a great deal of after trouble when the crop is growing. This may be done through a wire sieve, twelve bars to an inch. Home-saved seed has produced excellent crops, yet it will be best, in most cases, to use the seed which is saved at home for feeding, or to sell it for the oil mills. The proportion of seed may be stated at nearly two bushels and a peck to a statute acre. It is better to sow rather too thick than too thin, as with thick sowing the stems grow tall and straight, with only one or two seed capsules at the top; and the fiber is found greatly superior in fineness and length to that produced from thin sown flax, which grows course and branches out, producing much seed, but a very inferior quality of fiber. The ground being pulverized and well cleaned, roll and sow. If it had been laid off without ridges, it should be marked out in divisions eight or ten feet broad in order to give an equable supply of seed. After sowing, which should be done by a skillful person, as the seed is very slippery and apt to glide unevenly from the hand (a broad cast seed sower is best), cover with a seed harrow, going twice over it—once up and down, and once across or angle-wise, as this makes it more equably spread, and avoids the small drills made by the teeth of the harrow. Finish with the roller, which will leave the seed covered about an inch—the proper depth. The ridges should be very little raised in the centre, when the ground is ready for the seed; otherwise, the crop will not ripen evenly; and when land is properly drained there should be no ridges. Rolling the ground after sowing is advisable, care being taken not to roll when it is so wet that the earth adheres to the roller. If care has been paid to cleaning the seed and the soil, few weeds will appear; but if there be any they must be carefully pulled. It is done in Belgium by women and children, who, with course cloths around their knees, creep along on all-fours. This injures the young plant less than walking over it, which, if done, should be by persons whose shoes are not filled with nails. They should work also facing the wind, so that the plants laid flat by the pressure may be blown up again, or thus be assisted to gain their upright position. The tender plant pressed only one way, soon recovers, but if twisted or flattened by careless weeders, it seldom rises again. The weeding should be done before the flax exceeds six inches in height. The time when flax should be pulled is a point of much nicety to determine. The fiber is in the best state before the seed is quite ripe. If pulled too soon, although the fiber is fine, the great waste in scutching and hackling renders it unprofitable; and if pulled too late the additional weight does not compensate for the coarseness of the fiber. It may be stated that the best time for pulling is when the seed is beginning to change from a green to a pale brown color, and the stalk becomes yellow for about two-thirds of its height from the ground. When any of the crop is lying and suffering from wet, it should be pulled as soon as possible and kept by itself. So long as the ground is undrained and imperfectly levelled before sowing the flax will be found of different lengths. In such cases pull each length separately, and, if possible, keep it separate in the steep-pool. When there is much second growth, the flax should be caught by the puller just underneath the bolls, which will leave the short stalks behind. If the latter be few it is best not to pull them at all, as the loss from mixture and discoloration by weeds would counterbalance the profit. If the ground has been thoroughly drained and laid out evenly, the flax will likely be all of the same length. It is most essential to take time and care to keep the flax even, like a brush at the root ends. This increases the value to the spinner, and, of course, to the grower, who will be amply repaid by an additional price for his extra trouble. Let the handfuls of pulled flax be laid across each other diagonally, to be ready for separating the seed. Rippling should be done at the same time, and in the same field with the pulling. If the only advantage to be derived from rippling were the comparative ease with which rippled flax is handled, the practice ought to be adopted; but, besides this, the seed is a very valuable part of the crop, either for the oil mill or for feeding purposes at home. The apparatus for rippling is very simple, consisting of a row of iron teeth screwed into a block of wood. The best ripples are made of half-inch square rods of iron, placed with the angles towards the operator, three-sixteenths of an inch asunder at the bottom, half an inch at the top, and eighteen inches long, so as to allow a sufficient spring, and to save much breaking of flax. The points should begin to taper three inches from the top. The ripple is to be taken to the field where the flax is being pulled, and screwed down to the centre of a nine-foot plank resting on two stools. The ripplers may either stand or sit astride the opposite ends, and should be at such a distance from the comb as to allow them to strike it properly and alternately. A winnowing sheet must be placed under them to receive the bolls as they are rippled off, and then the ripplers are ready to receive the flax just pulled, the handfuls being placed diagonally and bound up in a sheaf, which is laid down at the right hand of the rippler and untied. He takes a handful with one hand, about six inches from the root ends, and a little nearer the tops with the other. He spreads the top of the handful like a fan, draws the one-half of it through the comb and the other half past the side, and, by a half turn of the wrist, the same operation is repeated with the rest of the bunch. Some, however, prefer rippling without turning the hand, giving the flax one or two pulls through, according to the quantity of bolls. The flax can often be rippled without being passed more than once through the comb. He then lays the handfuls down at his left side, each handful crossing the other, when the sheaf should be carefully tied up and removed. The object of crossing the handfuls so carefully after rippling, when tying up the beats for the steep, is that they will part freely from each other when they are taken to spread out on the grass, and not interlock and be put out of their even order, as would otherwise be the case. If the weather be fine, the bolls should be kept in the field, spread on winnow-cloths, or other contrivance for drying, and if turned over from time to time they will soon dry. Passing the bolls first through a coarse riddle, and afterwards through fanners, to remove straws and leaves, will facilitate the drying. If the weather be moist, they should be taken in-doors, and spread out thinly and evenly on a barn floor or on a loft, leaving windows and doors open to allow a thorough current of air, and turned twice a day until no moisture remains. By this mode of slow drying the seed has time to imbibe all juices that remain in the husk, and to become perfectly ripe. In fine seasons the bolls should always be dried in the open air, the seed threshed out, and the heaviest and plumpest used for crushing or sowing. The light seed and chaff form most wholesome food for stock. Flax ought not to be allowed to stand in the field, if possible, even the second day, but should be rippled as soon as practicable after it is pulled, and carried to the water to be steeped, that it may not harden. Watering requires the greatest care and attention. River water is the best. If spring water must be used, let the pond be filled some weeks before the flax is put in, that the sun and air may soften the water. That containing iron or other mineral substances should never be used. If river water can be had, it need not be let into the pond sooner than the day before the flax is to be steeped. The best size of a steep-pool is twelve feet broad, eighteen feet long, and from three and one-quarter to four feet deep. Place the flax loosely in the pool, in one layer, somewhat sloped, and in regular rows, with the root ends underneath, the tie of each row of sheaves to reach the root of the previous one. Cover with moss sods, or old, tough sward, cut thin, and laid perfectly close, the sheer of each fitted to the other. Before putting on the sods, a layer of rushes or weeds is recommended to be placed on the flax, especially in new ponds. As sods are not always at hand, a light covering of straw may do, with stones laid on it, so as to keep the flax just under the water, and as the fermentation proceeds, additional weight should be laid on, to be removed as soon as the fermentation ceases, so as not to sink the flax too much in the pool. Thus covered, it never sinks to the bottom, nor is affected by air or light. A small stream of water, allowed to run through a pool, has been found to improve the color of flax. The average time for steeping sufficiently is from eight to fourteen days, according to the heat of the weather and the nature of the water. Every grower should learn to know when the flax has had enough of the water, as a few hours too much may injure it. It is, however, much more frequently under watered than over watered. The best test is the following: Try some stalks, of average thickness, by breaking the shove, or woody part, in two places, about six or eight inches apart, at the middle of the stalk; catch the broken bit of wood, and if it will pull freely out, downwards, for that length, without breaking or tearing the fiber, and with none of the fiber adhering to it, the flax is ready to take out. Make this trial every six hours after fermentation subsides, for sometimes the change is sudden. Never lift the flax roughly from the pool with forks or gripes, but have it carefully handed out by men standing in the water. It is advantageous to let the flax drain from twelve to twenty-four hours after being taken from the pool, by placing the bundles on their root ends, close together, or on the flat, with the slope. But the heaps should not be too large, otherwise the flax will be injured by heating. Select, when practicable, clean, short, thick pasture ground for spreading, mowing down or removing any weeds, if necessary, that rise above the sward. Lay the flax evenly on the grass, and spread very equally and thin. If the directions given under the head of rippling have been attended to, the handfuls will readily come asunder without entangling. Some persons recommend turning the flax on the grass with a long rod. Six or eight days, if the weather is showery, or ten or twelve days, if it be dry, should be sufficient for the flax to remain on the grass. Ten days may be taken as a fair average in ordinary weather. A good test of its being ready to lift is to rub a few stalks from the top to the bottom; and when the wood breaks easily, and separates from the fiber, leaving it sound, it has had enough of the grass. Also, when a large proportion of the stalks is perceived to form a bow and string, from the fiber contracting and separating from the woody stalk. But the most certain way is, to prove a small quantity with a handbreak or in a mill In lifting the flax, keep the lengths straight and the ends even; otherwise great loss will occur in the process of scutching. If heavy dews or damp weather prevail, do not lift too late in the day. Let the flax be set up to dry for a few hours, and afterward tie it up in small bundles; and if not taken soon to be scutched, it will be much improved by being put up in small stacks, loosely built, with stones or slabs in the bottom to keep it dry and allow a free circulation of air. Drying, if by fire, is always most pernicious. If properly steeped and grassed, no such drying is necessary; and to make it ready for breaking and scutching exposure to the sun is sufficient. The imports of flax and hemp, raw and manufactured, into the United States during the year 1879, amount to $5,781,710, and of this amount $2,798,465 was paid for the raw material in the ratio of one to two, flax being the lesser import. For the foreign flax supply we depend mainly upon six or seven countries, and in the last ten years but fifteen countries are represented in all, only eight furnish a steady supply. Since 1877, inclusive, Russia has furnished the largest amount and England next, the last named country leading in the seven years previous. A considerable amount comes from Canada, either in the form of tow or line. The tow being subject to a duty of $10 a ton when intended for bagging manufacture, though it comes in free for paper-stock. The Boston market is largely supplied from Archangel, either direct or via England, though a large quantity of this fiber also comes to the port of New York. Holland flax is used to some extent, though it is not in such demand as formerly. At one time it was considered the most perfectly prepared flax in the market, being even at the ends, well cleaned and strong. Rotterdam and Zealand flax is imported in small quantities, and Belgium sends us small amounts, varying in the ten years from five to seventy-five tons. But ten tons were reported for the year 1879. It is difficult to get at the true figures as regards any one market, on account of this increased amount of indirect importation in small quantities. The quantity of flax—hackled and line—and also of tow received in Boston during the year 1879, was 3,730,000 pounds. By far the largest portion, or 3,583,400 pounds, was received from Russia, and of this quantity 1,405,300 pounds was imported in the form of tow. The small balance was received chiefly from Ireland and the Netherlands, there being 59,500 pounds from the former country and 87,100 pounds from the latter. In 1879 the flax importation into New York was 1,420 English tons, or 3,180,800 pounds; 970 tons of this was flax, costing from $300 to $550 per ton, leaving 450 tons of tow valued at $225 per ton, a total valuation of flax and tow to the amount of $600,000. Referring to the customs figures, we find that for the year ending June 30, 1879, there were 2,935 tons of raw flax fiber, including tow, imported from seven countries, at a cost of $969,451, a falling off from the previous year of $207,778, and a smaller amount than in any year since 1870, when the raw flax imports were 100 tons less than in the year previously mentioned.

FLAX, TOAD. *Linaria vulgaris.* It is called yellow toad flax.

FLEABANE. A name given to many weeds, as the inulas, etc.

FLEA BEETLE. Under the name Flea Beetle, there are several species of the *Haltica* family. The Cucumber Flea Beetle (*H. cucumeris*) is said to be often largely injurious to potato vines. Dr. Fitch thinks this, *H. Cucumeris*, and *H. Pubescens* is the same. This species certainly attack the potato. The Striped Flea Beetle (*H. orchestris vittata*) is one of the most troublesome species, often entirely destroying young cabbage, turnip, radish and other cruciferous plants. Some flowering plants, as stocks, are also attacked. Powdered lime or soot, applied when the dew lies, are among the popular remedies for all this class of insects; not always successful, however. London Purple or Paris Green, properly diluted, is efficient, but should not be applied to cabbage, radish, etc. It may be very much more diluted than when used for the Colorado Potato Beetle. Cruciferous plants may be treated with powdered white hellebore.



GRAPE-VINE FLEA BEETLE.

The dreaded Grape-vine Flea Beetle, *Haltica* (*graptodera*) *chalybea*, (see cut) is another member of this family of insects, *a*, grape leaf and larva feeding; *b*, larva magnified; *c*, earth-cell in which the insect transforms; *d*, beetle; the hair lines show natural size. This is sometimes called the Steel Blue Beetle, and in the vineyards about St. Louis and South is often most destructive. Hellebore powder is also destructive to this insect. There are many so-called Flea Beetles from their power of leaping, as the cabbage, and turnip, and the cucumber Flea Beetle, and all jumping beetles, are similar to the ordinary eye; some of them are exceedingly minute, and sometimes so abundant that the foliage of young plants will be black with them, but this is uncommon. On very young plants of the cabbage or cucumber families, there is no objection to the use of dilute Paris Green or London Purple.

FLEAM. The knife or lancet used in bleeding cattle and horses.

FLEAS. A species of the genus *Pulex*. They are wingless, but undergo regular transformations. Cleanliness, especially in the removal of old straw, litter, and similar trash, in which they harbor, washing the skins of animals, anointing with a mixture of oil and pennyroyal, or elder leaves, are effectual means to reduce their numbers.

FLECKED. Pied, or of mixed colors.

FLEECE. (See Wool.)

FLESH. Generally understood as the mixed muscle and fat of animals, but more strictly the muscle or lean only. Lean meat consists of twenty per cent. fibrin, with three per cent. of albumen, coloring matter, and salts; the rest, seventy-seven per cent., being water; it differs very little from blood.

FLEXIBILITY. The capacity of bending without breakage. It is a relative property, depending upon temperature, thickness, etc.

FLEXORS. The name of those muscles which cause the flexion or bending of the arm or leg.

FLEXUOSE. Full of bendings to the one side and the other.

FLIES. Insects furnished with two wings (*Diptera*), and living by suction. Several distinct families exist, viz., *Tachinadæ*, deposit their eggs in caterpillars; the *Sarcophagæ*, are viviparous, produce living maggots, and live on putrid meats. The *Stromoxys* genus, including the sharp stinging horseflies, which lay their eggs in dung; the *Muscadæ*, or house and meat flies, which infest butchers' stalls and houses. (See Fly.)

FLINT. A variety of *silica*, containing water and stained with iron, found interstratified with chalk.

FLINT GLASS. A glass composed of fine sand and red-lead, having a high refractive power, and used by opticians.

FLITCH OF BACON. The side, or shoulder, and middle piece together.

FLOAT. A raft of timber to be floated. To cover meadows with water.

FLOAT BOARDS. The boards attached to the circumference of an under shot wheel.

FLOCCUS. The loose hair at the end of the tail of some animals.

FLOODGATE. Any contrivance or gate to regulate the flow of water; a sluice.

FLORETS. The flowers of a capitulum, like the sunflower.

FLORICULTURE. The increasing taste for the cultivation of flowers not only in our city and village gardens but at our rural homesteads, is evidence not only of progress in refinement and material wealth, but also of correct appreciation of the beautiful in nature, and the goodly influences they bring in education to a higher human nature. With the explosion of the dogmas of the old gardeners that each species of plant must have its special soil, and in some cases mixed with the minutest care from many different sources, and that each plant should have a particular degree of heat and moisture, has come the abandonment, in a measure, of the practice, from the fact that the plants usually cultivated at our homes do well in ordinary soil, if well enriched—heavy soils, with a compost of rotted sods and decayed horse manure; and light soils, with rotted sods and decayed cow manure. Thus we may bring both these soils, the first to a light, friable condition, and the last to a state sufficiently compact to stand ordinary drying. For pot plants, for instance, rotted sods from a loamy pasture, one-half, rotted cow manure, one-quarter, and leaf mold, one-quarter, will answer for the majority of plants cultivated, and with proper watering they may be kept in vigorous health. With both pot plants and the garden flowers usually cultivated it should be remembered that fuchsias, begonias, and even geraniums, gladiolus, etc., do not like hot sun, and also that no flowers should be exposed to sweeping winds Another dogma, now exploded, that house-plants are injurious to health, should have been known long ago. The perfume of certain flowers is unpleasant to the senses of nervous individuals. Let them be avoided, but do not fear that the emanation of the plants ordinarily kept in rooms are detrimental to health. This misstatement has been accepted, and harped upon, by those who grudged the time and care necessary to this god-like means of enjoyment. There are no more healthy nor long lived persons than florists, who spend their days, and sometimes nights, in the atmosphere of green houses crowded with plants. It is the lack of fresh air that is fatal to health, and plants can not thrive without plenty of air. There is another class of persons, and here, among the class who cultivate flowers, who make the mistake of grudging the cutting of flowers for table and other indoor adornment. The true human mission of flowers is to be cut, and really nearly all that class, useful for indoor decoration, bloom better for moderate cutting at least. Do not, therefore, raise flowers merely to look at out of doors. If the housewife and children are the cultivators, leave them alone to follow their natural instincts and tastes in cutting flowers for use. If the master of the house be the cultivator, give the family full liberty in the matter of cutting, only designating certain specimens that must be reserved for the judgment and discretion of the master. The family will soon learn to discriminate between those that may be freely cut and those not so free in their bloom, but

PICOTEE PINK.

nevertheless worthy a place at the home, or in the green-house, for some rare peculiarity or grace. One other mistake, often made in the cultivation of annuals, is in sowing them too early. The hardy kinds should not be sown until just before corn (maize) planting time, or about the time of sowing flax. The tender varieties are better reserved until corn is above ground and growing. The most economical way with all varieties of plants, that will bear transplanting, is to sow them in a cold frame of nicely-prepared soil, and transplant at the proper season. Thus China and other garden pinks may be brought into bloom by July 1st; and balsams, candytuft, mignonette, nasturtiums, phlox, sweet alyssum, zinnias and, in fact, all annuals may be forwarded fully three weeks before bloom may be had where they are sown outside. The labor of sowing and transplanting is, in reality, far less than that of watching and waiting for, and weeding the tiny things when young, to say nothing of the vexation often arising from loss. Of the varieties mentioned above, nasturtium and mignonette should be sown in small pots, allowing three plants to each pot, and turned out with the balls entire, since they do not bear transplanting well. In transplanting plants are often killed by too much fussing with. Make a place sufficient to receive the roots, set the plant, press the earth firm about the roots, leaving a little depression; fill this with water, and when it has settled completely away, draw dry earth over all, and few plants will ever wilt to harm them. A little practice will soon enable any one to perform this work quickly and well. Much taste may be displayed in the formation of the beds, and by the exercise of tact in planting, by the selection of suitable varieties. The tasteful arrangement of cut flowers in bouquets, baskets, vases, and designs for decorative purposes, is an art worthy of study. The arrangement of color, mapping of designs, the grouping, and the added spray of leaves and tendrils, and the blending of perfumes, is a most fascinating study to all who have flowers. In the formation of floral designs, especially bouquets, as a rule, beginners crowd the flowers too much together, and do not use green enough. The filling up, as the adding of spray is called, and the arrangement of the ground work of green, and the preservation of individuality of color and character, may be called the fine art of decorative arrangement. For instance, we may easily see that heliotrope and alyssum, when combined, lose their individuality. Combined with other distinct flowers their charm is heightened. Flowers borne in long spikes, as lillies, gladiolus, etc., are best for vases, but individual blooms may be taken, wired to splints, and introduced with effect in flower pieces of considerable size. For articles on special flowers, see the several names as treated. See also landscape gardening for form of beds and planting.

BALSAMS.

FLOSS SILK. The silk broken off from cocoons in the filature, which is carded and worked like cotton, for coarse fabrics.

FLOUR. Any grain ground fine, and from which all the bran, shorts and middlings are removed, in contradistinction to meal, in which only the hull or outside skin is removed. Flour, of wheat, is now divided into many grades, fine, superfine, family flour, and extra, being the principal grades. Formerly, the word flour was only applied to the flour of wheat, that of rye and buckwheat being denominated meal, but now the word flour is used for all the better grades of ground bread grains, except Indian corn.

FLOWERLESS PLANTS. The cryptogamous plants of Linnæus; the acotyledons of Jussieu

FLOWERS. The most beautiful parts of plants and trees, which contain the organs of fructification. (See Botany.) From their frequent utility as medicinal drugs, as well as their external beauty, the cultivation of flowers in our gardens becomes an object of some importance. Flowers are many of them excellent indicators of the weather by expansion or closing, and other motions. It is an established fact, that flowers as well as fruits grow larger in the shade, and ripen and decay soonest when exposed to the sun. Flowers which are to be used or preserved for medicinal purposes should with a few exceptions, be gathered in full bloom, and dried as speedily as possible. The rose is gathered before it is fully blown. In drying flowers, the calyces, claws, etc., should be previously taken off; when the flowers are very small, the calyx is left, or even the whole flowering spike, as in the greatest portion of the labiate flowers. In some instances as in the *baulistines*, or pomegranate flower, the active matter resides chiefly in the calyx. Compound flowers with pappous seeds, as colt's foot, ought to be dried by a high heat, and before they are entirely open, otherwise the slight moisture that remains would develop the pappus, and form a kind of cottony nap, which would be very hurtful in infusions, by leaving irritating particles in the throat. Flowers of little or no smell may be dried in a heat of 75° to 100° Fahr. The succulent petals of the liliaceous plants, whose odor is very fugacious, can not well be dried, as their mucilaginous substance rots and grows black. Several sorts of flowering tops, as those of lesser centaury, worm-wood, melilot, water germander, etc., are tied in small parcels and hung up, or else exposed to the sun, wrapped in paper covers, that they may not be discolored. After some time, blue flowers, as those of violets, bugloss, or borage, grow yellow, and even become entirely discolored, especially if they are kept in glass vessels that admit the light; if however, they are dipped for a moment in boiling water, and slightly pressed before they are put into the drying stove, the blue color is rendered permanent. The origin of double flowers is believed to result from the luxuriant growth of the plant in consequence of excessive nourishment, moisture, and warmth; they arise from the increase of some parts of the flower, and the consequent exclusion of others; thus the stamens are often converted into petals. Botanists very properly term such multiplied flowers vegetable monsters, because they possess no stamens or pistils, and therefore can not produce seeds. There subsists (says Dr. Darwin) a curious analogy between these vegetable monsters and those of the animal world; for a duplicature of limbs frequently attend the latter, as chickens and turkeys with four legs and four wings, and calves with two heads, etc. Scientific floriculture, or the culture, propagation, and general management of plants, divides itself into five sections: 1, stove plants; 2, greenhouse plants; 3, hardy trees and shrubs; 4, hardy herbaceous plants; 5, annuals and biennials. Practically it is divided into three divisions: out-door floriculture; in-door floriculture, and commercial floriculture, the last, the raising of plants for the sale of the cut flowers. (See Floriculture.)

FLUE. Any channel or way along which the smoke or heat of a fire passes; used to designate any air passage, but generally that by which smoke and flame passes up the chimney.

FLUID. A body of particles which move freely among one another, and which transmit pressures equally in all directions. Fluids are divided into elastic and non-elastic, or gaseous and liquid; the former containing air and vapors, the latter water, etc.

FLUKE. *Distoma hepaticum.* A flat, entozoal worm, infesting the livers of sheep and some other animals; it is often seen in those which have died of the rot. (See Rot.)

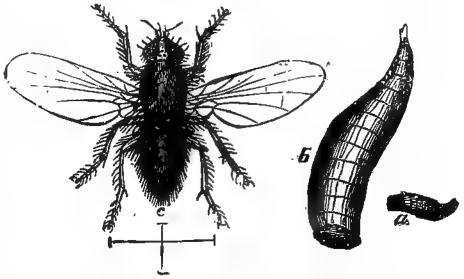
FLUOR SPAR. A beautiful crystalline mineral, fluoride of calcium. The mineral is of many colors, and cubical or octahedral in form. It is used as a flux, and to procure hydro-fluoric acid.

FLUTINGS. The grooves of columns.

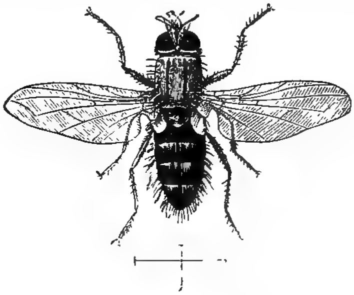
FLUVIALES. A tribe of water plants, of endogenous structure, nearly resembling seaweeds.

FLUX. In chemistry, substances which are in themselves very fusible, or which promote the fusion of other bodies. In diseases, any unusually increased discharge, as diarrhœa.

FLY. These in agriculture are small winged insects that are injurious to grain and other plants, but in fact any insects having smooth and transparent wings are often so denominated. The true flies, however, have only two wings. All such are included under the entomological distinction, *Diptera*, signifying two-winged. In this category come house flies, biting flies, biting gnats, the Hessian fly, wheat fly, radish fly, two-winged gall flies, fruit flies, and other dipterous insects. The perfect insect of the onion maggot is a fly, that is, a two-winged insect. The cut shows at *a*, maggot or larva, natural size; *b*, pupa, magnified; *c*, fly magnified, the cross lines showing natural size. Gall flies, fruit flies, the Hessian fly, the wheat fly, and tachina flies, (this last beneficial as parasitic on other insects) all have two wings. To illustrate we give cut of Tachina parasite, (*Lydella doryphoræ*) of the Colorado Potato Beetle, the hair lines showing the natural size of the fly. Of this insect Dr. Riley says they destroy fully ten per cent. of the second broods of beetles, and fully fifty per cent. of the third broods; and adds that it bears a close resemblance to the common house fly, but is readily distinguished by its extremely brilliant silver white face, and that no Ichneumon parasite has been found preying on it. Therefore, if the farmer sees these brilliant fellows, let them alone.



ONION MAGGOT AND FLY.



TACHINA PARASITE.

FOAL. The young of the horse and ass kind. The male is a colt, and the female a filly.

FOCAL DISTANCE. In optics, the distance between the center of a lens, or mirror, and the point into which the rays are collected.

FOCUS. A point where heat, light, sound, etc., are collected, either by the action of glass or reflecting surfaces. In geometry, certain points in the curves, called conic sections, which are also foci for radiant emanations.

FODDER. All substances used as food for animals. In the South it is sometimes confined to the leaves stripped from corn. Coarse fodders are those which, like straw, etc., occupy much bulk. The comparative value of fodders is an important question in the feeding of animals, and which can hardly have been said to assume a trustworthy estimate until the time when careful experiments had been made by Thaer, Reaumer, Block, and Boussingault. In the annexed table, by the latter, are shown the results obtained by chemical examination and in connection with practical feeding.

TABLE OF THE NUTRITIVE EQUIVALENTS OF DIFFERENT KINDS OF FODDERS.

Kinds of Food.	Standard water per cent.	Nitrogen per cent. dry.	Nitrogen per cent. in the article not dried.	Standard.
Ordinary natural meadow hay	11.0	1.34	1.15	100
Do. of fine quality	14.0	1.50	1.30	98
Do. select	18.8	2.40	2.00	58
Do. freed from woody stems	14.0	2.44	2.10	55
Lucerne hay	16.6	1.66	1.38	83
Red clover hay, 2nd year's growth	10.1	1.70	1.54	75
Red clover cut in flower, green, d	76.0	......	0.64	311
New wheat straw	26.0	0.36	0.27	426
Old wheat straw	8.5	0.53	0.49	235
Do. do. lower parts of the stalk	5.3	0.43	0.41	280
Do. do. upper parts of do. and ear	9.4	1.42	1.33	86
New rye straw	18.7	0.30	0.24	479
Old do	12.6	0.50	0.42	250
Oat straw	21.0	0.36	0.30	383
Barley do	11.0	0.30	0.25	460
Pea do	8.5	1.95	1.79	64
Millett do	19.0	0.96	0.78	147
Buckwheat do	11.6	0.54	0.48	240
Drum cabbage	92.3	3.70	0.28	411
Swedish turnip	91.0	1.83	0.17	676
Turnip	92.5	1.70	0.13	885
Field beet	87.8	1.70	0.21	548
Do. white Silesian	85.6	1.43	0.18	669
Carrots	87.6	2.40	0.30	382
Jerusalem artichokes	79.2	1 60	0.30	348
Do	75.5	2.20	0.42	274
Potatoes	65.9	1.50	0 36	319
Field beans	7.9	5.50	5.11	......
White peas	8.6	4.20	3.84	......
New Indian corn	18.0	2.00	1.64	......
Buckwheat	12.5	2.40	2.10	......
Barley	13.2	2.02	1.76	......
Barley-meal	13.0	2.46	2 14	......
Wheat	10.5	2.33	2.09	......
Do. from highly manured soil	16.6	3.18	2.65	......
Recent Bran	37.1	2.18	1.36	......
Wheat husk or chaff	7.6	0.94	0.85	......
Linseed cake	13.4	6.00	5.20	......
Colza do	10.5	5.50	4.92	......
Madia do	6.5	5.93	5.51	......
Hemp do	5.0	4.78	4.21	......
Poppy do	6.8	5.70*	5.36	......
Nut do	6.0	5.59	5.24	......
Beech mast do	6.2	3.53	3.31	......
Arachis (Pindars) do	6.6	8.89	8.33	......

In the first table given above, the amount of nitrogen in 100 parts is found, which gives the quantity of fibrin, albumen, and caseine, by multiplying by 6.3; thus, in the table, the nitrogen in good hay is 4.34 per cent., which is equivalent to eight and one-half nearly of fibrin. The practical values are ascertained by weighing the feed and animal, and giving enough of all fodders to maintain him in good condition. They are less true than the theoretical or chemical values, because not so well performed; but the theoretical values have been fully sustained by subsequent examination. One hundred pounds of ordinary hay is made the standard, other fodders being compared with this in their power of sustaining life in animals. The difference exhibited in the given valuations, by different authors, is, in a great measure, due to variations in the nutritiousness of the provender; thus, straw, pea vines, etc., are many times more nutritious when cut green than when dead ripe. In the same way, some wheat contains ten and some thirty per cent. of gluten, and here is a difference of one to three. The table is interesting as showing the actual value as determined in the cases named, meadow hay in theory being taken as a standard or 100.

FOLIATION, or VERNATION. The manner in which the young leaves are folded in the bud.

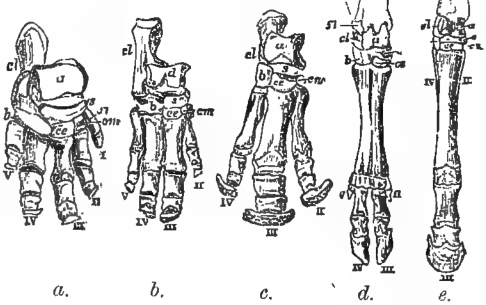
FOLLICLE, or FOLLICULUS. In botany, a one-valved, one-celled, many-seeded, superior, dehiscent fruit.

FOMENTATIONS. These are applications for cleansing or soothing irritable wounds; to relieve inflammation of parts near the surface, and to reduce internal inflammation, as in acute kidney difficulties, pleurisy, and pneumonia. They may be of cold or hot water, or mixed with vinegar, laudanum, or any antiseptic. As a rule fomentations should be hot, and applied continually until relief is had, the chief cause of failure being that they are not persevered in. For horses and cattle take a fully wooled sheepskin, and wring it out of hot water, and keep it on, renewing as often as it gets cool. After finishing, rub the parts dry, and it is better afterward, as a further means of guarding against cold, to rub a little mustard into the fomented surface.

FONTANEL. A small space existing between the bones of the head in the fœtus.

FOOT, ANATOMY OF. In the article Horse's Limbs and Feet, the importance of these members of the body, and something of their anatomical structure is discussed. The present article will deal only with the feet as organs of locomotion, and the successive stages by which the complex five-toed animal has been carried into the no less complex and delicate structures, four-toed, three-toed, two-toed, or hoofed, and single hoofed quadrupeds. Fig. 1 will show these several gradations as successive parts were dropped until we at least have a so-called solid, single hoofed animal (soliped) as in the horse. Whatever parts are dropped, are from the sides, with corresponding modifications of the carpal (wrist) and tarsal (instep of the foot) elements. This dropping of digital elements to contribute to greater simplicity of structure is not confined to the foot of the horse, but has its most complete manifestation, short of obliteration, in this animal, but is

Fig. 1.



seen to a less extent in other animals. An anatomical authority says, taking the five toes as the highest number presented in any land mammal, we have a reduction to four in the hippopotamus, Fig. 1 *b*, to three in the rhinocerus, Fig. 1 *c*, and two in the ox, Fig. 1 *d*. The elements not used are frequently present in a rudimentary form, as seen in the splint bones of the horse, and the two small toes in the ox and hog, Fig. 1 *d*. Fossil skeletons of horses show that, in previous geological eras long past, horses have lived having, to the fully developed single digit, two others perfect as to form but smaller in size. The anatomical foot of quadrupeds consists of all the parts beyond the radius, or radius and ulna, (lesser and larger bones of the fore arm) of the anterior extremities, and the tibia, or tibia and fibula, corresponding bones of the posteriors. This would include the carpal bones (the knee) and the bones below of the anterior, and the tarsal bones (the hock) and bones below of the posterior extremities. In point of fact, however, uses considered, the foot of the horse is much more limited in its extent, including only the terminal phalanx. Fig. 2 will give a correct idea, including the foot of the horse and splint bones. To recapitulate, Fig. 1 shows the digits present in the feet of different animals. Fig. 2 shows the plan of construction of the horse's foot. Fig. 3 shows the bone of fore leg including those of the hoof, being a front view; *a*, the bones of the knee, *b*, the leg bone, and *c*, *d*, *e*, the bones of the fetlock and hoof. To bring these up more clearly; Fig. 4, shows the splint bones; Fig. 5 the pastern bone; Fig. 6, the lower pastern or coronet bone; Fig. 7, the coffin bone; Fig. 8, a side view of a nearly perfect hoof, and Fig. 9, a vertical section of the hoof interior view, showing the horny laminæ. Thus from what we have shown the reader will get a correct idea of the anatomy of the foot of animals, or at least one sufficiently clear, to assist all to a correct understanding who do not wish to study anatomy as a science.

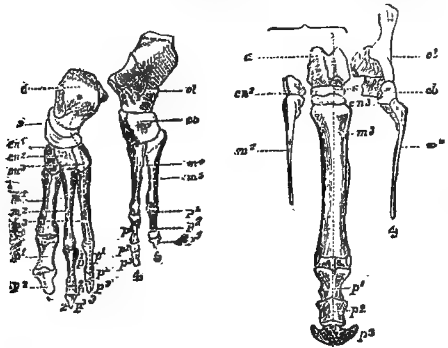


Fig. 2.

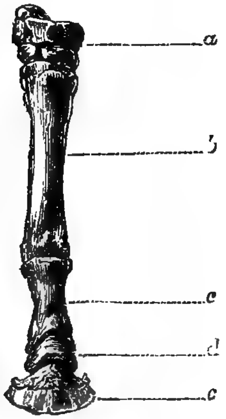


Fig. 3.

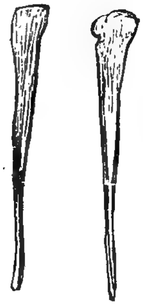


Fig. 4.

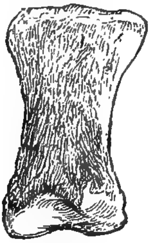


Fig. 5.

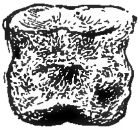


Fig. 6.

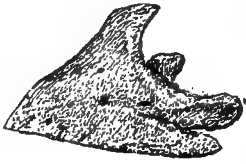


Fig. 7.

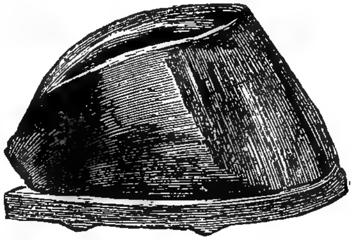


Fig. 8.

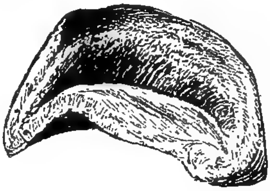


Fig. 9.

FOOT, SPRAINS OF. (See Sprains.)

FOOT, STRUCTURE OF. (See Horse; and Foot, anatomy of.)

FORAGE. The term signifies any food for cattle, horses, and sheep, whether it be grass, hay, grain, or other food plants. Fodder is generally used in the sense as applied to plants when cured, as hay, straw, corn-stalks, etc., although the original meaning of the word probably signified food. It is also correctly applied in the sense of hastily gathered up food, as, when an army is on the march, foraging parties are sent out.

FORAGE CROPS. Any crop grain for feeding farm animals, including the cereal grains, in contradistinction to fodder crops, which comprise these crops, when the leaves, or the leaves and stalks, are used for feeding. Thus fodder crops may be any of the grasses, clovers, or other plants used for feeding cattle, and also the cereal grains, when cut and saved as hay, while forage crops may imply, not only the straw but the threshed grain as well.

FORAMEN. In anatomy, a hole or perforation through a bone.

FORCE. Anything that produces motion or pressure. Mechanical forces are those which produce palpable movements, as gravitation, the descent of weights upon bodies, etc. Chemical forces are those producing molecular movements, which are only perceptible by their effects; they are heat, light, and electricity; these, however, occasionally give rise to more extensive movements.

FORCEPS. Instruments acting in the same way as pincers, but enabling the operator to acquire leverage.

FORCING. In horticulture, forcing is accelerating the growth of plants, by means of hot beds, forcing pits, cold frames, or hand glasses, by which they are brought forward earlier than usual, or out of their natural season. (See Hot Bed and Greenhouse.)

FORCING HOUSE. Any house covered with glass, and in which artificial heat is used in cold weather, is a forcing house. Thus artificial structures for growing plants may be so termed. Forcing houses, or pits as they are sometimes called, are generally cheap structures, used by commercial florists, hot beds being used by vegetable gardeners, and also largely by florists, especially for bedding plants. (See Hot Bed, also Conservatory.)

FORESTRY. The planting of trees for economical purposes is denominated forestry. The destruction of forests in the march of civilization was long ago recognized as an injury by European governments, and remedial means have been long since employed in their reinstatement by artificial planting. Thus almost all the European governments now have special officers whose duty it is to supervise this work In the United States we have no such officers, but congress was awakened to the importance of forestry through the representations of Horticultural Societies and, principally in the West, this resulted in the passage of laws for the protection of the public forests and, later, laws giving public lands to settlers on public lands, who planted and tended a fixed area for a certain number of years. States have also passed laws giving certain exemptions and perquisites to those who plant trees, and some State Boards of Agriculture, and Horticultural Societies, have also offered liberal premiums for systematic timber, belt, grove and forest tree planting. This industry is yearly an increasing one in the West, and principally performed by the farmers in prairie districts, for protective purposes. In France it is estimated that at least twenty-five per cent. of a country should be in wood land to produce the best results in tillage. Our estimate, for the West, is that if ten per cent. of the farms were planted to trees, as shelter belts, and small groves, the protection would be sufficient. The census returns estimate thirty-nine per cent. of the farms of the United States, excluding the Territories, as being in wood land. The estimate of the Department of Agriculture of the United States is twenty-nine per cent., and including the entire area of the States and also the Territories, twenty-nine per cent. The illustration we give shows—the figures on the blank surface the area of the States mentioned and the figures on the black surface the area of timber. In this connection, we may add that the impetus given of late years to timber planting in the West, bids fair to clothe not only the States immediately east and west of the Mississippi river with a sufficiency of timber for the best results in tillage, but more especially in the Territories beyond; but there is yet a wide field to be filled in providing future timber for economical purposes in the arts and manufactures. The showing, as given on page 369 would place the United States below Norway, Sweden Russia, Germany, and above all other European States, in the proportion of forests. In relation to these countries the German writer, Reutzsh, gives the following figures.

Countries.	Per cent.	Acres per head of population.
Norway	66	24.61
Sweden	60	8.55
Russia	30.90	4.28
Germany	26.58	0.663
Belgium	18.52	0.186
France	16.79	0.376
Switzerland	15	0.396
Sardinia	12.29	0.223
Naples	9.43	0.138
Holland	7 10	0.12
Spain	5.52	0.291
Denmark	5.50	0.22
Great Britain	5	0.1
Portugal	4.40	0.182

In some of the States the farm lands comprise nearly the entire area, exclusive of lakes and streams; in others, those more recently settled, and also some of the original thirteen, the unoccupied or wild lands constitute a considerable proportion of the whole area. Thus Maine has 5,835,058 acres in farms, while her area includes 22,400,000 acres of land and water. In the table following, an estimate of the forest area, outside of that belonging to farms, is added to the total acreage of farm woodlands, to make the estimated total area in forest. In estimating the proportion in woodland, the water surface on lakes and streams, the prairie, the ledges and other wastes incapable of producing trees, must be taken into consideration. After canvassing the facts affecting this proportion in the several States of the area exclusive of farms, one-half was assumed to be in forest in Maine, New Hampshire, Vermont, Pennsylvania, Maryland, Kentucky, Missouri, Michigan, Florida; six-tenths were taken for Arkansas, Virginia, West Virginia, and Louisiana; seven-tenths for North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Tennessee; one-third was taken for Massachusetts, New York, and New Jersey; one-fourth for Texas and Oregon; one-sixth for Wisconsin and Minnesota; one-eighth for Iowa; one-tenth for Rhode Island, Connecticut, Ohio, Indiana and Illinois; one-twelfth for California; one-twentieth for Kansas, Nebraska and Nevada. The proportion assumed respectively for the Territories is: Washington, thirty-three per cent.; Montana, sixteen; Idaho, fifteen; Utah, ten; Wyoming and Indian, eight; New Mexico and Arizona, six: Dakota, three. The result of adding this outside forest to that of the farm lands is given in the following table, which shows the percentage of forest area of States and Territories (second column) in comparison with the census percentage, which includes only the official count of farms:

States.	Percentage in farms.	Total percentage.
Maine	38.1	46.9
New Hampshire	29	37.2
Vermont	30.6	36.5
Massachusetts	25.8	29.2
Rhode Island	33.7	24.2
Connecticut	24.4	21.2
New York	25.5	27.6
New Jersey	24	28.1
Pennsylvania	31.9	38.9
Delaware	28	29.2
Maryland	31.8	38.4
Virginia	45.7	49.4
North Carolina	60.6	64.2
South Carolina	53.2	60.6
Georgia	54.6	60.2
Florida	60	50.6
Alabama	56	63.5
Mississippi	60.6	65.9
Louisiana	56.9	59.1
Texas	41.6	26.7
Arkansas	51.4	58
Tennessee	55	59.9
West Virginia	51.1	54.9
Kentucky	48.9	49.1
Ohio	31.7	28.4
Michigan	40.7	47.1
Indiana	39.6	34.8
Illinois	19.6	16.9
Wisconsin	29.3	20.9
Minnesota	20.6	17.1
Iowa	16.2	14.1
Missouri	41.3	45.4
Kansas	11.2	5.6
Nebraska	10.2	5.2
California	4.1	7.9
Oregon	31.8	25 2
Nevada	6.4	5
Colorado	3.5	10
Territories.		
Utah	0.1	10
New Mexico	12.7	6
Washington	44.8	33
Dakota	7.4	3
Montana	0.8	16
Idaho	9.6	15
Arizona	......	6
Wyoming	0.8	8
Indian	......	8
Alaska	......	30

A recently enacted law of the United States, for the encouragement of timber growing, contains provisions as follows:

1. The privilege of entry under this act is confined to persons who are heads of families, or over twenty-one years of age, and who are citizens of the United States, or who have declared their intention to become such.

2. The affidavit required for initiating an entry under this act (Form No. 22) may be made before the register or receiver of the district office for the land district embracing the desired tract, or before some officer authorized to administer oaths in that district, who is required by law to use an official seal.

3. Not more than one-quarter of any one section can be entered under this act.

4. The privilege of making more than one entry thereunder is confined to such parties as shall enter, in each and every instance, a fractional subdivision of less than forty acres, and the aggregate area of such entries shall not exceed 160 acres.

5. The ratio of area required to be broken, planted, etc., is, in all cases initiated under the first section of this act, one-fourth of the land embraced in the entry.

6. One-fourth part of the area required to be devoted to timber must be broken within one year from date of entry, one-fourth part more within two years from date of entry; and the remaining one-half within three years from date of entry.

7. One-fourth part of the area required to be devoted to timber must be planted within two years from date of entry; one-fourth part more within three years from date of entry; and the remaining one-half within four years from date of entry.

8. The trees are required to be not more than twelve feet apart each way, and the same are required to be protected, cultivated, and kept in a healthy growing condition for eight years, next succeeding the date of entry.

9. If, at the expiration of the said eight years, or at any time within five years thereafter, the person making the entry, or, if he or she be dead, his or her heirs or legal representatives shall prove, by two credible witnesses, the fact of such planting, cultivation, etc., of the said timber for not less than the said period of eight years, he, she, or they shall receive a patent for the land embraced in said entry.

10. In the case of the death of a person who, having entered a quarter-section, has complied with the provisions of this act for the period of three years—that is to say, who has broken ten acres the first year, ten acres the second year, and twenty acres the third year, and who has planted ten acres with timber the second year and ten acres the third year—then, and in that case, his or her heirs or legal representatives shall be permitted, at their option, to continue to comply with the provisions of this act during the unexpired portion of eight years, and thereupon receive a patent for said quarter-section: or, on making proper proof of compliance of the deceased settler with the requirements of the act for the said period of three years, they shall receive, without delay, a patent for forty acres of said quarter-section, upon the condition that they relinquish to the United States all claim to the remainder of the land embraced in such entry.

11. If, at any time after not less than one year from the date of entry under the first section of this act, and prior to the issue of a patent therefor, the claimant shall fail to do the breaking and planting required by this act, or any part thereof, or shall fail to cultivate, protect, and keep in good condition such timber, then, in that event, such land shall become liable to a contest in the manner provided in homestead cases, and, upon due proof of such failure, the entry shall be cancelled and the land become liable to a contest in the manner provided in homestead cases, and, upon due proof of such failure, the entry shall be cancelled and the land become again subject to entry under the homestead laws, or by some other persons under the provisions of this act.

12. Each and every homestead settler, at any time after the end of the third year of his or her residence, who, in addition to the settlement and improvements required by the homestead laws, shall have had under cultivation for two years one acre of timber (the trees thereon being not more than twelve feet apart each way, and in a good, thrifty condition) for each and every sixteen acres of said homestead, shall, upon due proof of such fact by two credible witnesses, receive his or her patent for said homestead.

13. No land acquired under the provisions of this act shall, in any event, become liable to the satisfaction of any debt or debts contracted prior to the issuing of the final certificate therefor.

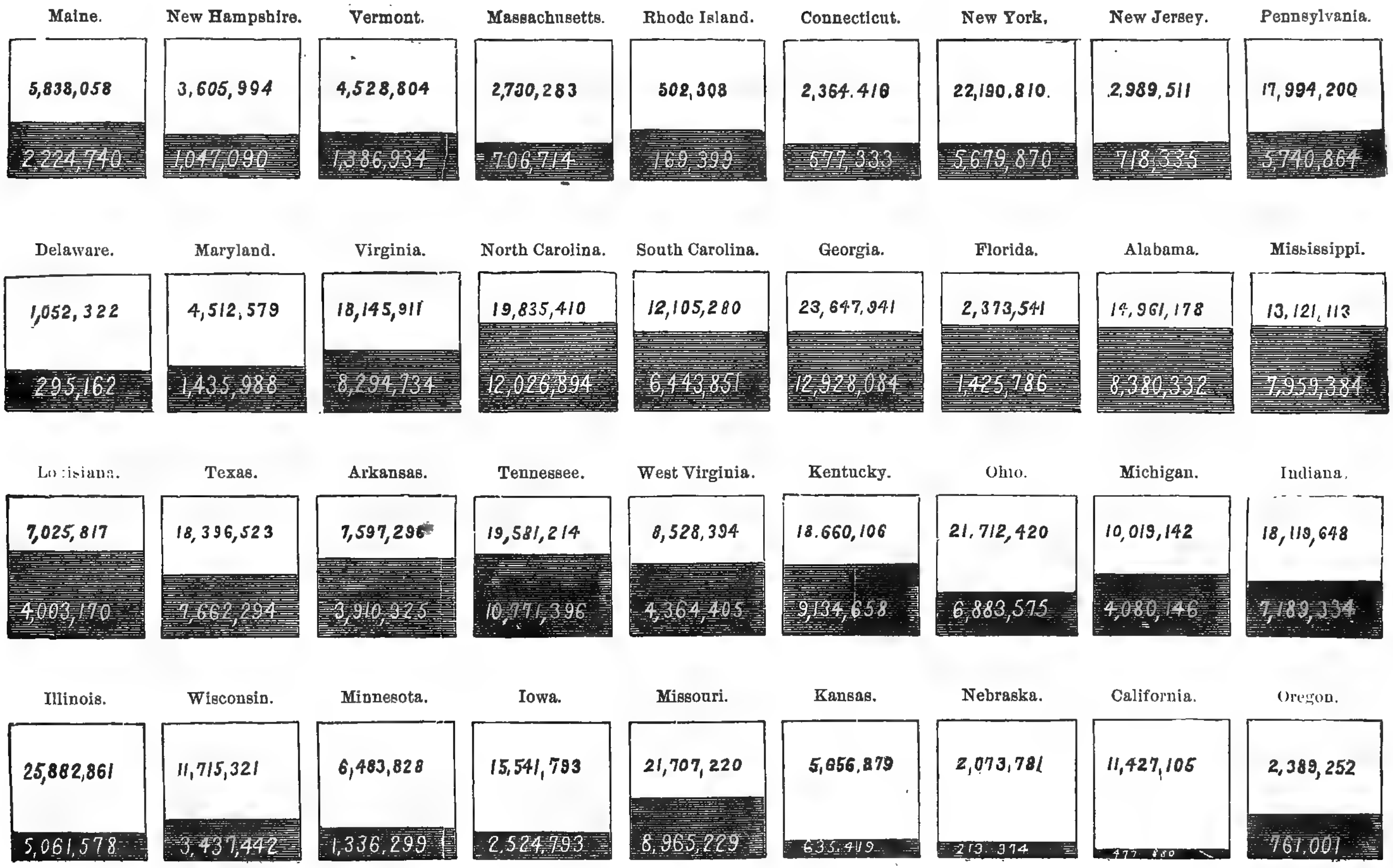
14. The fees for all entries under this act shall be ten dollars, and the commission of registers and receivers on all entries, irrespective of areas, shall be four dollars (two dollars to each) at the date of entry, and a like sum at the date of final proof.

15. No distinction is made as to area or the amount of fee and commissions between minimum and double-minimum lands; a party may enter 160 acres of either on payment of the prescribed fee and commissions.

16. The fifth section of the act entitled An act in addition to an act to punish crimes against the United States, and for other purposes, approved March 3, 1857, shall extend to all oaths, affirmations, and affidavits required or authorized by this act.

17. Parties who may have already made entries under the timber-culture act of March 3, 1873, of which this is amendatory, shall be permitted to continue and complete the same in the manner and under the conditions prescribed by this act.

There is something taking and eloquent in the immensity of the area of the newer States and Territories of the United States. These used to be considered as a wild, arid waste—a desert in fact, not susceptible of cultivation. The settlement of Kansas and Nebraska has shown the fallacy of this, and the States now being carved out in the Rocky mountains, rich both in vegetable and mineral wealth, show that there is still plenty of room for the energetic settler. The following table will show the number of



FOREST AREA OF THE UNITED STATES

acres in farms, the acres not in farms, and the number of acres in the total areas of the regions mentioned:

States and Territories.	No. acres in farms.	No. acres not in farms.	No. acres in total area.
Territories.			
Colorado	320,346	66,559,654	66,880,000
Utah	148,361	53,916,682	54,065,043
New Mexico	833,549	76,735,091	77,568,640
Washington	649,139	44,147,021	44,796,160
Dakota	302,376	96,293,752	96,596,128
Montana	139,537	91,877,103	92,016,640
Idaho	77,139	55,151,021	55,228,160
Arizona	21,807	72,884,433	72,906,240
Wyoming	4,341	62,640,727	62,645,068
Indian	....	44.154,240	44,154,240
Alaska	....	369,529,600	369,529,600
Total of Territories	2,496,595	1,033,889,324	1,036,385,919
Grand total	407,723,364	1,903,821,595	2,311,544,959

Taking into consideration only the farm-lands, the proportion of wood-lands is smallest in California, being 4.1 per cent. In order, respectively, follow Nevada, 6.4 per cent.; Nebraska 10.2; Kansas 11.2; Iowa, 16.2; Illinois, 19.6. The proportion increases, State by State, from the Pacific coast eastward to Indiana (39.6 per cent.,) and then comes the devastation of the axe, which reduces the percentage of Ohio, a region originally forest, with the exception of small patches of prairie, mainly about the headwaters of the Miami, to 31.7 per cent. Pennsylvania has about the same proportion, or 31.9, and New Jersey 24 per cent. There are only two other Western States that have percentages between 20 and 30, viz., Minnesota, 20.6; Wisconsin, 29.3. The Eastern States (besides New Jersey,) which come within the same limits, are Connecticut, 24.4; New York, 25.5; Massachusetts, 25.8; Delaware, 28; New Hampshire, 29; Vermont, 30.6. Those having between 30 and 40 per cent. of this farm area in forest are: Pennsylvania, Indiana, named above; Oregon, 31.8; Maryland, 31.8, Rhode Island, 33.7; Maine, 38.1. The States having between four and five tenths of their farm lands in forest are three: Michigan, 40.7; Texas (the eastern portion generally wooded,) 41.6; Virginia, 45.7. The southern belt is the most heavily wooded portion of the country, all the States, with the exception of Virginia and Texas, having more than half of their farm areas in woodland, and a larger portion still if the wooded wild lands should be counted in with the farm-lands. The proportion in the occupied or farm areas is as follows: West Virginia, 51.1; Arkansas, 51.4; South Carolina, 53.2; Georgia, 54.6; Tennessee, 55; Alabama, 56; Florida, 60; North Carolina and Mississippi, each 60.6 per cent. The Territories have only a very small portion of their respective areas in farms. Here and there only a small survey has been made, near some town, along some stream, or in the neighborhood of mining operations. The areas in wood are mainly among the mountains, the most heavily wooded on northern slopes and in the gorges protected from the winds; the proportion given for farm lands is, therefore, in all probability, less than the real portion for the entire area of a Territory, notwithstanding the fact that available woodlands in surveyed tracts are rapidly taken up by farmers. Utah, one-tenth of one per cent.; Montana and Wyoming, eight-tenths of one per cent.; Colorado, 3.5; Dakota, 7.4; Idaho, 9.6; New Mexico, 12.7; Washington, 44.8. Most of the States, in their several counties, exhibit great diversity in the abundance of their wood and timber supplies. In the new States it is due to the existence of prairies, or treeless plains, traversed by streams shaded by a line of forest, which characterize the surface of all or a portion of a State; in the older States it is simply the result of settlement and cultivation, in the destruction of forests, by clearing lands for farms, for supplies of wood for fuel, in obtaining timber for building, and for the various uses of mechanism. East of the Alleghanies almost the entire surface of the land was originally in forest. On the very summit of the Alleghanies are comparatively large tracts of level meadows, or mountain prairies, known as glades, which are found in undrained soils not suited to the growth of trees, though this mountain-chain is generally wooded, on slope and summit, with as fine and various an aborescent growth as can be seen in any part of the North American continent. West of the mountains, through West Virginia, Ohio, and Kentucky, there was little less than forest in the times of the aborigines; and in northeastern, southern, and southwestern Indiana, a wooded surface was the prevailing characteristic, and even now it is a favorite resort for obtaining black walnuts and poplars of enormous size, and great trunks of oaks, fit for use in many a man-of-war. The South was, and is, a wooded region, with very few and small prairies in the valley of the Mississippi, and none really worth mentioning until central Texas is reached. In northern Missouri are extensive prairies, but almost half the area of the State is now covered with forest, notwithstanding the extensive clearing of farm-lands during more than fifty years since its settlement; and more than half the surface of Arkansas and Louisiana, both west of the Mississippi, is now covered with wood. Meteorological records show that the lines of equal moisture, in this section, run northeast and southwest, through western Kansas, eastern Nebraska, Iowa, and Wisconsin; the records of the rain-fall of any given period correspond on that line, rather than with a line through Kansas and Missouri; so the rains of central Nebraska and Minnesota, in point of time and quantity, correspond more nearly than those of Nebraska and Iowa. As might naturally be expected, we find the forest boundary, from Texas to Illinois, beyond which the prairies stretch westward, running in a general direction corresponding with the lines of equal rain-fall. As a result, (though the lack of trees further west can not be attributed to insufficient rain-fall alone,) we find plains predominating in western Texas, in nearly all of the Indian Territory, in a strip of western and nearly all of northern Missouri, in a large portion of Illinois, and in western and northern Indiana, nearly to Lake Erie. Southern Illinois has an average proportion of forest. The belt south of the Ohio and Mississippi Railroad has a percentage of 43.5, which is greater than that of Missouri, and almost equal to that of Virginia.

FORMATION. Deposits or strata referable to a common geological period.

FORMICA. The genus of ants, now the type of a tribe the *Formicidæ.*

FORMIC ACID. The fluid ejected by ants when irritated contains this acid. The acid is formed by distilling tartaric acid with sulphuric acid and peroxide of manganese. It is a highly corrosive acid, and of a peculiar odor; combines with bases to form *formiates*, which are very soluble. Formic acid contains a compound radical *formyl.*

FORMULA. In chemistry, the expression, by symbols, of the composition of any substance.

FOSSA. In zoology, a depression of a bone.

FOSSIL. A part or the whole of any animal or plant imbedded in the earth, and more or less converted into stony matter.

FOSSORES. A group of hymenopterous insects, which dig or excavate cells in wood or earth to deposit their eggs.

FOSSORIAL. Animals which dig their holes, as moles.

FOUL BROOD. Foul Brood in the hives of bees has become a source of serious annoyance to many bee-keepers. The following digest of the subject, from a number of sources, will show the result of some of the later investigations upon this subject: Putrid Foul Brood is a disease which attacks the young brood of the hive, showing itself fully after the larvæ have been sealed up. It may be known by the viscous, gelatinous, and yeast-like appearance of the decomposing brood, the unpleasant odor arising from the hive, and by the sunken covers of the cells. The cause of foul brood has been, until recently, involved in doubt, but late discoveries in Germany have thrown much light upon its origin. Mr. Lamprecht alleges that he has discovered the cause of the disease. His theory is this: The chyme which the workers prepare from honey and pollen by partial digestion, and with which the larvæ are fed, contains a nitrogenous, plastic, formative substance, from which all the organs and tissues of the larvæ are derived and composed; and precisely because of this its complicated composition it is peculiarly susceptible of rapid decomposition when exposed to air and moisture; that is, to undergo fermentation and putrefaction. It is hence obvious that pollen, even though having undergone only a partial decomposition, must affect the bodies of bees and larvæ differently from what it did or would do in its natural condition; and there is no longer a doubt that it is from pollen, thus partially decomposed, that the foul brood originates. That it can readily undergo decomposition is manifest. Moisture, emanating in part from unsealed honey, and in part from the perspiration of the bees, becomes condensed in the hive from external cold, and in the fall and toward spring it is frequently found hanging in drops on the combs, just as we find it condensed on the windows of our dwelling houses. If one of these drops falls into a cell containing pollen, decomposition of the latter speedily commences, and is then communicated by the bees to the pollen in the other cells; and the cause of foul brood is hence abundantly present in a hive thus circumstanced. The discovery of Dr. Preuss, an eminent physician and mycologist, is that a microscopic fungus, *Cryptococcus alvearis*, developed from fermenting matter, feeds upon the young larvæ, and thus causes foul brood; and that by means of the numerous sporules of the fungus, the disease is spread through the hive, and finally through the apiary. To show the character of this microscopic pest we quote the following from the article of Dr. Preuss, in the *Bienenzeitung:* The foul brood fungus, which I have named *Cryptococcus alvearis*, belongs to the smallest of the fungoid forms. It is round and dust-shaped, and has a diameter of 1.500 millimeter, or 1.1095 line; consequently 1,095 can lie side by side within a Rhenish line, but within a square line, 1.095+1,095, that is, 1,199,825, or, in round numbers, 1,200,000. The cubic line, according to this, would contain 1,440,000,000,000 fungi, and a cubic inch of foul brood, which consists of 1728 lines, would contain 2,488,320,000,000,000. If we reckon, further, that a cubic inch of comb contains fifty cells, the contents of each would be 49,766,400,000,000; in round numbers, fifty billions; or, deducting one-fifth for wax, forty billions of fungi. There is no cure for this disease when it has once obtained headway. Destruction of the bees and honey, and thorough purification of the hive is the only remedy to prevent the spread of the disease. As a means of preventing the disease, Dr. Preuss gives the following directions: Feed no fermenting honey; feed no meal, especially when the hive is threatened with disease; destroy carefully every particle of dead and moldering matter; and avoid weakening the bees during the brooding seasons, so that they will not be able properly to maintain the heat necessary for the development of the brood. With the light now thrown upon the nature of this disease by recent discoveries, bee-keepers should be able to conquer the contagious malady whenever it makes its appearance.

FOULS. This is sometimes called foul claw, and incident to cattle and sheep, caused by overgrowth of the hoofs, irritation of pebbles, thorns, dirt, etc., and is sometimes produced by a scrofulous condition of the animal. If occasioned by injury, cleanse the hoofs thoroughly with warm water, cut off all supernumerary hoof, and apply, with a feather, a solution of from ten to twenty grains of chloride of zinc in an ounce of water. The foot must be protected from dirt until healed.

FOUNDATION. In architecture, the lower part of a wall, on which the wall is raised, and always of much greater thickness than such wall. Heavy buildings sometimes have their foundations on a bed of concrete, which is a mixture of rough, small stones or large gravel with sand and stone, lime and water, with just enough of the lime to act as a cement or medium with the best effect. In soil not solid the precaution is often taken to rest the building on piles driven close together; and deep enough to penetrate a firm compact clay.

FOUL TEETH. (See Lampas.)

FOUNDER. This disease is an inflammation of the sensitive parts of the foot, sometimes including the laminæ, the sole and also the foot-bone. Hence the name laminitis, and also inflammation of the feet, and fever in the feet. In slight cases only one fore foot may be affected, but often both, and sometimes all, of the feet. The following will be found to embody all necessary to be said upon this common disease, one almost always the result of carelessness or direct abuse; it is written by one competent in every respect: Of the affections of the soft tissues, perhaps the most common is laminitis. This term applies to inflammation not only of the laminæ, but of the entire fleshy portion of the foot. It is not always the most readily detected, and in some of its more common and milder forms it entirely escapes notice. The lameness is assigned to the shoulder or some other locality; but when we refer to the position of this tissue, between a dense bone and a dense, unyielding horny envelope, and to its use to suspend the bone and consequent entire weight of the animal from the wall, and consider that it suffers some degree of pressure at every step, we can understand how the slightest morbid condition of the part, the congestion of its vessels, or irritation of its nerves, may—nay, must—give rise to pain and consequent lameness. Fortunately, in practice this is much less frequent than, theoretically, we might expect it to be. Any horse that has been driven for several hours upon a hard, or stony, or hot and sandy road, would seem to be fairly fitted for some degree of congestion of the soft tissues of the feet. At the close of such exertion he is stabled, perhaps upon a damp floor, or where a draft of air may blow upon him. No thought is given to the condition of his feet. He is fed, and perhaps he may have been moderately groomed; but of the entire animal no part has undergone so much exposure or hardship as the feet, and no part really needs so much attention. Laminitis, or, as it has been called by writers, fever of the feet, or founder, may exist in all degrees, from the simple congestion of the part to the most severe and disorganizing inflammation. It is mainly exhibited in the fore feet, being an uncommon disease in the hind feet. This is mainly due to the different kinds and degrees of force used in the action of the fore and hind legs and feet. In movement a much greater amount of weight comes upon the fore legs and feet, the direction of the blow upon the ground is different, and the consequent strain and pressure upon the soft tissues much greater. If acute laminitis is present in one or both fore feet, it is manifested by the very obvious efforts of the animal to relieve itself from pressure. If one foot only is suffering, this is put forward and is rested upon the heel that not only is pressure taken off, but the parts are relaxed to a still greater extent by the weight of the limb, the foot is kept in continual motion, indicating extreme pain. There is heat in the hoof, and especially in the coronary band around its summit. There may also be tenderness in this tissue on pressure. If both forefeet are affected, the animal endeavors as far as possible, by settling back over the hind feet, to take off the pressure from them. This attempt may also be shown by the continuous change from one foot to the other. In severe forms of the acute disease the entire system will sympathize with the local disease. The arteries supplying the part or parts will be found throbbing; the general arterial circulation will be quickened; the pulse will become considerably accelerated, and the constitutional condition will be one of symptomatic fever. The disease if unchecked may go on to the destruction of the soft tissues of the foot. Cases are on record in which the entire hoof has been shed by the separation of the soft from the horny foot. This is a rare termination, but the formation of an abscess and partial separation is not so uncommon. Before this result occurs, however, the disease has usually passed into the chronic form. Prompt resort to appropriate treatment may result in restoration to health. By no means advocating indiscriminate blood-letting, we would in this case recommend the free local abstraction of blood, either from the toe of the afflicted foot, or from the plantar vein. If the case is a very severe one, a branch of the plantar artery of one side may be divided. The foot should be placed in a large bucket of warm water, and allowed to bleed in it. Care should be taken to keep up the temperature by frequent additions of hot water. When the foot is removed, it may be placed in a large poultice, having previously been drenched about the coronary border with a liniment composed of two ounces each of the tincture of aconite root, belladonna, and opium, with six ounces of soap liniment. For the constitutional disturbance, the tincture of aconite root, fifteen to twenty drops in water, may be administered every hour or half hour until a decided impression is made upon the frequency and hardness of the pulse. Half a drachm of belladonna with fifteen grains of digitalis may be given every half hour, or in emergency the following draught may be given every hour until the proper impression is made on the system: Tincture aconite root and tincture belladonna fifteen drops each, and sulphuric ether and laudanum half an ounce each. Later, saline medicines, such as the nitrate of potash, will aid in preventing secondary affections. Laminitis may have a variety of terminations. First it may terminate in a complete disappearance of all the symptoms, that is, by resolution, and there be a complete recovery. Second, it may pass into a chronic condition in which all the symptoms are of a mitigated character. When quiet, the pain is slight, and the heat is little, if any, in excess of the natural state. If the animal is allowed rest upon a soft floor, or is turned to run in a paddock, the lameness may be scarcely obvious; but attempt to drive him and, either while on the road or afterward, he becomes very lame again. This condition may continue almost indefinitely. Third, the inflammation may terminate in suppuration, which may be confined to a small region of the foot, and eventuate in a partial recovery, or it may be general and so extensive as to destroy the connection of the hoof with the soft tissues. Under the latter circumstances the hoof may be lost. When the destructive suppuration falls short of producing complete separation, it may be sufficient to permit of a change of relation of the coffin-bone to the hoof. A portion of the anterior attachments may be destroyed so that the bone may fall away from the horn. In a flat and weak foot this may cause a bulging of the sole, producing what is called pumice foot. If the hoof is preserved, the space produced by the falling of the coffin-bone is filled by fleshy granulations. The foot, however, suffers permanently, and lameness is constantly present. Such is the structure of the foot that, even when the damage is less than that just described, the suppuration continues and burrows in various directions, seeking an outlet. Except when the inflammation and suppuration are confined to a limited space in the sole of the foot, the discharge must escape from the crown. At some part of the coronal border of the hoof, swelling is perceived, which either opens of itself or is opened by the knife, which is preferable. When suppuration has commenced, the animal should receive better and more nutritious food, while stimulating injections to the opening may be useful. Should the sinuses become chronic, it has been recommended to trace their number and direction with a delicate probe, and then freely lay them open. To do this, the hoof must be softened by soaking in warm alkaline water, when it may be cut easily. Limited suppuration of the soft tissues of the foot may occur from a variety of other causes, such as a wound made by the shoe of one foot in the coronet of the other, or by the prick of a nail driven into the quick or so near it as to cause inflammation by pressure, or by a bruise made by the heel of the coffin-bone, to which the term corn is applied. In all these cases suppuration may follow inflammation, and the severity and extent of the trouble will depend upon the locality of the injury, and the distance the product of suppuration has to travel to reach a point of exit. A fourth termination may be designated—that by metastasis. The inflammation being situated in the fibrous tissues of the foot is liable to leave that locality and to seize upon similar tissues elsewhere, and under unfavorable circumstances we may have resulting inflammation of the brain or pleura, or indeed of any of the fibrous tissues. A fifth termination may be in mortification, the result of which would be almost certainly fatal at any early period. Laminitis may be, and sometimes is, subacute from its commencement. It is apt to take this form in old horses that have been subjected for a long time to hard work. Its approach is gradual, pain at first small, and lameness slight and not constant. The foot should be given the same treatment as in the more acute form. The warm bath should be used freely. Bleeding would probably be injurious, and any debilitating medicines must be withheld. The bowels may be loosened by fresh vegetable food, such as potatoes or carrots, and if pain is present one or two draughts in the day containing an ounce of sulphuric ether and a drachm of laudanum may be given. Plenty of good, nutritious food should be given. The horse should not be used on the road until all the symptoms have been absent for several days. He may be gently exercised on a soft sward as soon as the inflammation is subdued. A permanent, incurable lameness often results from the continued use of a horse suffering from some degree of inflammation of the soft tissues of the foot. Whenever this condition is detected, the animal should be given rest, and subjected to treatment with a view to the cure of the disease.

FOUNTAIN. A jet of water or fluid. The simplest way of forming a fountain is to conduct water by a small pipe from a higher elevation, where a tank or other reservoir exists; the open end of the tube below being made fine, the fluid is driven out with a pressure proportionate to the height of the reservoir, and of any desired form of spray.

FOVEATUS, FOVEATE. Having a depression or pit; applied to the nectary of flowers

FOVILLA. One of the granules contained in pollen.

FOX. *Canis vulpes.* In countries where foxes abound, notably in hilly, rocky, and timbered regions, foxes are one of the greatest pests of the farmer, since they do not hesitate to attack any animal they can easily overcome, even small pigs sometimes falling a prey to them. Barnyard fowls, however, are their favorite prey. Their exceeding cunning makes it difficult to trap them. The best means for their extermination is to bait them continually with something they like until they come and eat fearlessly, and then to hide what strychnine will lie on the point of a pen-knife in each bait, as is usual in killing prairie wolves. The hunting of foxes, with horses and hounds, is a great rural sport in England, and somewhat practiced in the hill districts of the South.

FOXGLOVE. *Digitalis purpurea.* A very handsome biennial plant, bearing purplish-crimson, or occasionally white flowers, from June to September. In gardens it is easily propagated by seed. The lesser yellow foxglove, (*D. parviflora*) is a native of Italy, and perennial; grows three feet high, bearing yellow flowers in June and July; propagated from seed. The large yellow foxglove, (*D. ambigua,*) with larger flowers, is also a perennial, growing three feet high. The medicinal qualities of the foxglove are diuretic, powerfully emetic, and narcotic; and, under proper management, it is a most useful medicine. The leaves are inert in the first year of the growth of the plant. As every part of the foxglove is poisonous, children ought to be warned against it.

FOX-TAIL GRASS. *Setaria glauca.* A common American grass, with a bristly head, found in cultivated grounds, old stubble-fields, orchards, etc., flowering in July. Its root is annual, and the stem grows two or three feet high. When mature it has a tawny, or orange color. Another species of fox-tail is popularly called green fox-tail, or butter-grass, (*Setaria viridis*). Its general resemblance to the species first-named, render it liable to be passed by as a green variety of that plant. Another species of *Setaria* (*S. verticillata*) commonly found about gardens and cultivated lots in the Middle States, has teeth on the bristles, which cause the spikes to adhere to objects with which they come in contact. Another species called *German Setaria*, millet or Bengal grass, is occasionally found in fallow fields. Dr. Muhlenburg supposed this annual plant might be a variety of the green fox-tail, to which Dr. Darlington thinks it certainly allied. Several other species of this genus are found in the United States, of which one called *Italian Setaria* is distinguished by its very large spikes. The others are Southern plants. None of them, except the German setaria, possess any value to the agriculturist.

FRACTURE. In farriery, the breakage of a bone in the body. Fractures are called simple when a bone is broken without tearing the muscles and passing through the skin, and compound in the latter case. In mineralogy, the appearance of a broken mineral which is not crystalline. It is termed resinous, conchoidal, vitreous, earthy, etc , according as it resembles that of resin, a shell, glass, or earth.

FRÆNUM. A membranous fold, which binds down one part of the body to another, especially the tongue to the mouth.

FRAGARIA. The generic name of the strawberry.

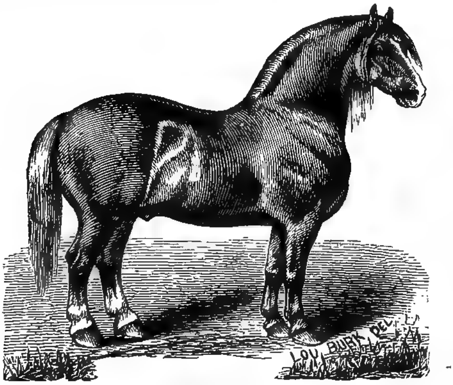
FRANKLINIA. *Gordonia pubescens.* An ornamental tree of Georgia, somewhat resembling the dogwood when in flower.

FRAXINUS. The genus of the ash. (See Ash.)

FREEMARTIN. A twin cow calf born with a male calf. If it resembles the bull it is barren, and is often barren when having the general appearance of a heifer.

FREEZING. Congelation. The conversion of water into ice. It takes place at 32° Fahrenheit, or below, and is promoted by a sharp wind, which hastens evaporation. Water, in freezing, expands one-ninth, and, if confined, will break the stoutest vessels. Rocks and the soil are disintegrated by the freezing of water in them, which, expanding, tears the particles asunder. By freezing some mixtures or solutions, the watery parts may be, in some measure, separated, and the spiritous left untouched. (See Frost.)

FRENCH HORSES. The ordinary mixed breeds of French horses require no notice. The Arden horse has many good points as a work horse. The distinctive breeds that have acquired celebrity, are the Norman and the Percheron, sometimes called Norman-Percheron. Of these the principal difference seems to be in the fact that the horse of Normandy is larger, heavier, and slower than the horse of Perche, the latter showing more of the original Andalusian stock, from which both varieties are said to have sprung. However these admirable draft horses may have originated, whether they have been known in France since the Crusades, a very doubtful question, or whether they were produced by breeding from the fine Arabian stallions, which fell into the hands of the French, at the victory of Charles Martel over the Saracen Chief Abd-er-Rahmän, and being brought into La Perche and Normandy, and bred upon the heavy Norman horse, from which they have been developed into the present strains; whichever may have been the case, there is no doubt but they are entitled to stand in the first rank of horses, where all that constitutes activity, constitutional vigor, and ability to pull a heavy load at a good pace is desired. So strong is the character of the Percheron and Norman, in perpetuating their distinguishing features, that the stallion is sure to impress the foal, and in like manner the mare when bred to another breed, gives her impress sure in the foal. There has been much controversy first and last, over the proper name to be given to these two varieties of French horses. The fact is they are different strains of one breed, and do not differ more than thorough-bred horses, or short-horn cattle, both composite breeds. Reference to the cut of Percheron-Norman, will give a correct idea of the form and appearance of one of the best of the race. The original race of LaPerche, as they existed fifty years ago, were from fifteen to sixteen hands high, and weighed from 1,200 to 1,400 pounds, and before the advent of railroads were used to move the heavy road vehicles, (Diligences) of France, at a swift pace. Later, heavier weights being required, by selection and crossing, immense animals weighing up to 2,000 pounds have been produced, and it is said that now scarcely one of the active Percherons of fifty years ago are to be found. Yet the medium to smaller stallions of to day, are admirable getters of horses adapted to hauling heavy loads, and especially to city trucking and omnibus work. As we understand it, the Norman or large horses seem to have been mixed with the large Belgian and Flemish horses, while the horses of La Perche have retained to a greater degree, the distinguishing characteristics of the lighter and more agile ancestors. So difficult did it seem to draw dividing lines, that the editor of the Percheron-Norman Stud-Book, seemed at fault as to just what should constitute fitness for entry. The plan adopted was to give a full account of the course of breeding and crossing practiced in France, and admit to registry all horses imported from France, as Percheron, Norman, Percheron-Norman, and Norman-Percheron.


LOU BURK DEL.

PERCHERON-NORMAN.

FRIABLE. Powdery, mealy, or readily broken into a powder.

FRIEZE. In architecture, the central portion of the entablature between the architrave and cornice. It is plain in the Tuscan, but adorned in other styles.

FRIGID ZONE. The space above 76½ degrees of north or south latitude. It is scarcely occupied by any plants but a few lichens.

FRINGE-TREE. *Chionanthus Virginica.* A beautiful ornamental tree, growing wild as far north as Delaware, and bearing white flowers in May.

FRINGILLIDÆ. A tribe of birds of the Passerine family, with stout, conical bills (*conirostres*), including the linnets, canaries, finches, all of which eat grain.

FROGS. Amphibious animals, of the genus *Rana.* The common species (*R. temporaria* and *esculenta*) are, for the most part, insectivorous. They should not be destroyed by the farmer as they clear his garden of insects, snails, and other small pests. The green frog (*esculenta*) is a great delicacy with some; the flesh of the hind leg is the part eaten.

FROG OF THE HORSE. A triangular portion of horn projection from the sole almost on a level with the crust, and defending a soft and elastic substance called the sensible frog. The sensible frog occupies the whole of the back part of the foot, above the horny frog and between the cartilages.

FROG HOPPERS. FROG SPITTLE. CUCKOO SPITTLE. Small insects (*Cercopidæ*) which inhabit the twigs and branches of plants, from which they extract so much juice that the place on which they are collected appears covered with spittle. Some species are said to secrete a saccharine substance which is fed on by ants.

FROND. The leaf of a fern is the frond.

FRONTAL. In anatomy, appertaining to the forehead.

FRONTLET. In ornithology, the part of the head next the bill, usually covered with bristles.

FROST. In the article Dew we noticed frost incidentally. Frost is crystallized vapor, and can only fall on clear, still nights, when the atmosphere is in repose, and the radiation strong. Thus, the atmosphere as it is robbed of its heat, settles by gravitation in strata, the heaviest becoming the lowest. Dew is formed, and, if the temperature sinks below forty degrees, frost occurs. The new researches into the phenomena of heat, which have overturned the old hypothesis of caloric and substituted the theory of vibrations have brought to light the extraordinary fact that vapor of water is opaque to the rays of heat of low intensity, such as that which proceeds from the soil and from plants by night; in other words, that the heat of the earth can not be radiated or projected towards the sky if there exist in the air above the spot observed a large proportion of aqueous vapor. Through pure air, free from moisture, the heat may pass off as readily as if no air existed above the cooling region. It is believed that air saturated with moisture at the ordinary temperature absorbs more than five hundredths of the heat radiated from a metallic vessel filled with boiling water, and Prof. Tyndall calculates that of the heat radiated from the earth's surface warmed by the sun's rays, one-tenth is intercepted by the aqueous vapor within ten feet of its surface. Hence the powerful influence of moist air upon the climate of the globe. Like a covering of glass, it allows the sun's rays to reach the earth, but prevents, to a great extent, the loss by radiation of the heat thus communicated. In accordance with this theory, it should be shown that the withdrawal of the sun from any region over which the atmosphere is dry, would be followed by quick refrigeration. It is said that the winters of Thibet are rendered almost unendurable from an uninterrupted outward radiation, unimpeded by aqueous vapor, and that everywhere the absence of the sun favors powerful radiation when the air is dry. The removal for a single summer night of the aqueous vapor from the atmosphere that covers England would, says Prof. Tyndall, be attended by the destruction of every plant which a freezing temperature would kill. In the Sahara, where the soil is fire and the wind is flame, the refrigeration at night is painful to bear, so that ice is sometimes formed there. In short, says the Professor, it may be safely predicted that wherever the air is dry the daily thermometric range, or the difference between the extremes of heat and cold, will be very great. All great discoveries have been partially anticipated by keen observers, who could not wholly explain certain anomalous appearances, but whose shrewdness led them beyond the borders of the unknown. These results of Prof. Tyndall were thus foretold by R. Russell, Esq., of Scotland, who visited America in 1854 in order to study the effects of our climate upon agriculture. He asserts that the influences of moisture in tempering the sun's rays is a remarkable fact and well worthy of further investigation. When the dew-point is high, or the air is filled with moisture, radiation from the earth is prevented and the temperature of the night remains almost as high as that of the day. When the dew-point is low, the sun's rays pass without absorption to the earth, and impart little of their heat directly to the air. The medium dew-points are therefore most favorable to extreme heat in the atmosphere, and the greater heat beyond the tropics is probably owing to this cause. The fact that the amount of moisture in the air regulates the temperature of the nights has not received the attention it deserves. The great amount of moisture in the air within the tropics is the cause of the warm and brilliant nights. Radiation from the air and ground, under these conditions, seems to lose its power. On the other hand, travelers in all parts of the world inform us, incidentally, as to the connection between dry air and cold nights. Mr. Inglis, in his travels through Spain, relates that he was oppressed by the hot rays of the sun in the valley of Grenada while the hoar frost was lying white in the shade. Eastern travelers in the desert often complain of the broiling heat of the air during the day, and of its chill temperature at night. The means of warding against the effects of frost by any covering, however slight, to prevent radiation, has long been known; also, by means of smothered fires, allowing the smoke to settle like a cloud over orchards and other exposed situations. Frost, however, forms at night when there is sufficient air moving to carry away the smoke, and hence the means noticed are only clearly beneficial in a still atmosphere. This still atmosphere, however, is usually present during the exhibition of untimely frosts. Water begins to freeze when the temperature of the air is at 32° Fahr. At this temperature ice begins to appear, unless some circumstance, for example, the agitation of the water, prevents its formation. As the cold increases, the frost becomes more intense, and liquids which resist the degree of cold required to congeal water at length pass into the solid state. When water remains at complete rest, it may be cooled down to 28° Fahr. without freezing; but the moment it is agitated, the thermometer rises to 32° and the water freezes. In this case the insensible heat of the water is retained when the fluid is at rest. No experiments have hitherto ascertained to what depth frost will extend, either in earth or water, but its effects will, of course, vary according to the degree of coldness in the air, the longer or shorter duration of the frost, the texture of the earth, the nature of the fluids with which the ground is impregnated, etc. In England the frost rarely extends in the ground below eighteen inches from the surface. In some portions of the United States it penetrates to the depth of several feet; yet in these localities many summer plants are raised in the open air, that in England must be kept under glass. During severe frost almost all vegetables fall into a state of decay, and even a moderate degree of frost is sufficient to destroy many of the more tender kinds. The injury which vegetables sustain from frost is greatest when it is preceded by a thaw or copious rains; for the plants are then turgid with moisture, which, expanding in bulk as it passes into the solid state, produces the rupture of the vegetable fibers. Therefore it is that a sharp wind, or any thing which dries the sap or juices of vegetables previous to frost, tends to their preservation. The great power of frost on vegetables is well known. Trees are sometimes destroyed by it as if by fire, and split with a noise resembling the explosion of artillery, since the juices of the tree expand with great force, as they are converted into ice. Frost, however, is most beneficial to the agriculturist in disintegrating heavy clayey soils, turned up to its influence in winter, and the rougher the plowing is left for the winter, the more beneficial its effects.

FRUCTIFICATION. The part of plants destined to produce fruit or sporules.

FRUIT. In a general sense fruit is whatever is produced in vegetable life, for the sustenance of animals and man. In a more limited sense, it is the last production of a plant, its seeds, or that which contains the seeds. In botany, the fruit is the seed of a plant; or the seed with the enveloping pericarp. (See Botany.)

FRUIT TREES. Any tree which produces food for man. In horticulture it is applied to those cultivated sorts, as the apple, pear, cherry, peach, etc. The clinging plants, as the grape, are denominated vines, those bearing currants, gooseberries, raspberries, etc., are denominated bushes, and herbaceous plants, as the strawberry, are denominated running plants; yet, correctly speaking, any distinct species of vegetation may be a plant, and all plants are vegetable; nevertheless, the term vegetable is now generally applied to that class of plants grown in the garden and prepared in the kitchen. While a tree may be correctly denominated a plant, a plant may not be a tree, but succulent or a shrub. The ultimate end of all plants is to produce fruit; yet again all plants do not produce fruits fit for man or the domestic animals, hence fruit plants, as generally understood, are those which produce fruits fit for eating in their natural state, and fruit trees are those which produce fruits, as the apple, pear. cherry, etc., which produce fruits that may be eaten in their natural state.

FRUMENTACEOUS. Resembling wheat, or made of wheat.

FRUSTUM. The part of a solid cone left after cutting off the top.

FRUTESCENT. Becoming shrubby, or having the appearance of a shrub.

FRUTEX. A shrub, a small tree, the branches of which start from the soil without any regular trunk.

FUCOID. Like a sea-weed.

FUCUS. A genus of sea-weeds.

FUEL. Any combustible substance which is used for the production of heat constitutes fuel; but the term is more properly limited to coal, coke, charcoal, wood, and a few other substances. Coal, from its abundance and cheapness, is the commonly employed fuel in the northern portions of the United States, but where wood is abundant, or where its value is little more than that of felling it, it is used either in its original state, or in the form of charcoal. It is essential to good and profitable fuel that it should be free from moisture; for unless it be dry, much of the heat which it generates is consumed in converting its moisture into vapor; hence the superior value of old, dense, and dry wood, to that which is porous and damp. The pound of dry wood which will heat thirty-five pounds of water from 32° to 212°, will not, when damp, heat more than twenty-five pounds from the same to the same temperature; the value, of different woods for fuel is nearly inversely as their moisture, and this may be roughly ascertained by finding how much a given weight of their shavings loses by drying them at 212°. In the case of anthracite coal, however, it does not absorb sufficient moisture to seriously impair its nature. The value of turf and peat, as fuel, is liable to much variation, and depends partly upon density, and partly upon freedom from earthly impurities. A pound of turf will heat about twenty-six pounds of water from 32° to 212°, and a pound of dense peat about thirty pounds; by compressing and drying peat its value as a fuel is greatly increased.

FULCRUM. The point about which a lever moves. A prop.

FULIGINOUS. Sooty, of the color or appearance of soot.

FULLER'S EARTH. A clay used for scouring or cleansing cloth of grease. Pipe clay.

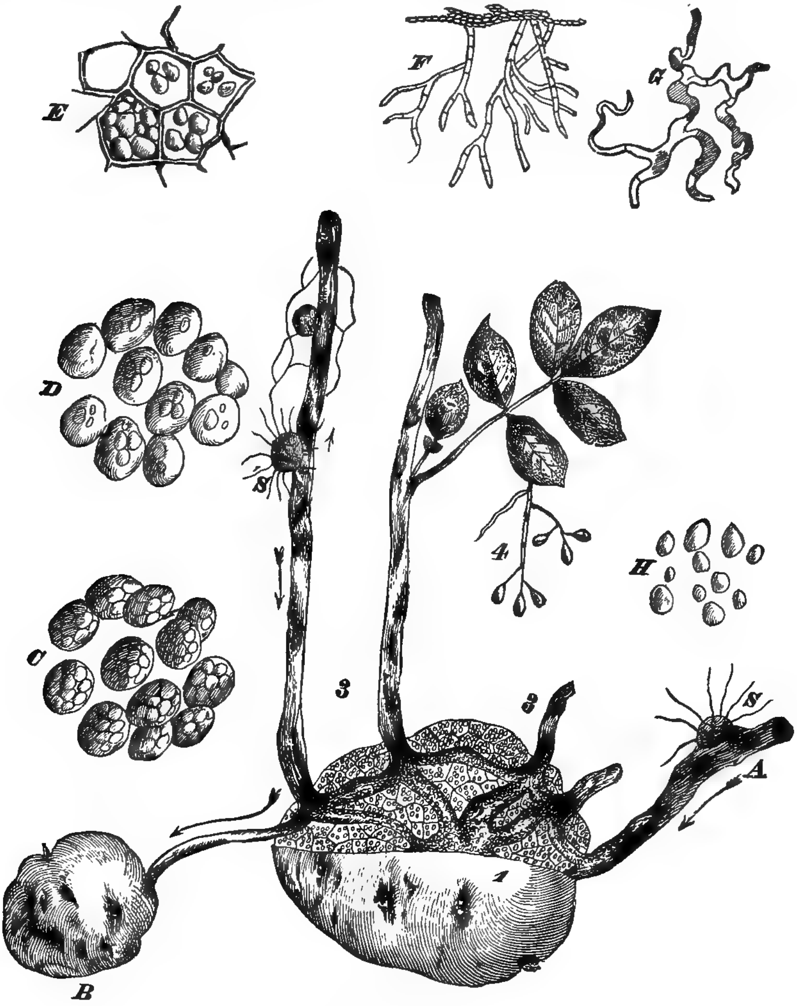
FUMIGATION. The exposure of substances, or the air of a room, to vapors; to counteract a disease or to purify, thorough ventilation is necessary. The chlorine given off from chloride of lime, or generated by adding muriatic acid to black oxide of manganese, is the best fumigating substance It has the power of neutralizing the most disagreeable odors, but is injurious to health, and must only be used in vacant apartments. (See Disinfection.)

FUMITORY. *Fumaria officinalis*. Cultivated chiefly as a flower; cattle will eat the herbage.

FUNGI. The race of mushrooms, toad-stools, blight, rust, etc. They consist of cells only, and produce spores, or seeds, without flowers. Fungi grow, for the most part, on dead or living vegetable matters. Those fungi are poisonous that have a disagreeable narcotic smell. (See Fungus.)

FUNGICOLA. A genus of coleopterous insects dwelling in mushrooms.

FUNGUS. To the botanist the fungi are a most interesting class of plants. Their seeds, (spores) and many of the resulting plants are so small that they must be examined with the microscope to bring out their character. What are understood as funguses by the ordinary observer, are toad-stools and puff-balls. Smut, mildew and rust are generally termed blight; yet they all belong to the larger class of fungi, the more minute forms below those of mildew, being largely in excess of those larger than mildew. Fungus attacks all plants, especially those in a more or less diseased or disorganized condition. Fungus sometimes does attack apparently healthy trees. It attacks all living trees, and also is one of the means of the decomposition and decay of dead plants. It is propagated by spores, minute grains which perform the function of seeds. These, says a writer on fungus life, begin to germinate by sending out numerous filamentous rootlets, composed of a succession of small cells, which perform the office of roots in supporting the plant in an erect position, and supplying it with nourishment. These rootlets are called the *mycelium*. They also send up stems (*stipes*) of various shapes, according to the class to which they belong. The *Botrytis infestans*, more recently called the *Peronospora infestans*, is one of the most destructive of the fungi that cause the potato-rot. It has the form of a spreading tree, bearing some three thousand ovoidal spore-cases (*acrospores*) on the ends of the branches, somewhat resembling, when taken collectively, clusters of grapes, and hence its generic name *Botrytis*. The seeds of the fungi, which are contained in the spore-cases, usually have a brown color, like fine dust, and are almost infinite in number. A single plant is said sometimes to produce millions, so small and light as scarcely to be affected by gravity. They cover everything around them—earth, plants, and animals. The air is filled with them, and they wait only for a state of the atmosphere favorable to their growth to seize upon every object within their reach. They live principally upon decaying substances, but the living do not always escape them. The conditions best adapted to their growth are, first, a debilitated or morbid state of the plant; and, secondly, a proper degree of heat, moisture, and electric influence to induce germination. They do not germinate readily, and the conditions must be very nicely balanced to insure germination at all. They frequently remain inert for a long time, and, when the conditions are complete, fall upon plants like an epidemic, and after a time disappear almost entirely. Such may, perhaps, sometimes have been the case in their attacks upon the potato. Long-continued, warm, damp weather, often causes them to appear in great numbers; but a single day of dry weather will arrest their progress. They mature with wonderful rapidity. Puff-balls sometimes grow six inches in diameter in a single night. Certain species have been found growing on the surface of iron that had been heated in the forge only a few hours before. They have also been found growing on the surface of glass. *Peronospora infestans* matures in a few days, sometimes in fifteen to eighteen hours even, when conditions are most favorable to its growth, and scatters its seeds by thousands and tens of thousands, to prey, with each successive brood, from day to day, upon the expiring plant. The seeds are supposed to enter the pores (*stomata*) of the leaves and stems, and also to be taken up by the spongioles of the roots; and carried along in the circulation of the sap through the plant. They take root in the cellular tissues of the stems and leaves, stop up the pores with their roots, pre-



POTATO DISEASE.

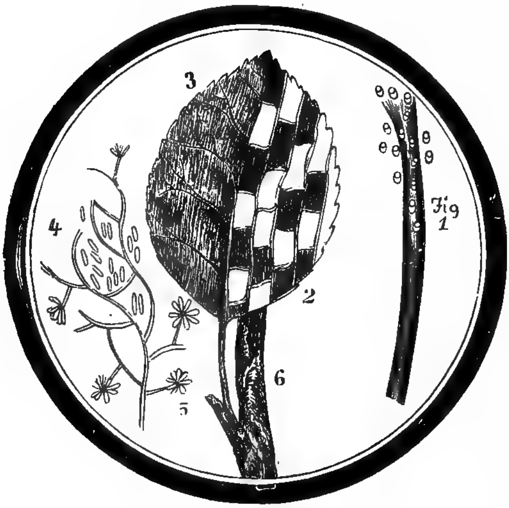


Fig. 1.

vent the proper elaboration of the crude sap, and exhaust large portions for their own support, besides probably exerting a deleterious chemical influence on the plant. That the seeds of this fungus are capable of destroying the potato has been demonstrated by Dr. DeBary, who mixed some of them in a drop of water and applied them to the leaves and tubers, when brown and livid spots appeared, and afterward decay. All the members of this genus, *peronospora*, are parasitic on living plants, inducing in them speedy decay, of which they are themselves the cause. To those who wish to study cryptogamic botany, the following from a lecture by Prof. McNab, delivered in the Royal Agricultural College, England, will be found interesting: The study of the lower order of plants is attended with many and great difficulties. This is owing chiefly to the minute size of the objects themselves, requiring as they do the microscope for their investigation. Then, again, most of our botanical text-books give only the most superficial description of the lower groups, and fix the whole time and attention of the student on the higher or flowering plants. The consequence of this is that the study of the higher plants is carried to such a length in our lectures on botany that little or no time is given to the lower orders, a plan of procedure as philosophical as that of teaching zoology merely from the vertebrates and omitting all other divisions. To the more or less flattened or rounded cellular expansion of these plants, which may consist of only one or of thousands of cells, the term thallus has been applied; and the three groups possessing this may be united, to form a large division of the vegetable kingdom, called the *Thallophytes.* The thallus may consist of one cell or of many cells; these may be either similar or dissimilar. In some of these *Thallophytes* we have plants consisting of one cell, which performs the functions of nutrition during the day, and those of reproduction during the night. In others we have one part of the plant set aside to perform the function of nutrition, while another part performs the function of multiplication only. In most of the sea-weeds the part of the thallus set apart for the purpose of nutrition is large, while the reproductive organs occupy only a small portion. In the funguses we have plants which obtain most ot the nutriment ready made, and, and as a consequence, an elaborate nutrient system is not required. Hence that portion of the thallus in funguses set aside for the purposes of nutrition, called the mycelium or spawn, is comparatively small, while the organs for performing the functions of reproduction predominate. The same law holds in the animal kingdom, as in many parasites we have a low type of the nutritive system and a largely developed reproductive system. In most of the *Thallophytes* we have two modes of reproduction, one a true sexual process, in which we have parts equivalent to the stamens and pistils of the higher plants, while the other is asexual, and therefore to be considered as a process of budding. These two modes of reproduction either alternate or else we may have budding taking place two or more times in succession before sexual reproduction again occurs. This fact is of the greatest importance, and must not be lost sight of. In many of the sea-weeds we have this alternation of sexual generation with budding. At one period in the life-history of the plant true sexual organs may be produced, while at the other periods we have numerous small cells given off, each armed with two or more hair-like appendages. As these appendages are capable of moving, they propel the whole mass, to which, on account of its peculiar animal-like motions, the term zoöspore has been applied. The zoöspore may therefore be considered as a movable bud of the simplest possible construction. The same alternation of sexual generation with budding is to be met with in the funguses, and the *Peronospora* affords a very good example of it. Many of our readers must have observed dead flies floating in water in the autumn, with their bodies all covered with fine hair-like threads. This appearance is produced by a plant, which was formerly believed to be a sea-weed, but is now placed among the funguses. If we examine the thread with the

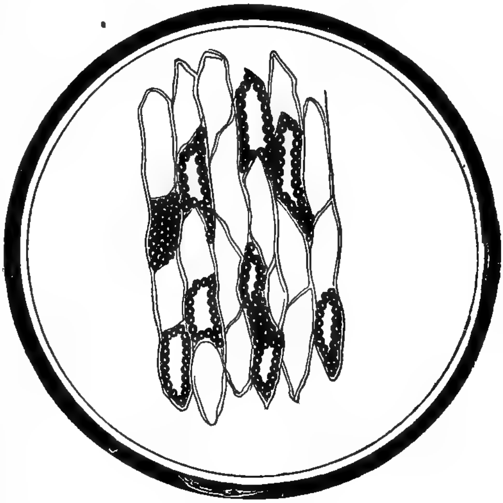


Fig. 2.

microscope, we observe a cellular mycelium or nutritive portion of the thallus. At the end of some of the portions of the mycelium we may probably observe a single large cell, the contents of which become broken up into small portions. These small portions of the protoplasm become liberated, and are zoöspores or rounded masses of protoplasm, with two hair-like appendages. When free, they are capable of moving about for some time, and then growth takes place, and each one will form a new plant; but in another we may observe that the ends of the branches of mycelium form a club-shaped cell.

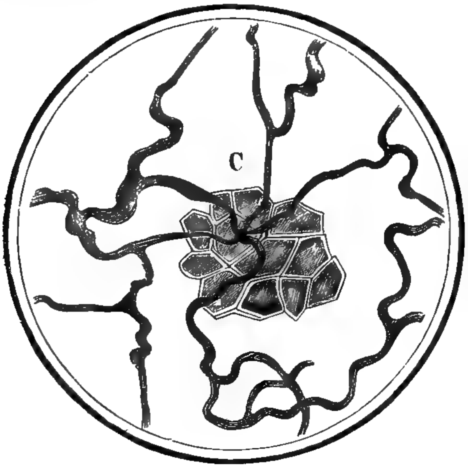


Fig. 3.

This club-shaped body is the female reproductive organ, and is called by botanists oögonium. At each side of this club-shaped body two smaller bodies can be seen, which spring from the same portion of mycelium as the oögonium, but below it; they are two small branches, which grow upward until they come in contact with the oögonium, being, in fact, the male reproductive organs, called by botanists antheridia.

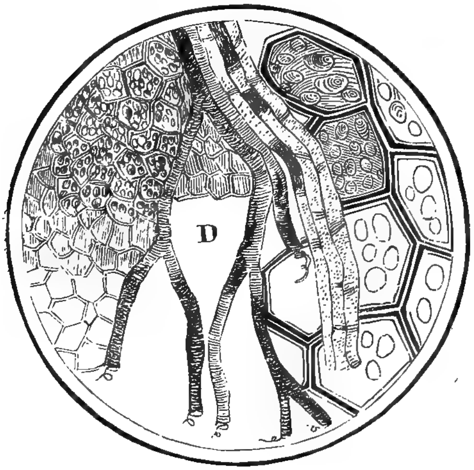


Fig. 4.

Inside the oögonium are the granular contents, or protoplasm, forming the oösphere. The oösphere is fertilized by the contents of the small male branches, one or more oöspores being in this way produced. The oöspores are in fact comparable with the fertilized seed of the higher plants. After a period of rest the oöspore germinates and produces a new plant. The reproductive process in the fungus resembles that of many sea-weeds which form oögonia and oöspores, the oöspores being formed after fertilization from the contents of the oögonium.

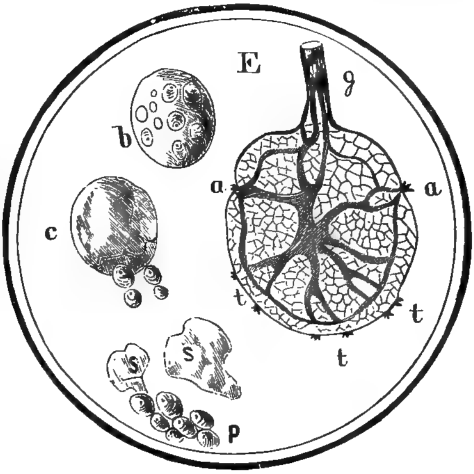


Fig. 5.

Then, in the production of the moving buds, the zoöspores, which multiply the plant asexually, these funguses closely approach the sea-weeds. The passage from *Achyla* (the fungus possesses the sea-weed like character just described) to the fungus producing the potato-disease is but a single step.

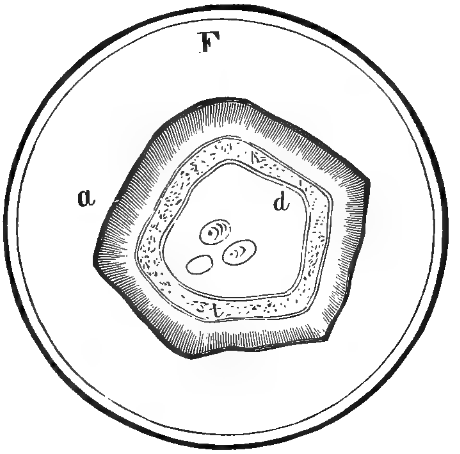


Fig. 6.

In *Peronospora infestans* we have a thallus with the nutritive portion of it, the mycelium, ramifying through the potato-plant. It has also two modes of reproduction, sexual and asexual. In the asexual form we have a branching tree-like form of the mycelium, making its way through the stomata or breathing pores of the leaf. This branching portion bears rounded swellings, arranged in a somewhat beaded manner, and called conidia. They do not produce zoöspores, but develop a mycelium distinctly. Other observers, however, assert that the conidia never produce a mycelium directly, but always from several, in general ten, zoöspores. The zoöspores, after moving freely about, attach themselves to the cuticle of the plant, and surround themselves by a delicate wall; they then bore through the outer wall of the epidermic cell, and form a mycelium ramifying through the intercellular spaces of the potato-plant. If the young mycelium is formed in the tuber or potato, it may remain dormant during the winter, and then spread through the young plant as it grows. The sexual organs of *Peronospora* develop inside the tissue of the infested plant. The extremities of certain of the threads of mycelium form rounded bodies—the oögonia. Inside the oögonia a portion of the protoplasmic contents form the oösphere On another branch of mycelium the antheridium is produced, which adheres to the wall of the oögonium. the contents passing into the oösphere, which is thus fertilized, and the oöspore formed. The oöspore is surrounded by a thickened skin, which is rough and dark brown in color. After a period of rest, the fertilized oöspore germinates and produces mycelium. The fungus producing the potato-disease is thus interesting botanically from its peculiar relations to certain of the sea-weeds, in its mode of reproduction, and in the production of moving zoöspores. From the effect of rain or dew in liberating these zoöspores it is not difficult to understand how the disease spreads in damp weather. Since it is easier for the unscientific reader to catch ideas by the eye more readily than from scientific descriptions, we give cuts showing some principal forms of fungi. On page 377 we have illustrated the potato disease or fungi. A disease spot appears in a potato. The microscope will show the disease commencing where the vascular bundles concentrate. There the air is in greater volumes than elsewhere, such spots exposed to the atmosphere causes the blue mold fungus to appear. This however, has no relation to the potato rot. Blue Mold, is *Penicillium glaucum.* F, represents the mycelium or roots, at G, is shown that of potato rot, (*Peronospora infestans*). The following definition is from the report of the Microscopist of the Department of Agriculture at Washington: 2, and 3, 3, potato disease, represent the combination of the spiral and dotted ducts; A, the root stem; B, a new growth or tuber from 1. Viewing their connection in this way, it will be seen that any germinal disease entering through the root-stem A, will necessarily communicate through all the connecting links, viz., A, 2, 3, 3, B. S, S represent the fruit of a slender light-colored mycelium, which was found traversing the exterior and interior of the withered potato stalks. In the more advanced stages the fruit has appendages in length about one and a half times their diameter. They have a thornlike appearance, slightly wavy, and of amber color. To the naked eye they appear like fly-spots, and are very numerous. They appear black, but when treated by nitric acid the dark color is removed and a cellular structure of an amber color is exhibited. Thus far I have not been able to detect any sporangia in them. This may be accounted for from the fact that all the specimens I have examined had been dried up for a long period. 4 represents the fruit of *Peronospora infestans* on the leaves very highly magnified. The arrows represent the movements of the fungus matter; C, starch-cells, liberated by the fungoid solution and full of starch granules; D, the starch-cells of watery potatoes. They contain very little starch. E, the starch-cells as arranged in the potato. Some are void of starch, while some are well filled; others partially so. H represents the condition of starch in water when a potato is grated down, or when the cellulose cells are rotted away by fermentation, as in the case stated. Prof. Burrill, in an address before the Illinois Horticultural Society, upon parasitic plants, held that the parasites now classed in the family *Peronosporæ*, and in the two genera *Peronospora* and *Cystopus*, are among the worst pests of the fields and gardens. Those of the former genus are especially destructive. They blight like contagion, and wither like death itself. Over forty species of the Peronosporas are known in Europe, while only six have so far been observed in this country, three of which came under the notice of Dr. Burrill. These are *Peronospora infestans*, on potatoes and tomatoes; *P. gangliformis*, on lettuce; and *P. viticola*, on grapes. The species of the genus Cystopus do not seem to have the destructive effects of the former, yet must cause much loss of vitality to the supporting plants. They appear as small scabs or

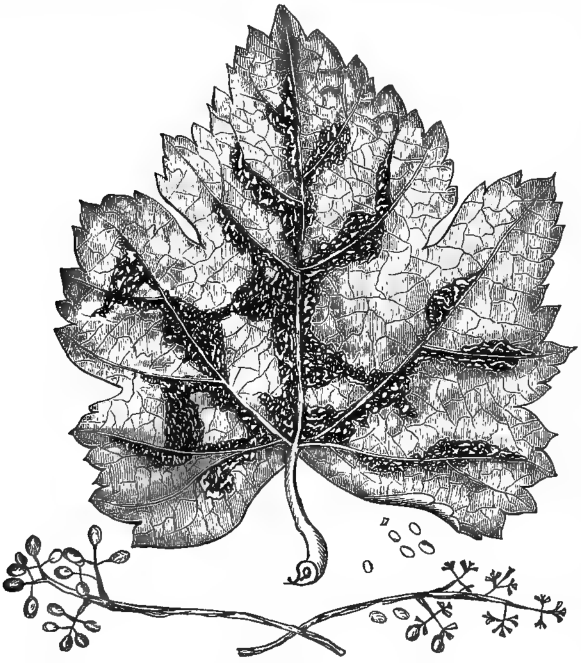


Fig. 7.

blotches on leaves and green stems. Cruciferous plants, especially with us horse-radish and cabbage, are commonly thickly spotted by the parasite. The weeds known as purslane (pusly) and pig-weed or red-root (*Amarantus retroflexus*) are similarly scabbed, and even the ubiquitous rag-weed (*Ambrosia artemisiæfolia*) does not escape. Returning to the characteristics of the family, we must notice the striking peculiarity, so far as fungi are concerned, of the production of *Zoospores.* The spores of all other fungi, upon germination, throw out one or more threads, which directly or indirectly reproduce the plant, but, though the same thing often occurs here, the more common thing is the division of the spore into five or six portions, which become free by the rupture of the spore coat. On each part two very fine hair-like appendages are produced, which become locomotive organs, propelling the little body for some minutes or hours through the drop of water in which they originate, with astonishing rapidity, as seen under the microscope. Having had their run, they settle down and germinate like the ordinary spore. The term zoöspore has been given on account of these motions, which were supposed, at one time, to be peculiar to animals. Besides multiplying greatly the germinating bodies, the zoöspores doubtless aid greatly in the dissemination of the species. Another and more proper form of fruit is produced, not however, strictly confined to this group, the so-called Oöspore. This arises from a process of fertilization, analogous to that brought about by pollen in flowering plants. The oöspore is the winter spore, the others probably perishing during that season. In the spring it, too, splits up into zoöspores, which appear in every way similar to those spoken of above. Much interest has lately been taken in the finding of the oöspores in the potato fungus, by G. Worthington Smith, of England. Its existence had not before been certainly known as such, though really it had been observed several times and named as belonging to another species. But the great loss caused by this fungus, and the hopes of finding some remedy, set many sharp eyes to investigating its development. We wonder now that Mr. Smith's discovery was not made long before. The fact is now, however, known that this parasite, causing the rot of potatoes, is preserved during winter in the old stems or vines and in diseased tubers. Mr. Smith has followed up his discovery by making some compound of sulphur, potash, etc., which is to be tried on a large scale in England, by application to the seed tubers, the vines of course being carefully burned. In the moist climate of England this disease is much worse than with us, which is bad enough. The remedy, if indeed it proves such, will be a blessing little short of that of the potato itself. As showing fungous growths as seen under the microscope, we give a series of illustrations, showing some of the forms assumed, as shown under a high magnifying power, Fig. 1 and 2 show pear blight; Fig. 1 at 2 shows the cellular structure of the leaf; 3 shows the leaf blackened from internal disorganization; 4 represents a single structure of mycelium, having a fine silken appearance. Fig. 2 represents the general appearance of the cellular matter, spores of the blighted bark, in their arrangement, form and depth of color. Fig. 3 represents a highly magnified interior view of the cells of the skin of an affected potato, traversed by a dark jointed amber. Fig. 4 exhibits the appearance of a section of a potato showing the starch-cells and vascular bundles, dotted ducts, and spiral ducts intermixed. The largest cells shown are very highly magnified, in order to exhibit their real structure. The pentagonal lines, which will be observed inclosing the starch granules, represent a section of three distinct cell-walls, one within the other. The interior, or third cell, contains the starch.

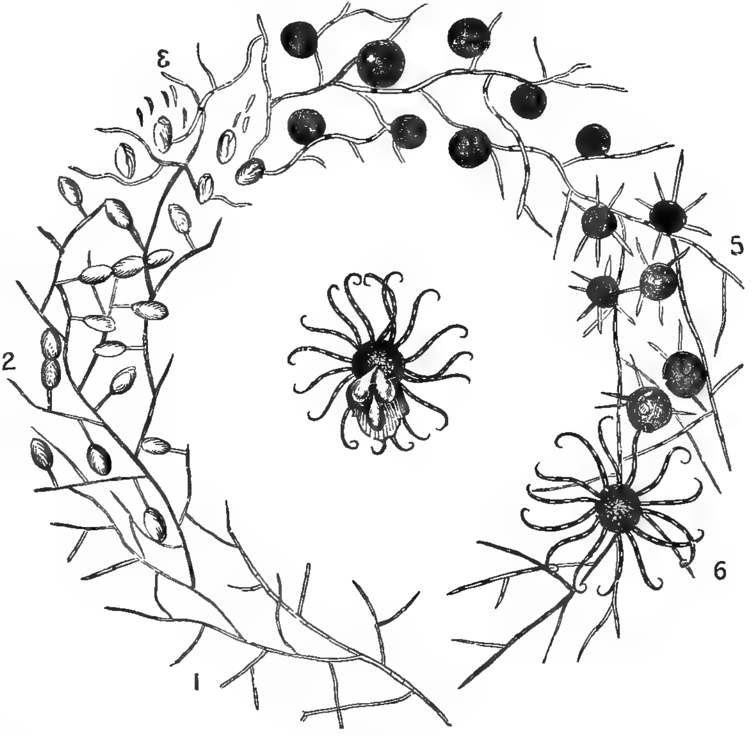


Fig. 8.

Fig. 5 exhibits a section of a potato; *g*, the root-stem; *a a*, sections of eyes; *t t t* exhibits the position of other eyes, but not in section. It will be seen that the inner markings exhibit a series of central circular and radiating lines leading from and returning to the root-branch *g*. These lines represent the arrangement of the vascular bundles of the potato. When a potato is cut in two, sectionally, lines will be exhibited as shown, and, if exposed to the action of the air for a short time, the nitrogenous matter in the immediate vicinity of the vascular bundles blackens. The starch is inclosed in three cells. They consist of, first, an outer cellulose transparent cell; secondly, an opaque nitrogenous cell or lining; and thirdly, an inner cell, composed of very transparent cellulose, in which the starch-granules grow; *b* represents such a cell. These cells contain from thirty to seventy granules. *c* represents a broken cell, from which the starch is seen as if in the act of leaving; *s* represents a portion of a broken cell; *p*, precipitated starch. The starch-granules, individually considered, consist of starch and cellulose, the starch proper and a cellulose covering or cell. A reference to Fig. 6, F, will show the position of cellulose cells *a*, *d*, *t*. They are held in position in the potato by the nitrogenous cell *t*, which is held in turn by an outer and inner cellulose cell, *a, d.* When a sound potato is grated down, all these cells are broken, because of their perfect cohesion to one another. One cell can not be broken without breaking all. But in the case of rotting potatoes, the nitrogenous cell which binds the three together is partly removed by the fungoid action, but principally by infusorial life (*bacteria*) which live on it. The inner or center cell containing the starch is thereby liberated. This is owing partly to the soft and yielding character of the cells and the machinery used in reducing the potatoes to a pulp, and being so buoyant as to float the starch granules within them, are carried away in the process of washing. Fig. 7 shows the fungus (*Botrytis viticola*) of a mature grape leaf. This fungus attacks the summer or second growth leaves and produces either by absorption of the sap, or by cellular disorganization caused by its processes. It is of a whitish spotted appearance when attacked, and causes the withering of the leaves attacked. A dry atmosphere is the preventive to the attack, the first appearance of this fungus being observed on the under side of the leaf. Fig. 8 shows fungus of the germs *uncinula*, a fungus found on the upper surface of the native grape vines in autumn. No. 1, 2, 3, 4, 5, 6 and 7 show consecutive stages, 7 shows the bursting and throwing out of the *sporangia* (spore cases,) analogous to the seed vessels, in flowering plants. The species of *Uncinula* is somewhat similar to *Œdium Tuckeri*, which attacks the European vine. The fungus is seen in late summer or autumn showing on the upper surface of the leaves as white spots, the woolly-leaved varieties being most subject to attack, although sometimes the smooth leaved varieties, as Clinton for instance, are not exempt, if the conditions, heat and moisture, are favorable. Fig. 9 shows forms of the genus *Mucor*, or microscopic toad stools, formed on a vine leaf bruised to a pulp and fermented. These assume various forms, living and dead organisms having their special forms of parasitic plants. Thus fungus forms attacking a living plant, may continue to exist, or they may attack fruit after it is severed from the parent stem, but decay setting in a different class of fungi appears, that is when vitality is lost and disorganization ensues.

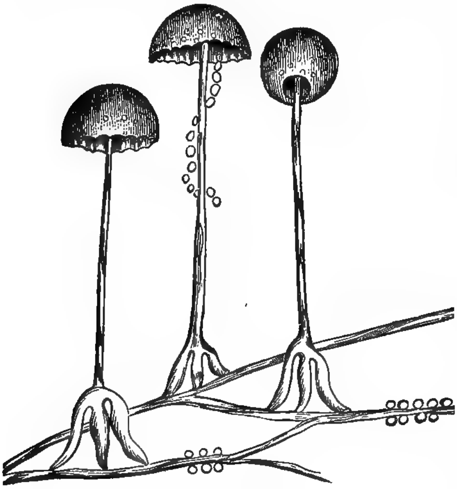


Fig. 9.

FUNICULUS. In anatomy, the cord which attaches the fœtus to the after birth, or placenta, also called the umbilical cord. The thread by which the seed is fastened to the carpel.

FUNNEL. A trumpet-shaped vessel open at both ends, used to transfer fluids, and especially in chemistry, to lay filters upon.

FUNNEL-SHAPED. *Infundibuli* form. A term descriptive of the figure of some flowers.

FUR. The skins of animals well covered with hair. The unprepared dry skins are called *peltries*.

FURFURACEOUS. From *furfur*. Resembling bran.

FURLONG. The eighth of a mile; forty poles.

FURROW. The movement of the earth produced by the action of a plow; furrow slice is the slice of the earth turned over in plowing. The rationale of turning of furrows by the plow is not understood by one plowman out of ten, even by those who profess to be plowmen. Very few of the ordinary hands of the farm understand how to turn furrows, so they shall lap evenly, or fall beside each other, in lap furrowing in contradistinction to lying flat, and at the same time close together. So in turning under stubble and other trash, sufficient care is not taken in cutting the furrows, so the vegetation will be distributed evenly, and not in lumps, thus allowing the furrow to lie smooth and evenly disintegrable throughout. The subject will be found treated of in the article plowing.

FURROW, WATER. The furrow made in plowed lands to let off surface water.

FURZE. Shrubs of the genus *Ulex*, the most common of which, *U. Europeus*, is also called gorse and whin. It is hardy, leguminous evergreen, growing abundantly on poor lands, and made use of for hedging and coarse fodder in Europe. It grows rapidly, so that it can be cut every four years for fuel, and is so far nutritious that horses are sometimes maintained on furze only.

FUSIFORM. Spindle-shaped, tapering to each end; a descriptive term in botany.

G

GABLE The triangular piece of wall at the ends of a house; immediately under the roof.

GADFLY. This is the name of the bot-fly, (*Æstrus equi*) producing the bot-grub in horses, and also of the sheep bots, or fly, (*Æstrus ovis*) producing grubs in the heads of sheep, or head maggots, as they are sometimes called. (See article Bots, and also Sheep.) The large, black gad, or horse fly, (*Tabanidæ*) are dreadfully troublesome to horses in some seasons, especially in the West and South. The green head, a smaller fly, is so rapacious in the prairie regions in the West, that it is impossible to manage a team with any comfort in driving, except they are completely covered with netting. A still smaller species, the golden-eyed forest-fly, (*Chrysops*), called ear-fly in the West, will sometimes render animals frantic. As a means of securing exemption, the head, neck and ears of horses should be carefully covered. The skin bot-fly (*Æstrus bovis*), is often annoying to both horses and cattle in the South and West, from their habit of depositing the eggs, one in a place, in the backs of horses, and especially cattle, which, hatching, live on the integuments under the skin, emerging in the spring. They may be felt in the winter as hard lumps. The opening should be slightly enlarged with a lancet, and the grub squeezed out by pressure on each side. Then wash the wounds clean with a tincture of aloes and myrrh, and the abscesses will soon heal.

GADFLY, BREEZE. Dipterous insects of the genus *Æstrus.* These insects nearly resemble bot-flies; they deposit their eggs under the skin of animals, which they pierce, giving considerable pain. They are nearly if not identical with the skin bot-fly.

GAGE, GAUGE. In physics, an instrument to measure any result, as wind-gage, rain-gage.

GALBANUM. *Galbanum officinale.* An umbelliferous herb of Africa. A fetid gum resin exudes spontaneously from it having antispasmodic properties.

GALBULA. A genus of climbing birds like king-fishers; they live in wet forests and are insectivorous.

GALBULUS. A fruit of a rounded form, but with an internal conical arrangement of the carpels; as that of the savin, juniper, and yew.

GALEATE. Helmet-shaped. In botany, the term is applied to the upper arched lip of personate flowers.

GALERUCA. A genus of coleopterous insects, the type of the *Galerucidæ*, including the *Haltica.* They are vegetable feeders in the perfect and larva state. The yellow-striped squash beetle (*G. vitata*) is of this genus.

GALLINACEOUS. Birds resembling the domestic cock, as turkeys, pheasants, pigeons.

GALLIZING. Adding sugar and water to the must of grapes containing too large a proportion of acid and tannin, as the Concord and Clinton, and fermenting it therewith is called Gallizing, after its inventor, Dr. Gall. Another means, adding sugar and water to the husks, after the first pressing, (and then fermenting) is called Chaptalizing, after its inventor, Chaptal. In Gallizing the juice of grapes, or in Chaptalizing, the husks, after pressing, are taken; the idea being to add water and sugar sufficient to bring the specific gravity up to eighty degrees of Œchsle's saccharometer, and so it shall contain four per mill acid, by Geisle's acidimeter. Fifty gallons of water to 100 gallons of mashed grapes and two pounds of best crushed sugar to the gallon of water, is one formula. Test the mixture and if the weight is between eighty degrees and ninety degrees, press immediately without fermenting the husks. If the grapes are very ripe, they may require less, if unripe, and very acid, more. The husks may be afterward Chaptalized, by adding water and sugar to the husks to make it weigh eighty degrees as strained juice. Then ferment on the husks from twenty-four to forty-eight hours according to the temperature, or more or less violent fermentation. It will require practice and experience to reach high success, and it is still an open question, warmly discussed, as to the propriety of either of these practices It is fairly well-established, however, that good judges may be easily deceived, so it is pretty much guess work with them, as to which samples of wine inspected may or may not be Gallized. The making of cider wine is precisely after the same process. The apple juice is augmented with sugar and water, the resulting liquid to be of a standard of seventy to eighty degrees according to the strength required. Here again practice alone can make perfect. So any of our juicy fruits, especially currants, gooseberries, raspberries, blackberries, strawberries and tomatoes, and the crushed stalks of rhubarb, can be made into most palatable wine, by Gallizing, as directed for cider. Indeed the acid fruits can not be made drinkable in any other way. So it must be confessed as applied to American grapes the result has been most excellent wine, and so far as tests have been made, the product is not more injurious to the human system than the pure juice of the grape fermented and made into wine.

GALLON. The imperial measure contains 277 274 inches, or ten pounds of distilled water at 62° Fahr. It is equal to four quarts, or eight pints. The old wine gallon contained 231 cubic inches; the beer gallon, 282 cubic inches. Each of these standards is used in different States. The half peck is a gallon in dry measure.

GALLOWAY. A pony of thirteen to fourteen hands. Originally, a small breed of horses. A variety of Scotch cattle.

GALLOWAY CATTLE. It is more than probable that representatives of this hornless race of cattle were early brought to America by the English and Scotch settlers since, as a boy, we often found this blood cropping out in what were then termed Muley cows, and, as a rule, they were better than average milkers, and generally brown or black. About the year 1850 Galloways were imported into Canada, where they were carefully bred, and from whence they have been disseminated through the West, herds of them being not now uncommon at our yearly State Fairs, being much liked in the colder districts of country for their docility, hardiness and feeding qualities. The Galloway constitutes one of the most important breeds in Scotland, and made its appearance in the Lowlands within the last hundred years. Up to that time the cattle of the country were chiefly horned, like the rest of the Highland Scots. Since then the polled beasts, of which there were some even then, have gradually supplanted the horned breed, being much preferred by the English graziers as being more docile and kindly feeders. About the time of the general revival in agriculture, Lord Selkirk had his attention drawn toward the improvement of the stock of his own county, and he began his experiments upon the polled breed, and by selection and care raised it to the most prominent position among the Scotch cattle. Since his day many good breeders have continued the work, and brought them to the high state of perfection in which we now find them. Youatt thus describes the Galloway of his day and date: They are straight and broad in the back, and nearly level from the head to the rump. They are round in the ribs, and also between the shoulders and the ribs, and the ribs and the loin. They are broad in the loin, without large projecting (hip) bones. In roundness of barrel and fulness of rib they will compare with any breed, and also in the proportion which the loins bear to the hook bones or protuberances of the ribs. The Rev. Mr. Smith, the author of the Survey of Galloway, says that when viewed from above the whole body appears beautifully rounded, like the longitudinal section of a roller. They are long in the quarters and ribs, and deep in the chest, but not broad in the twist. The slightest inspection will show that there is less space between the hip bones and the ribs than in most other breeds, a consideration of much importance, for the advantage of length of carcass consists in the animal being well ribbed home, or as little span as possible lost in the flank. The Galloway is short in the leg and moderately fine in the shank bones; the happy medium seems to be preserved in the leg, which secures hardihood and a disposition to fatten. With the same cleanness and shortness of shank there is no breed so muscular above the knee, while there is more room for the deep, broad, capacious chest. He is clean, not fine and slender, but well-proportioned in the neck and chops; a thin and delicate neck would not correspond with the broad shoulders, deep chest, and close, compact form of the breed. The neck of the Galloway bull is thick almost to a fault. The head is rather heavy, the eyes are not prominent, and the ears are large, rough, and full of long hairs on the inside. The Galloway is covered with a loose, mellow skin of medium thickness, and which is clothed with long, soft, silky hair. The skin is thinner than that of the Leicestershire, but not so fine as the hide of the improved Durham breed; but it handles soft and kindly. Even on the moorland farms, where the cattle, during the greater part of the year, are fed on the scantiest fare, it is remarkable how little their hides indicate the privations they endure. The prevailing and fashionable color is black; a few are of a dark brindled brown, and still fewer speckled with white spots, and some of them are of a dun or drab color, perhaps acquired from a cross with the Suffolk cattle. Dark colors are uniformly preferred, from the belief that they indicate hardiness of constitution. The Galloway is essentially the grazier's beast, being little fitted for the dairy, though the milk is rich. Great numbers of heifers are spayed, and then make superior fat animals. The calves are allowed to suck their dams for some time, until they begin to eat, when they are gradually weaned by allowing them to suck but two teats, while the other two are being milked. When the milk is finally discontinued they are turned onto fresh grass. They are well kept the first winter, the Galloway farmer believing that if once checked at that age in their growth they rarely attain the size or feed as well afterwards. But after the first season they are left to rough it, being rarely housed and only fed, during the winter, a little hay or straw in the fields, picking up the rest of their food from the remains left from the summer's grass. As may be inferred from this treatment, these animals are very hardy, and at the same time quiet and docile, entirely differing from the vicious, restless little Highlanders, their forefathers. They do not arrive very early at maturity, but at three and three and a half years old will weigh from six to eight hundred pounds, and when older they can be fed up to fourteen hundred without difficulty. The spayed heifers are rather smaller than the bullocks, but they are fit to turn off at an earlier age and their meat is considered more delicate. They are usually spayed when calves, and the operation is no more difficult or dangerous than that of castration. At the Smithfield fat-cattle show, in 1861, a black Galloway cow was shown by Mr. McCombie, of such remarkable merit that some of the critics went so far as to say she should have won the gold medal for the best fat cow of any breed, instead of the short-horn cow to which it was awarded. We copy the remarks of the Mark Lane *Express* about this animal: Here we have unquestionably the best Scot that has put in an appearance for many a year, perhaps the best that was ever seen. Not only is her form so perfect—back, rib, shoulder point, breast end, loin, hip, flank, and rump—but her thigh and twist are wonderful, the rounds of beef full and heavy to the very hocks; her head is beautiful, exactly characteristic of the breed; her coat just what it should be, and she handles like what she is, a magnificent feeder, of a quality worth something to the butcher, and calculated to make the appreciative epicure smack his lips. In proportion to her symmetrical figure elsewhere, her girth forms her weak point; but even this is eight feet nine inches at four years and ten months old. Such commendation as this, among so many superbly fatted animals as are annually collected at the Smithfield show, speaks volumes for the feeding qualities of the Galloway. It is a curious fact that so thoroughly indigenous and acclimated is this breed to their native county, that all crosses of them with improved breeds, have been inferior to the pure race; even the short-horns have failed here to communicate the improvement they have been proverbial for doing in almost all other instances, and the Galloway breeder now wisely confines his attention to the improvement by selection and care of his own native breed. We are inclined to think, from the uncommon hardiness and vigorous constitution of this breed, together with their property of laying the fat on the most valuable parts, and the superior quality of their beef, that there are portions of our country where they would be more profitably bred than some of the larger races of cattle. There are large tracts, of greater or less extent, along the whole range of the Alleghanies, as well as in the northern portions of New York and the New

England States, which might be occupied with advantage by some hardy breed of cattle, adapted to the climate and region, whose product of beef would be remunerative, and whose constitutional vigor would enable them to live and thrive in those localities. We think were the Galloways introduced into such situations they would be found admirably suited to them, and would soon acquire the reputation and value in our markets that their well recognized quality of meat gives them in England.

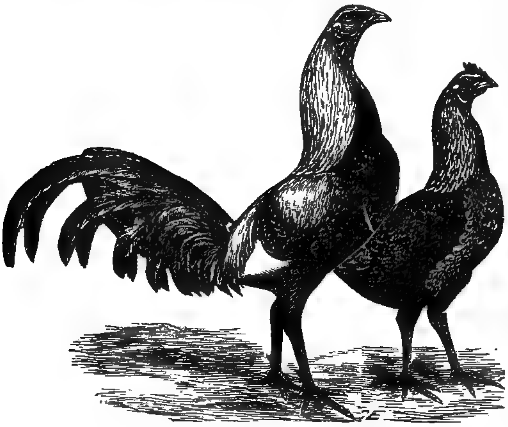
GALLOWS OF A PLOW. A part of the plow head.

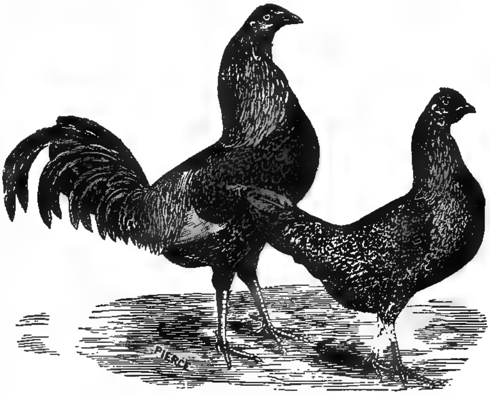
GALLS. In farriery, wounds produced by the friction of harness. The little tumors formed under saddles are called warbles. Washing the galled places with a solution of sugar of lead, or keeping them clean with a plaster of common ointment, or dressing with simple cerate, and allowing no further pressure on the part until it is healed, are the proper remedies. Windgalls are little tumors about the heels of horses over-driven, not, however, constituting unsoundness.

GAMA GRASS. *Tripsacum dactyloides* A coarse, perennial, indigenous southern grass, growing to four or five feet. It is very productive, and may be propagated by seeds or roots. The cultivation is scarcely thought advantageous. It is distinct from Grama grass, (*Bouteloua*) a valuable grass of the plains.

GAMBOGE. The dry juice of the *Stalagmites cambogioïdes*, and other East Indian trees; a gum resin; poisonous, a drastic purge and emetic.

GAME FOWLS. While it is a fact that the Game Fowl is the most elegant and intelligent of the gallinaceous tribe of barnyard fowls, it is as true that they are not generally liked by farmers, on account of their pugnacious dispositions. In fact they can not be kept with other breeds, since they at once master and drive every other male bird away. Hence they must be kept separate, this rule will follow with all pure breeds. If to be bred pure, breeds must be kept separate. With game fowls however, males of other breeds will seldom mix with game hens, since the male bird of games never allows an approach of others to his flock. In the United States the same care in breeding games is not generally followed as in England. Since public opinion and law is so strongly against cock fighting that it must be practiced in secret. Yet among those who do breed them pure, as much care and intelligence is bestowed as in England itself. The eggs and flesh of Game fowls are among the most delicate food of any of the gallinaceous tribe, and many fanciers keep them solely for the sake of the flesh and eggs. Their size is medium, the weight of mature birds varying from four to six pounds. The varieties are numerous, and there are many sub-varieties, often having but a local celebrity. So the English, Irish, Malay, Cuban, Mexican, Spanish, all claim special celebrity, while in the South, the Georgian are held to be the most superior, in point of plumage, shape, carriage, hardiness and courage, as they are generally admitted to be superior in the quality of the eggs and flesh. Among fanciers for the pit, the Derby and Duck-wing games are regarded, as among the best of the games. The cut given above shows the Black-breasted Red Game cock and hen. The cocks of this breed, must have the feathers of the head dark red, inclining to orange; the hackle clear orange-red to the very point of the feathers; the back, shoulder and shoulder coverts rich violet-red, the saddle orange-red, and the breast and tail a rich black, perfectly free from white. Red eyes denote pure blood. Lewis describes them as follows: The cock's hackle is striped underneath, but never above; the comb and wattles bright red; the wings are of the same color in the upper part, and rich red chestnut in the lower, with steel blue bar across; breast bluish black, with glossy reflections; thighs the same; tail greenish black, without much down at the roots of the feathers; legs are usually yellow in color. The hen should be of a rich partridge-brown, with red fawn-colored breast; reddish golden hackle with dark stripes. The Duck-wing Game, as illustrated, is another of the breeds of the first class. There are yellow or birchen Duck-wings, but the pure Duck-wings are considered to be the same as the Silver Grays, the blood being acknowledged purer, and it is claimed that they are finer, hardier, and better fighters than the others. Their character is given by Tegetmeier as follows: The cocks, to be correct in color, should have the hackle nearly clear white, with a very slight tinge of straw color, without any decided yellow tinge or dark streak on the feather. The saddle should be as nearly as possible the color of the hackle; the breast a maroon straw; the shoulder coverts a


DUCK-WING GAME.



BLACK-BREASTED RED GAME.

rich brass or copper maroon; the breast and tail pure black. The hens to match these cocks should have their necks of a clear silver, striped with black, the silver to go right up to the comb, but being a little darker above the eyes; the back and shoulder coverts a bluish-gray shaft of feather scarcely showing any difference from the rest of the feather, any approach to red or pencilling being decidedly objectionable; the breast salmon color, of a nice, rich shade. Salmon Pile Games and Dominique Games, comprise the principal additional varieties of Game Fowls, except those previously mentioned.

GANGLION. A natural swelling or enlargement on a nerve. A painful tumor formed on the sheath of a tendon.

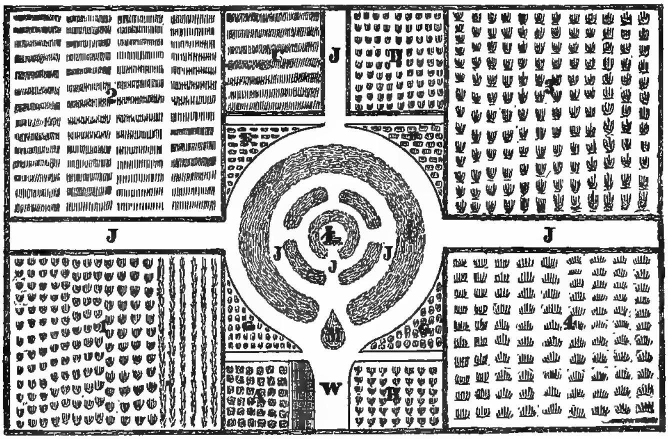
GANGRENE. Mortification. An ulcer which produces the death of the part; this result is usually the consequence of very feeble health. Nutritious stimulants are to be administered.

GAPE. In ornithology, the opening between the mandibles.

GARDEN. An enclosed place or plat, where plants of any kind are carefully cultivated. Thus we have vegetable garden, fruit garden—generally applied to the cultivation of dwarf trees, berries, and small fruits—herb garden, flower garden, landscape garden—used sometimes to designate places where landscape effects are used in combination with carpet bedding, and dwarf trees, and shrubs. The term now-a-days is used generally as applying to the vegetable garden, and flower garden, although it may be properly applied to all the special uses we have mentioned. (See Gardening)

GARDENER. (See Gardening.)

GARDENING. The term gardening is used to designate the cultivation of culinary plants, flowers, and the adornment of the landscape. Thus we have in special branches of these elegant and fascinating branches of agriculture, kitchen gardeners, who raise vegetables solely for private use, or, as in the case of large hotels, where persons are especially employed to grow the vegetables daily prepared for the guests. Market gardeners are those who cultivate tracts of land for the daily markets of cities and villages. A gardener proper, as the term is now-a-days generally understood, is one who raises flowers and vegetables for his own account, or for wealthy citizens, and includes the use of hot-beds, cold frames, green-houses, conservatories, and hot-houses. The landscape gardener deals principally with landscape effects in the building of ornamental walks, drives, roadways, rock work, bridges, lakes, ponds, water courses, and the planting and adornment of the same. The florist, to whom the term gardener may be correctly applied, is one who devotes his time to certain classes of flowering plants, for sale, and also to cut flowers and the making of bouquets and floral designs. Their province is chiefly in the green-house and conservatory, strictly hot-house plants being rarely cultivated by them. The term is also generally applied to those individuals and firms in cities, who make a specialty of selling flowering and other plants, and to the making of bouquets and floral designs. Gardening is as old as history. The Lord God is stated to have planted a garden in Eden. Wherever civilization extends gardening early receives attention, but high art is never attained until wealth and refinement is fairly established. England, France, Germany, Austria, Holland, Belgium, and the United States, have more fine gardens, and higher art in gardening than all the rest of the nations and tribes of the earth together, and in the countries mentioned there is more wealth and refinement than in all the rest of the world. As an aid in laying out a garden and in its economical working, we give an illustration of a garden as laid out by the editor (see cut), and plain practical directions so that no one need err. But the next thing is how to grow them economically, and this can be accomplished in a well-drained soil, deeply tilled, heavily manured, and watered when dry. The drainage we suppose to be good. If not, make it so by thorough draining with tile, laid at least three feet deep. This may cost you sixty or seventy dollars, but it will be money well expended. It is one of the prerequisites in gardening. The deep tillage may be accomplished by the aid of three horses, or, which is better, three mules abreast. Each and every plat of this garden may be manured from the main and circular roadway, and the watering may be accomplished by means of a force pump in the center, and a hose. The hot-bed—that *sine qua non* of every well-arranged garden—is placed near the entrance at the south of the roadway. This will enable you to handle the sash and covers easily, and it will, besides, be near enough to the water so it may be easily accessible for watering. In cropping a garden, the deeper the tilth, the more manure may be applied; and this should always be thoroughly decomposed if possible. If this is the case, one hundred loads may be safely applied, to start with, and thereafter, from thirty to forty loads annually. But some of you may say: It is no easy matter to plow under one hundred loads of manure. It is easy enough, however. Spread, evenly, forty loads over the surface and harrow thoroughly, then, with your deep tiller plow turn



GARDEN PLAT.

this in, a foot deep if you can. Spread forty loads more and plow six or eight inches deep. Then spread twenty loads of the finest manure on top, and in the spring before working the land, harrow it until the tilth is perfect. The other work should have been done in the fall. Upon a soil prepared in this manner you will not suffer from too much, or from a lack of moisture, and your principal waterings will have to be expended upon your rhubarb, asparagus, strawberries, lettuce, radish, celery, and other moisture-loving plants, if you want these extra nice. One reason why a garden should be heavily manured and have plenty of water is, that the excellence of most vegetables consists in their succulence, and this can only be produced by forcing their growth. This, plenty of food, water, and good cultivation will always accomplish. No idle spots must be allowed in the garden. They will become harbors for weeds. No useless fallows—the spaces between the rows are the fallows—no yearly rotation. The land must labor with a rotation each year—thus, early radish, lettuce, turnips, beets, top-onions, carrots, spinach, and other quick-growing vegetables may be succeeded by sorts transplanted from the hot-bed, and also by the late corn, beans, and melons. The only rotation being to succeed fibrous rooted plants, when practicable, with tap-rooted ones, and plants maturing their fruit above ground, with those bearing their fruit below; and plants loving a partial shade should be planted in such portions of the garden as will most easily ensure this. Pains should be taken also, to plant the taller growing vegetables so as to obstruct the view from the walks as little as possible, which may be accomplished, measurably at least, by the exercise of a little skill and forethought. As before stated many practical amateur gardeners object to the use of the plow in the garden at all, and with very good reason especially in a small place, but the use of the plow in preparing the land need not be dispensed with, since the cross-roadways need only be temporary paths, which may be made yearly, while the central portion of the garden is entirely filled up with perennial plants. The principal objection to plowing, heretofore, has been that the spade would more thoroughly pulverize the soil than the plow. But with our present improved forms of plows, the pulverization is fully as complete as the ordinary spadesman will effect, and much better than an unpracticed one would accomplish. Within all the angular and circular surfaces, however, and wherever perennials are planted, nothing but the spade and other hand-implements may be allowed. Where space is an object, but little care need be required with the roadways, except the wagon way. This ought, if possible, to present a hard surface; but if this is not practicable, the surface should be kept rounded, smooth and clean, as should indeed all the paths. This may be accomplished, principally with a good rake, by raking to the middle of the roadway from both sides. The great objection among farmers, to the kitchen garden is the cost. They dislike to spend thirty, forty, or fifty dollars a year upon an acre of land. But if they would reflect for a moment that this outlay will produce from two to five hundred dollars in produce, the surplus of which, or that not needed for consumption in their own families, may be easily sold at good prices in the nearest village or city, if not, indeed, to their more negligent neighbors, the objection must cease; for there is no doubt that the product of an acre of garden, well attended, will supply all the vegetables a large family will need, besides selling enough therefrom to defray all the expenses of its cultivation. Hot beds and forcing houses are warmed either by fermenting manure or by fire heat, but for hot beds manure is the best. Hot beds for winter forcing should be about two and a half feet under ground and one to one and a half feet above ground This will enable you to use from two and a half to three feet of manure. The principal crop for winter forcing is lettuce, which may be sown about the middle of September, in a cold frame, covering with glass only during cold nights and severe storms. By the first of November it will be ready to prick out at a distance of two and a half inches each way in a hot bed, and from this time it may have a heat of from 50° to 70° Fahr. By the first of December it will be ready to transplant, the last time, at a distance of five inches each way. By taking out alternate rows, we leave one-half. If we now take alternate plants of the remaining rows, we have one quarter left which will be just five inches apart. Those taken out are transplanted in other beds at the same distance apart. By the first to the middle of January your lettuce will have completly filled the frames, when it should be cut, and, after renewing the heat with fresh manure, other lettuce should be planted therein, which has been brought forward for the purpose, as heretofore directed. By this means, after having matured the first crop, you will raise succeeding ones at intervals of about one month, but since some parts of your beds are colder than others, it will not all come on alike, and with a little care, you can cut a regular supply, each day until it will grow in the open air. About January fifteenth to February first, radish may be sown in drills four inches apart, thinning to one-half inch in the row. These will be fit to pull in from thirty to fifty days. About the twentieth of February provision must be made for forcing cabbage, cauliflower, pepper, egg plant, tomato and cucumbers. The first two named must be grown at a low heat like lettuce and radish; the others require a stronger heat say, 60° to 80°. The least frost will kill these latter plants, but if your lettuce, radish, cabbage, and cauliflower are slightly frozen, the bed should be covered up tight and kept dark until the frost is drawn out of them naturally. If light and air are admitted they are ruined, for it must be remembered that plants grown in this artificial manner are more succulent and tender than the same plants grown in the open air. Air must, however, be admitted to growing plants every day when it is not freezing, and care must be taken that the wind does not blow directly on the plant, by tilting the sash against the direction of the wind. The beds are kept from freezing by covering with slough hay, straw, or mats. My practice is to use two thicknesses of straw or reed mats, and about twelve to fifteen inches of prairie hay, varying it for extreme cold or mild weather. By these means I have grown lettuce when the thermometer has sunk as low as 27° below zero. It is sometimes necessary to keep the beds covered for days together, during cold storms. There can be no directions given which will enable a person to force vegetables in winter with entire success. Practice must also come to our aid. What is essential is to keep them warm at the bottom, not to allow them to get chilled at the top, and to give plenty of air when not too cold. Cucumbers, melon, squash, etc., should be sown in pots, or on inverted sods four to six inches square. As soon as cucumbers show signs of running, they should be transplanted, one hill to each sash, and tomatoes, egg plant, pepper, etc., grown in the vacant spaces, pinching the vines from time to time to make them stocky and fruitful, and removing the other plants as they are crowded. Do not, in any event, allow them to become so. Once spindled, they can never after be made stocky and handsome. Tomato and egg plants sown in February, will require to be transplanted three times before the final setting in the open air, at two and a half, five and eight inches apart. Cabbage and cauliflower should be transplanted once at about three inches apart, and if they come on too fast, keep them cool; in fact, hardening plants for the open air—that is, inuring them to the temperature in which they must finally grow—is one of the things that gardeners too much neglect. It is good practice to grow them slowly, and give plenty of air, and bad practice to grow them fast and harden suddenly. Manure for hot beds should be turned two or three times, until fermentation is equal and the color uniform. It should not be streaked with gray, nor fire-fanged. In placing it in the frames, lay it evenly, throwing out hard lumps, patting it from time to time with the fork, to give it some solidity, and find the soft places. Six inches is the proper depth of mold for the generality of plants, except radish, which requires eight inches. The frames above ground require to be banked with horse manure, even with the sash, and if your bed gets too cold the lining should be renewed. The best manure for hot beds that I have ever used is from the city stables, where saw dust is used for bedding, and next, where oat straw is used. The most important plant for forcing, after lettuce, is parsley. It is treated precisely like lettuce, except that when once planted, the heat is kept up by relining, until the plant is exhausted. Another important article, near large cities especially, is mint (*mentha viridis*). The roots are placed in the beds about the middle of February, by strewing, rather thickly, upon five inches of soil and covering two inches deep, adding another inch just as the plants are coming up. In relation to sashes, six feet long by three feet wide, is a suitable size, but the great proportion of my sash are about eighteen inches square, containing six lights of six by eight glass. These are fastened together by means of thin strips, by placing four sash together, making a sash six feet long by eighteen inches wide. Two of these sections, or eight sash, are equal to one of the previous size. After you are all done forcing your plants in the spring, you take the sash apart, and place single ones over boxes to fit, for covering cucumbers, melons and other tender plants. These sash however, will not do for winter forcing, but are admirable for general use. Drainage is so important a matter in connection with gardening that it must not be passed lightly over. If the soil is at all stiff and retentive, it must be underdrained in order to successfully cultivate vegetables; and it is best and cheapest done, all things considered, with tile. We will suppose that your garden land descends regularly to the east, but that in spring, and after heavy rains, it is wet from the percolation of water from above; in this case, if the drains are three feet deep, they may be placed thirty feet apart and should run directly up and down the slope, the grade being uniform to the bottom, that is, not steeper in one place than another. Tile of a caliber of two inches should be laid so that their ends may meet as nicely as possible. Pipe tile are the best, and collars are advantageous though not indispensable. My practice, where collars were not used, has been to spread two or three corn husks over the joints, which do not obstruct the packing of the earth and yet keep out silt which might enter before the earth was firmly impacted about them, besides which they leave scarcely any deposit from decay as does hay and other like material. The best soil for gardening is a deep, rich, warm sand. A good soil is a friable loam and the worst is a stiff clay. Upon the latter, even if well drained, it is useless to attempt to raise early vegetables; one must content himself with the grosser and later crops. Three important considerations with the market gardener are, a warm, rich soil, nearness to market, and ample facilities for getting manure. Without the first he can not raise early crops; without the second, he can not get them to market in good condition, and without the last, he can not cultivate successfully at all. In gardening it is not sufficient that the land was manured last year. It must be manured this year as well, and the best manure is a compost, composed of every waste thing liable to decay about a city, a village or farm. Forty tons per acre each year of such manure will not hurt any land, and we know soils that receive and consume one hundred loads with profit, per acre, to the owner.

GARDEN LAVENDER. (See Lavender.)

GARGET. This is an inflammation of the udder, and may attack the suckling females, of any farm stock, but is principally confined to cows and ewes. It is not common that the entire udder is attacked, the inflammation being confined generally to one or two sections. There will be swelling, heat, pain and redness of the parts; the system will be generally disordered, and there will be loss of appetite, chills followed by fever, and a disordered state of the bowels. There will be loss of milk, it will be thick, lumpy and bloody. The inflamed parts at length suppurate, break down, and in extreme cases there is a total loss of milk, and in any case if the inflammation pass into suppuration, the value of the animal is permanently diminished. In the early stage the persistent application of cold water, or hot water fomentations, will often remove the difficulty. The milk must be drawn often. A syphon is good. When the fomentation is discontinued, the udder should be dried, and thoroughly rubbed with one half ounce of powdered camphor and two ounces, each, of extract of belladonna, and lard oil, the whole thoroughly incorporated together. If the pain is great the udder must be supported with a cloth, with holes for the teats, and to be fastened over the back. If suppuration ensues and abscesses form they must be freely lanced, the abscesses syringed with weak carbolic acid water, and healed by applying an ointment composed of two drachms of chloride of lime to three ounces of lard, thoroughly mixed. If hard swellings remain, reduce them with an ointment of one drachm of iodide of sulphur, and six ounces of glycerine. In every case we ever had ending in suppuration, we have always found it cheaper, in the end, to fatten and sell the cow.

GARGET-ROOT. (See Pigeon Berry.)

GARLIC. *Allim sepa.* The cultivation of the garlic is of great antiquity. The priests of Isis, in ancient Egypt, were forbidden to eat either garlic or onion. The Romans disliked garlic on account of its strong and disagreeable odor. The Greeks cultivated it extensively, and it was used freely by the poorer classes, and the Greeks of this day eat it freely. In Spain, Italy and other countries of southern Europe it is still eaten in a variety of dishes, and it is grown all over central and southern Asia. Its cultivation is exceedingly simple. The cloves are planted in rows six inches apart, by the same distance in the row, and kept free of weeds. When ripe and dry they are tied in bunches or strings and exposed for sale. In the United States garlic is seldom eaten, its use being almost wholly confined to medicine.

GASTRÆUM. In zoology, the whole under surface of an animal.

GASTRIC JUICE. The secretion of the stomach, which, by dissolving fibrin, albumen, caseine, and nutritious matters, has the power of producing chyle, which repairs the waste of the body. It contains pepsin, and is sometimes acid, at others alkaline.

GASTRITIS. This is the name applied to impaction of the third stomach in ruminants, also called stomach staggers and mawhound. It is the distention of the third stomach (*omasum*) with undigested food, and may be followed by congestion, and inflammation of the lining membrane extending even to the fourth stomach. The symptoms are, glaring eyes, madness, staggering, or even prostration by fits, at other times there will be stupidity, and paralysis of the hind quarters. The bowels will first be loose followed by the most obstinate constipation. Blood and water may be passed, with violent straining, and hard lumps may be felt on the belly over the stomach. Give as a sedative two drachms extract of belladonna, and one ounce of bicarbonate of soda, in a pint and a half of water, three or four times a day, allowing it to trickle down slowly, until the urgent symptoms are abated. After that give a quart of linseed oil every day until the bowels are freely moved. The form of Gastritis occasioned in the West, by cattle eating smutty corn in the fields, is attended with sluggishness, stupor and staggering, or by wildness, delirium, and apparent blindness. The following is recommended by Prof. Gamgee, who investigated this disease in behalf of the United States Government. One pound Epsom salts, four drachms powdered aloes, two drachms powdered ginger, and one quart of linseed tea or corn meal gruel, aided by warm injections of a quart or two of lukewarm water every half hour, until the bowels are evacuated. If the bowels do not act freely by the second day, give one half drachm carbonate of ammonia, in a quart of linseed tea, repeated two or three times a day. Upon the return of the appetite, feed succulent food—roots and sweet hay, until the animal is entirely recovered.

GATES. There are few more important conveniences about a farm, and certainly comparatively few farms that are as well supplied as they should be with free swinging gates, that will remain open without sagging. The cause of the sagging is from the settling of the post, or from its being drawn over out of the perpendicular line by the weight of the gate. This obviated, the construction of the gate is merely a question of taste and of the time or money to be expended. To prevent sagging, the posts should be large, set deep on a flat stone, and braced underground in the direction of the strain. The earth must be rammed hard, little by little, around the post. When great strain is expected, as in very heavy, long gates, a trench should be dug from the post at the heel to that at the latch end of the gate, and the two posts connected by scantling mortised into each post, six inches from the bottom, and again six inches from the top. Thus both posts are firmly united, and all sagging is prevented. If a gate is hung exactly perpendicular, it will turn freely in any direction and remain at rest whenever it is stopped. It is extremely difficult, however, to so nicely adjust a gate that it shall always remain exactly true. Hence, various devices have been adopted to prevent sagging or getting out of line. A gate to be self-shutting must be hung with an inclination. If the turning point of the upper hinge is one and a half to two inches nearer the gate than the lower hinges, the gate will fall shut if not opened more than three-quarters of the semi-circle it describes in being fully opened. Thus if the hinges are three feet apart, and two inches out of plumb, a gate twelve feet long will rise at the latch end, eight inches in opening, thus working over ordinary drifts in a snowy country. When the fixtures may be had, all things considered, slide gates are most handy. The swing and slide gate is easy to handle and easy to make, so far as light gates are concerned. Patents were granted in 1862 upon this device, senselessly, if not criminally so, since this idea has been used in the West for forty years or more. The idea is simply to set the posts, upon which the gate slides or turns, diagonally; connect the posts with pins where the top and bottom slat rests; the gate may be pushed back part of the way, and then swung round as desired. Any farmer who is handy with tools, may, by paying attention to the hints given, construct rough gates for the farm. When ornament is desired, any good carpenter should be competent to perform the work.

GEINE. The same as humus, geic acid, ulmin, humic acid. (See Humus.)

GELATIN. That species of animal matter which forms jelly with water when cold. Isinglass, glue, and size are representatives of this body in different states of purity. It abounds in skin, membranes, horns, and bones, but requires long boiling, at a high temperature, for its extraction. A very dilute solution is precipitated by infusion of galls, the product being leather. Gelatin is not capable of itself to sustain life. When moist, it runs into the putrefactive decay, yielding a fetid odor, carbonic acid, water and ammonia. It is a powerful ammoniacal manure in this state, and is best economized in composts. Unboiled bones owe some part of their effects to the decay of their gelatin, which is present to the extent of thirty per cent.

GELDING. A castrated animal. The act of castrating. The most proper seasons are either the early spring months or those of the autumn.

GEMMA. A bud. Hence gemmiparous, bearing buds, or parts capable of development.

GENA. In zoology, the cheek, or part of the face between the eye and mouth.

GENERATION. The production of life has always been a favorite study of scientific minds. All labor, however, to this end, has really added little to our knowledge of the genesis of life. The theory of spontaneous generation has been a favorite dogma with many superior minds, and yet, again, we have no real facts to support the theory. Hence it soon began to lose ground, and is now generally denied by scientific minds. The following condensed arrangements of facts, as stated by the Chemist of the Department of Agriculture of the United States, some years ago, will illustrate how generation may become active, as well as give some means of preventing generation, as in preserving substances necessary to be kept intact. (See also Fermentation and Fungi.) In regard to the origin of yeast cells, for instance, we have to contend with the same conjectures and diversity of opinion as when accounting for the sudden appearance of millions of infusoriæ in stagnant water, or in explaining the origin of intestinal worms. It has been stated that the yeast cells already existed in the juice of the living grape, and all other kinds of fruit able to yield fermentable juice, such as apples, pears, blackberries, etc. These minute vesicles, it was said, might readily pass through filtering paper, but it is certain that filtered juice of fresh fruit when examined under the microscope, exhibits no solids, no organized ferment of any kind, but after two of three days apple or pear juice, for instance, will exhibit yeast fungi, and, at the same time begin to ferment. Hence the conclusion is inevitable that we have here to do with a spontaneous cell formation, called *generatio equivoca* or *originaria;* that is, the yeast plant may, without the mediation of a mother plant, originate in a liquid containing, besides water, sugar, dextrine, (gum,) and albuminous matter. The experiments of Schulze, Schwann, Pasteur, Schroeder, and Dusch favor the idea that the germs of the yeast fungi are diffused in the air and water ready to germinate and multiply whenever a favorable opportunity presents itself, like the eggs of the infusoria which have actually been traced in the air, water, mist, and even snow. Profs. Wormley and Sullivant, of Columbus, O., have carefully determined that even with the most powerful microscopes, vision is limited to objects of about one eighty-thousandth of an inch in diameter. Now, some infusoriæ are not more than one twenty-four thousandth of an inch in diameter, and if we suppose that the ova of infusoria and the spores of minute fungi are no more than one-tenth of the linear dimensions of the parent organism, there must be an incalculable amount of germs no larger than one two-hundred-and-forty thousandth or one one-hundred thousandth of an inch in diameter, which may appear in putrescible liquids, in far greater numbers than the germs in atmospheric dust, visible by the aid of the microscope, would lead us to expect. Schwann established the experimental proof that when air is first passed through an ignited tube, before coming in contact with the solutions of sugar, containing besides some nitrogenous substances, no fermentation is excited. The same negative result is witnessed when the air is conducted through an apparatus filled with concentrated sulphuric acid (oil of vitriol) or even a strong solution of caustic potash, (Schulze) or even when filtered through cotton-wool, (Schroeder and Dusch). Dr. F. Mohr makes some recommendations founded upon Schroeder's experiments, among which we will mention that the casks should be closed, after the wine has ceased fermenting, with a bung, through which passes an air-tight glass tube filled with cotton-wool. Thus the air will be sifted of germs as it enters the cask upon the withdrawal of wine by the stop-cock. The fermentation previous to that precaution is best conducted in casks closed by means of a glass tube bent like an inverted letter U, one leg of which is inserted through the perforated bung, while the other dips into water placed in a vessel. By means of this arrangement all the carbonic acid liberated during the fermentation passes out through the water and can easily be watched, while the air is prevented from coming in contact with the liquid in the barrel. A layer of the heavier carbonic-acid gas on the surface of the liquor makes the exclusion still more complete and prevents the gathering of mold (*fleurs du vin*) though the cask be not full. Without such an arrangement it is impossible to prevent the access of air and spores through the invisible openings and fissures in the staves of the casks. On the other hand a slow oxidation seems desirable, to separate nitrogenous matter and to ripen and improve young wines, whilst the development of the bouquet in older wines seems to be promoted by the exclusion of air or oxygen. This gas, in fact, destroys it when brought in free contact with the wine. The germs being destroyed by heat, chemical agencies, or mechanically removed from the air, no yeast fungi are formed. From these facts, Appert's method for preserving different kinds of food may find its explanation. Milk, meat, and vegetables are put into tin cans; these are placed in boiling water and immediately hermetically sealed. Liebig's explanation is that the trace of oxygen in the air that may still be present with the food is at once taken up by some parts of it without giving rise to the formation of ferment at this high temperature; while Schwann believes that by the destructive influence of the heat on the germs of fungi and infusoria, the food is preserved. Though the old theory of spontaneous generation, even when limited to some of the lowest orders of vegetable and animal life, is daily losing ground, and the *omne vivum ex ovo* has become the axiom with naturalists, still there remain yet many unsettled points in connection with this matter, which require further investigation. Thus if we take it for granted that, according to Gay Lussac's experiments, a few bubbles of oxygen gas obtained from chlorate of potassa at a high temperature induce fermentation (when admitted to grape-juice surrounded by an atmosphere of hydrogen or carbonic acid,) it must be admitted that in this case any vegetable germs must have been excluded, provided that those already present in the juice had been destroyed by boiling, and still fermentation took place; and if this be so, were there no yeast plants present? It must also be remarked that in some of the experiments, where the results appeared to favor spontaneous generation a mercurial bath was made use of, to isolate the substances experimented upon. Pasteur has since ascertained that mercury taken from the bath of any laboratory is itself loaded with organic germs. He likewise found that the contact of the atmospheric air with a fermenting liquor is primarily indispensable, only as being a vehicle for the germs of the various ferments. Vegetable organisms frequently collect as mold in saline solutions, and decompose them; also even in dilute sulphuric acid. They have never as yet been observed in solutions of chromic acid and chromates, whence these answer well for preserving brains and other highly albuminous anatomical preparations. A solution of tartaric acid will, even when left in tight glass-stoppered bottles, soon become turbid, and lose its acid taste. A microscopic examination will always trace the cause to a formation of mold which feeds upon the acid. The so-called vinegar plant is a vegetable organism, and acts as a ferment when brought into dilute alcohol. Some mineral waters containing free sulphuric acid, and tasting strongly sour, are filled with vegetable mold. Thermal springs of a very high temperature are not exempt from vegetable productions. Even in poisonous liquids containing arsenic, etc., we find some species of fungi which flourish and multiply. Ehrenberg, the distinguished Prussian naturalist, who has devoted the greater part of his life to the study of infusorial life, is opposed to a *generatio equivoca*, and believes that infusoriæ are developed from eggs. He has described about eight hundred living species of these microscopic animals, which swarm almost everywhere. They abound in countless numbers even in the fluids of living and healthy animals. Owing to the extreme lightness of these beings we must not be surprised to learn of their transportation by storms over whole seas and continents. Ehrenberg believes that the baccilariæ found upon some steeples at Berlin came originally from South America. In the Alps there is sometimes found a snow of a blood-red color; it has been ascertained that this coloring matter is composed chiefly of a one-celled plant (*Protococcus nivalis*) of the tribe *algæ;* and, what is most singular, when the snow has been melted for a short time so as to become a little warmer than the freezing point, these beings die because they can not endure so much heat! The effect of antiseptics in arresting fermentation may be differently explained according as we favor Liebig's or Schwann's theory. The former assumes that corrosive sublimate, arsenic, and creosote, uniting with the ferment, prevent the decomposition of it, and, in consequence, that of other organic bodies with which it is in contact. Schwann believes that these substances, acting as poisons, destroy the life of the previously described organisms, and that hence the metamorphosis of vegetable substances is arrested by them. We must acknowledge that, notwithstanding the voluminous writings regarding the origin of many of the lowest forms of animal and vegetable life, it is yet a mystery, and that here fancy has as great scope as ever. The spontaneous change of azotized organic matter called putrefaction is most closely allied to the process of fermentation, being mainly characterized by the evolution of gases of a disagreeable odor, as ammonia, and sulphuretted and phosphoretted hydrogen. For this transposition of elements, moisture, and contact with air, are in the first instance indispensable. It was believed that the animalculæ making their appearance in putrescent substances constituted the primary agent or cause of decomposition; and even if more recent investigations have modified this view, it must be admitted that these minute animals hasten and intensify the resolution of the elements.

GENERATION, EQUIVOCAL or SPONTANEOUS. Being produced without known parents. Originating without apparent seed or germs.

GENESEE OIL. A petroleum found floating on some of the waters of western New York, Ohio, Kentucky, etc.

GENICULATE. Bent at a sharp angle, like the flexed knee.

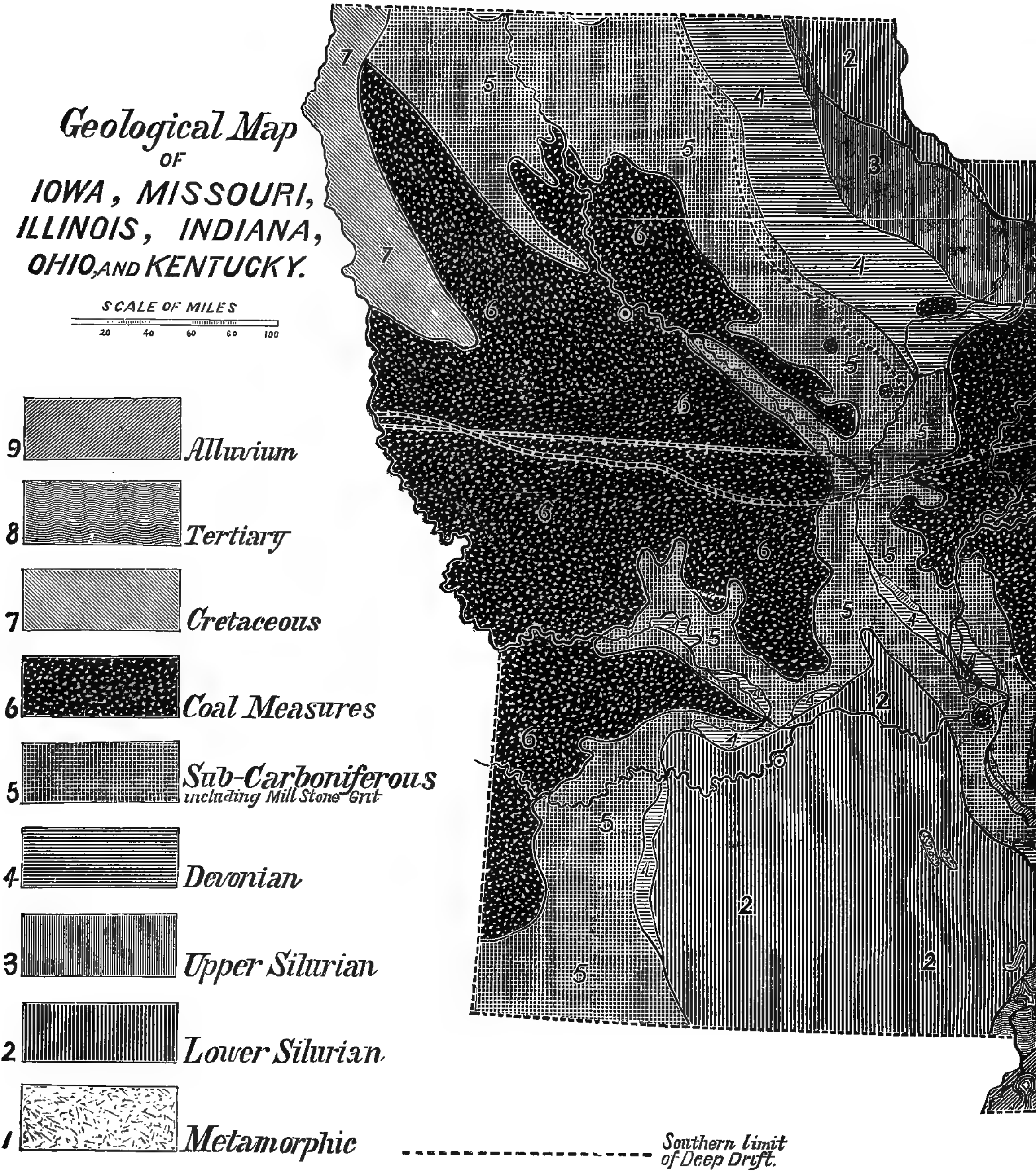
GENTIAN. A genus of highly ornamental plants; the roots of some afford fine bitters, especially the *Gentiana lutea* of Switzerland.

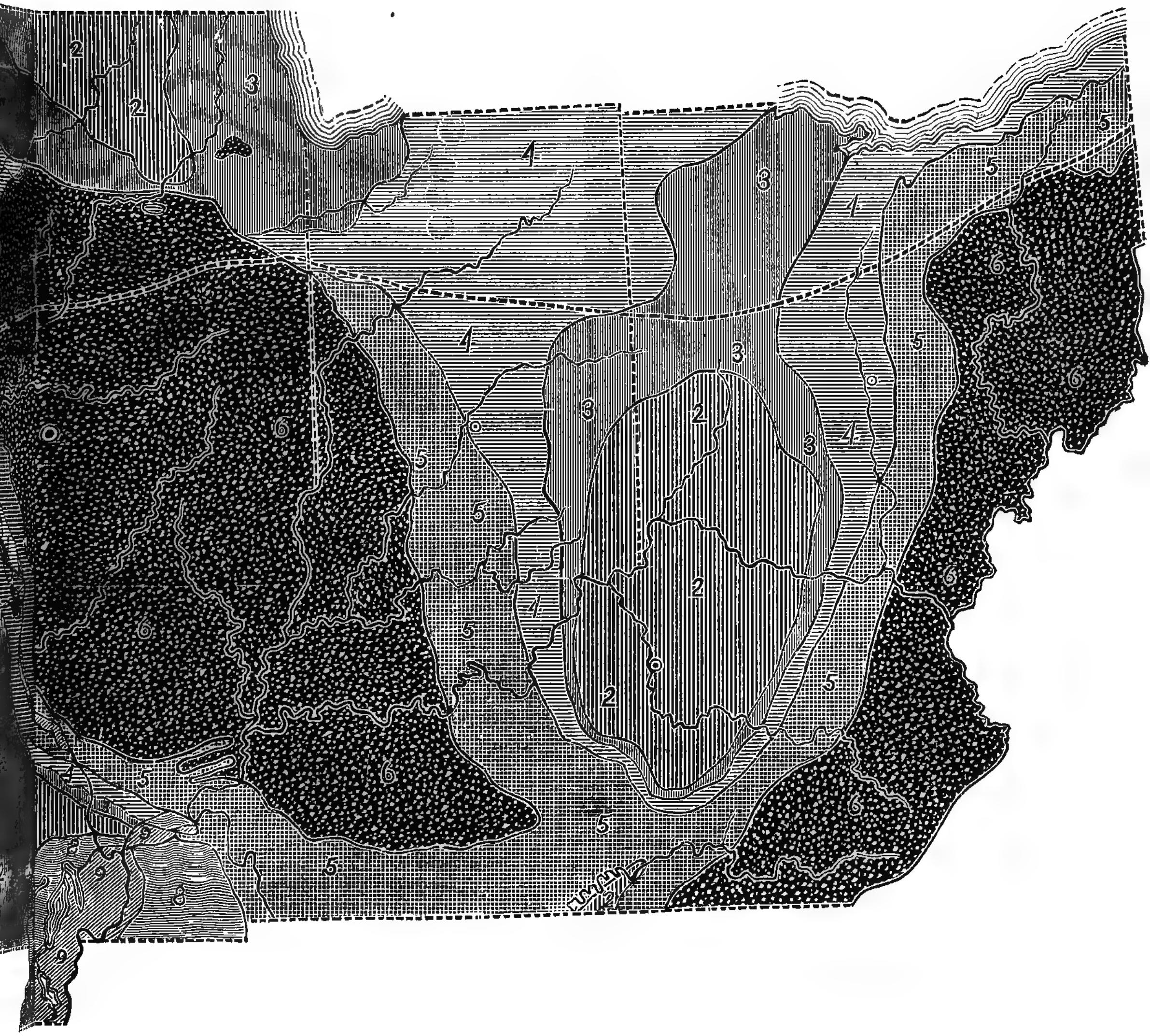
GENUS. Plural *Genera.* In natural history, a distinct but lesser family of plants or animals which are grouped under one general name, and contains distinct species.

GEODES. Mineral masses having a hollow center.

GEODESY. The measurement of the earth's surface.

GEOLOGY. Geology as an agency in the formation of soils is an interesting study to the farmer. By it he may not only form a definite opinion as to the nature of the soil, by knowing what earths are produced by the decomposition of certain rocks, and the elements of which they were composed, and the study is interesting as showing the various agencies in nature used in the formation of soils, and especially in the formation of western soils. Hon. James Shaw, of Illinois, some years ago, when more actively engaged than now in studies relating to the soil and soil uses, in an address before the Illinois State Horticultural Society, well and accurately elucidated the subject of geology, as relating to the origin and formation of soil, the district of country referred to being rich in various strata, and in its diversity of soil. Speaking of that part of Illinois lying north of the old Silurian beach, which crosses the State from a point near Hampton, north of Rock Island, on the Mississippi river, and passes eastward, a few miles south of Ottawa, bending up a little north of Morris, and passing on to the eastern line of the State, south of Chicago, says: The land north of this Silurian beach was comparatively elevated table land at the time the coal deposits of the great coal basin lying south of this old beach were in process of formation. And there is evidence that over this comparatively elevated table land a great denudation has taken place. Some great force has worn off and swept away, from southern Wisconsin and Northern Illinois, a large amount of material, which has been deposited over the face of the country south and west of that elevated region. It is estimated by Prof. Whitney and other good geological authorities, that at least 300 feet has been denuded and carried away in the region of the Illinois and Wisconsin mounds. These mounds—Scales mound, the Blue mounds, Terrapin ridge, and the various elevated and island-like elevations left over the general level surface of that part of the State north of this old Silurian beach—


Geological Map of IOWA, MISSOURI, ILLINOIS, INDIANA, OHIO, AND KENTUCKY.
SCALE OF MILES
20 40 60 80 100
9 Alluvium
8 Tertiary
7 Cretaceous
6 Coal Measures
5 Sub-Carboniferous including Mill Stone Grit
4 Devonian
3 Upper Silurian
2 Lower Silurian
1 Metamorphic
Southern limit of Deep Drift.



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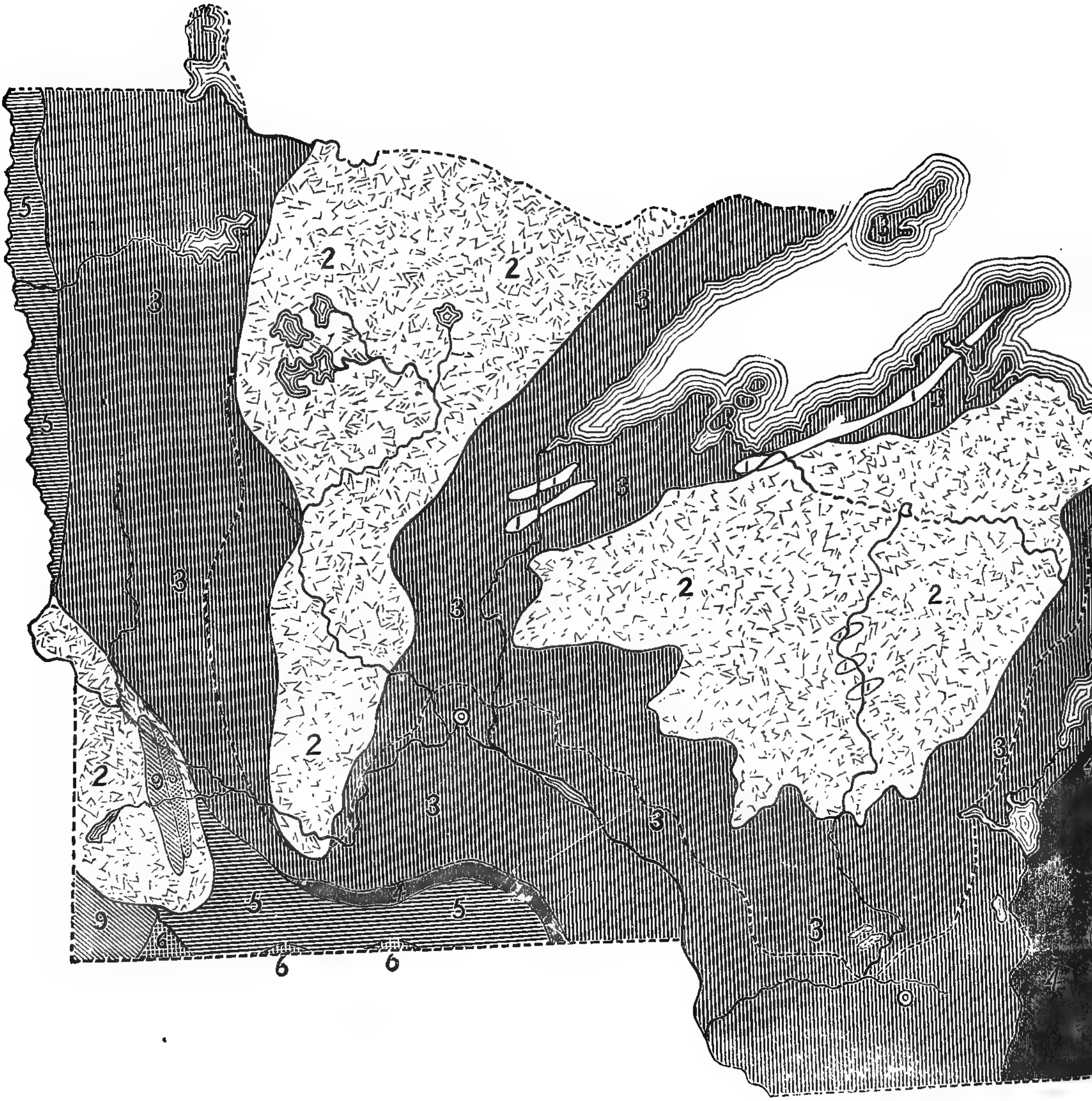
are mountains left standing when the rest of the formation was swept away. Any one with thoughtful mind, who stands upon their tops and looks over the surrounding country, or who examines the regular succession of outcrops up their sloping sides, can not resist the conclusion that the general level of the whole country surrounding once corresponded with these highest points. As in reading a book, we at once miss the pages which are torn out, so in examining these mounds, we at once miss whole leaves and parts of leaves in the Great Stone Book, which have been removed by the forces of which I shall presently speak. The Galena Limestone, the Cincinnati Group, and the Niagara Limestone, are the leaves, whose fragments yet remain to attest a time when each one of them in regular succession spread over the region now under discussion. Against this Silurian beach the coal measures are shingled, as it were, or deposited. At Ottawa, Ill., the old St. Peter's sandstone shines like sugary masses along the river banks, and is elevated in fantastic shapes at Deer Park and Starved Rock, a little to the northeast; but at LaSalle, a few miles southwest, coal pits are sunk for hundreds of feet, and the black treasures of the earth found in the greatest abundance. At Sublette the Galena limestone is the bed rock nearest the surface; but at Princeton, toward the south and west, an artesian well, five hundred feet deep, still exhibits coal measure deposits. This shows that this old Silurian beach, in the carboniferous ages of the world, presented the appearance of a somewhat abrupt range of hills across that part of the State. Over that part of the country north of this beach, the bed rocks are covered with superficial deposits from ten to fifty or one hundred feet in thickness, composed of clays, sands, loams, gravels, drift materials, and prairie soils of later growths. If this superincumbent mass should all be removed, leaving the naked bed rocks, the general face of the country as to levelness of appearance, would not vary much from the present state of things. In classifying the soils in this Rock river district, we find several well marked varieties. The alluvial deposits of the river bottoms are latest in formation, and deserve a brief notice. In examining river deposits, the first thing worthy of consideration is the flood bed. Here the action of the river is that of currents, or flowing water. Where the current runs strong, sand will be thrown up in tow heads, and sand banks, and sand islands; in the still places a fine black mud will be deposited; and this force will exert a sifting and assorting influence, and form mud flats and banks, and deposits of pure sand. The next action of the river will be over its flood plain, or that part of its bed covered only by the high water of the spring inundations. This is usually a low bottom, covered at the flood of the river with water, and producing a heavy crop of sour prairie grass later in the season. Over this the water usually rises and falls without much current action, and a yearly Nile-like detritus, or fine mud, is precipitated. The soil thus formed is fat, deep, and sour, and is unfit for agricultural and horticultural purposes, until it has been built up beyond the influence of the river floods, and sweetened by the sun and atmospheric influences. Then it becomes a soil of inexhaustible richness and productiveness. Stepping backward in geological time, we next come to the old river terraces, which are simply the ancient flood-beds and flood-plains of these same rivers, at a time when they rolled an infinitely larger volume of water to the sea. Over these are the sandy soils, and the rich, flat bottom lands, Nile-like in their inexhaustible productiveness. The Mississippi river, Rock river towards its mouth, and many of the smaller interior streams present these well known river phenomena; and make a notice of these alluvial deposits, and this fluviatile action necessary in speaking of the soils of the State. Receding backward in geological time, we come to the bluff formations, the oldest deposits of the Quaternary system. This is called the Loess, or Bluff formation. It is not extensively developed in Northern Illinois, but is present in most of the bluffs which skirt our streams. Deep rooting trees and vines find in it a congenial soil, and the best soil conditions of growth. Some of these Loess or partly Loess formations in our part of the State would be the best fruit and wine producing districts in the world if kindly Italian skies and genial atmospheric conditions smiled on the tops of the trees and vines. When the Mississippi and the Illinois rivers were lake-like in their expanses, and the waves beat up against their bluff shores, throwing up silt, oozy detritus, and frothy marls and sand, this bluff formation was deposited and accumulated. It is composed of light cream colored clays, greenish marls, muddy sands, and various combinations and mixtures of these; and, as already intimated, it affords the best soil conditions in the State, or in the world, for the growth of the vine and all kinds of fruit trees. Even in our chilling and unfavorable climate, fruit and grapes of fine appearance and good quality are beginning to be produced in considerable abundance. At Galena, Morrison, Mount Carroll, and Sterling, I have seen small vineyards purple with their great crops of generous fruit, and orchards laden with the finest of our hardier apples; while the strawberry, raspberry, gooseberry, cherry, and other kindred fruits are raised in the greatest abundance, and of good quality. Next to the Loess in succession are the regular soils and clayey deposits which cover the uplands or general prairie level of the country. And inasmuch as these are originally derived from the decomposition of the rocks, it will be well to call attention to the character of the bed rocks in this part of the State. If the dirt mantle covering these rocks, in that part of the State now under consideration, was all stripped off, the rocks then exposed would be found to belong to the Galena Limestone, Cincinnati Shales, and Niagara Limestone, coming to the surface in irregularly shaped patches. Now, the soil or earth mantle covering these rocks, notwithstanding the tremendous mixing to which they are subjected by the drift forces, to be spoken of hereafter, partake somewhat of the nature of the deposits lying immediately beneath it, and were in part derived from their decomposition. The evidences of this are strikingly manifest. The Galena Limestone and Niagara Limestone, although separated by an intervening formation, are strikingly alike in lithological character. Both are a coarse grained, cream colored and reddish magnesian limestone When they decompose a rather coarse grained soil is the resultant. In many places, if we dig from the surface to these rocks, we find a coarse, reddish, hard pan, or crumbly clay, resembling closely these rocks. As we sink into this clay we find pieces of float mineral and bits of the rock itself, the latter lying evidently in situ, unworn by water, and appearing like pieces of the original rocky mass, which was harder and had resisted the surrounding decay and rotting away of the rocky ledges. On the other hand, portions of the country underlaid by the Cincinnati Shales are covered by a close grained, finely comminuted, greenish, creamy colored subsoil, closely resembling in texture and lithological character the Shales from which it has evidently been derived. But these resemblances of the earthy mantle to the rocks lying under them are only found in certain localities in and around the lead basin; and only to that extent is the lead basin a driftless region. But the Lead Basin is not a driftless region. In many places around it and through it evidences of true northern drift are found. Bowlders are not rare in these places; float or drift copper is frequently found; drift clay exists, regularly stratified, and old river terraces may be traced, and modified drift and gravel is not rare. The lead region seems to have been only partially invaded by the drift forces, and these forces seem to have acted in a modified form. The heavy denuding forces spoken of already acted before the drift period. Then came on the drift conditions and the glaciation of the continent, during which the transportation of clays and soils and a universal mingling and mixing of the surface materials of the earth took place, modified in the lead region in the manner just noticed. Soils and clays and sands in the first place, are derived from the decomposition of the rocky formations at and near the earth's surface. The processes of nature to-day, as in past geological ages are grinding rocks into soils and re-cementing and hardening soils into rocks. There was a time when the surface of the earth was covered with rocks, and rocks only, but atmospherical and chemical agencies, the solvent power of water, dews, and dampness, and aqueous forces kept in constant action processes of slow decay, and soils were gradually formed and carried as sediments into ancient seas. We all know the old adages about the constant dropping which wears holes in the stones; and the files of time, which wear and make no noise; but few realize how important a part these peaceful agencies have played in the creation of the present order of things. The frost and the rain, the dissolving power of water and the mighty power of freezing and cold, and other like agencies and energies of nature are all powerful to bring about the mightiest results. The tooth of time, gnawing away age after age, will nibble into clay and sand, the solidest rocky ledges. If undisturbed by mechanical forces, the superficial clays, loams, sands, subsoils and soils covering the underlying rocky masses, would be nothing but the residuum left after the removal by percolation of water of the more soluble portions of the decomposed rocks. The soil would then be in situ. Regions of country underlaid by sandstone would be covered with a sandy soil; limestone districts would be covered with a soil with a limestone base, and the geologists could tell at a glance from the appearance of the soil, what rocks lay beneath it, and vice versa. But certain forces of nature transposed, mixed and mingled into one mass the materials derived from widely separated sources. The first of these forces are the same silent, peaceful agencies which we see operating round us in our daily walks over the earth's surface. There is a struggle going on all the time in our fields, in our streets, and everywhere, building up and tearing down, construction and destruction, an ever balanced antagonism. Gentle rains and earth-born torrents, little trickling rills and strong streams are tearing down the soil from the hill sides and bearing it away to the lower levels. The small water-plowed trench of to-day, next year becomes a chasm, and ages hence a hollow, and the transported materials have been built up in alluvial deposits, or are the fillings in in the bottom of some stream. Alternate freezing and thawing helps along the varying struggle, and God's great plowshare, the frost, runs annually through the surface, mellowing the whole. These familiar, always acting, somewhat silent agencies, in time produce great results. They mix the soil, they transport it to some extent, but they never carry it long distances from its place of origin, nor do they carry the heavy masses of the drift materials for hundreds of miles away from their parent ledges. Other and mightier forces did this, and while doing it, they ground the stones into clays, and the clays into impalpable powder, as the wheat kernels are ground into superfine flour between the upper and nether mill stone. They were the mills of the gods, which ground exceedingly slow, but ground exceedingly small. There was some tremendous force, which tore the bowlders from their parent out-crops in the distant Lake Superior regions, and drifted them on their journey to the South; which grooved and planed the surface of the solid rocks, and strewed for hundreds of miles in its track beds of clay and sand and gravel, and mingled, mixed, transported and reformed the soils to such an extent as to well-nigh destroy their separate characteristics and origins over large portions of Northern Illinois, and greatly increase the difficulty of their proper classification. This force, whether floes and bergs of ice, loaded with stones, gravel and detrital matter, and borne along by winds and currents, or strong, earth-born water torrents, moving along and wearing the abraded materials, or the slow procession of the all-powerful, crawling glacier—whatever it was, it moved like a vast army of shovelers, multiplied millions of tons of the loose materials denuded and worn down from the rocks of the north, and piled them like a thick earth mantle over the coal basins to the south and west. Of that great force I propose now to speak. In order to understand what that force is, it will be necessary to refer to the well-known action of ice and snow in the glaciers of the polar world. It has been shown that the struggle of the rain drop to get back to its mother the sea, produces the silent, peaceful agencies and energies of nature. The struggle of the snow flake to get back to its mother, the same sea, produced those mighty drift forces whose results are so evident around us. Agassiz, Tyndall, Forbes, and other trustworthy scientific travelers, have made us familiar with the action of the ice forces as they now exist in the Alpine glaciers. Away up in the mountain basins of the Alps snows accumulate in vast fields and in great thickness. When the mass becomes heavy and thick, pressure changes the bottom of the mass into a plastic, porous sort of ice. This basin is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Geological Map
OF
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AND
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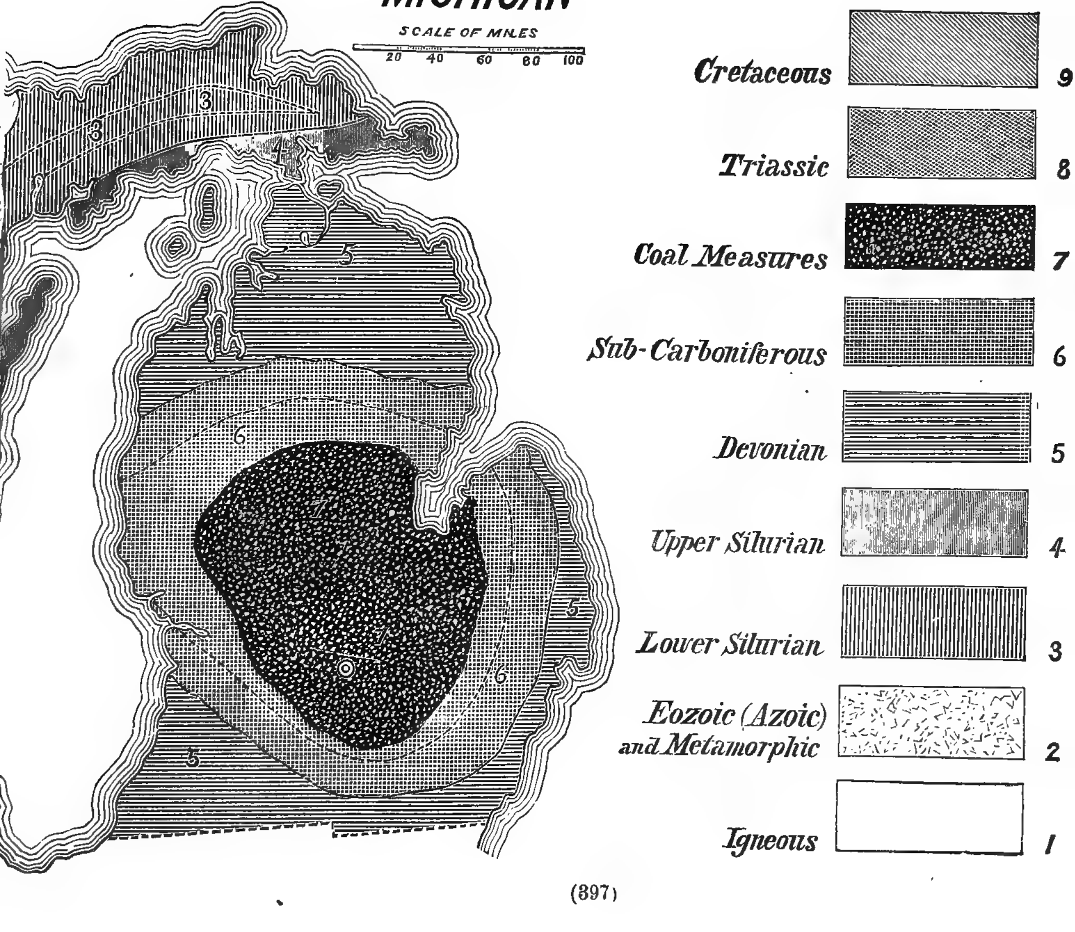


the *Mer de Glace*, or sea of ice. Inasmuch as snow is constantly being added to it, the volume and thickness of this sea of ice would soon become so great as to produce serious consequences if some safety valve was not found to afford vent to the pent up mass. The lower part takes upon itself a slow, almost imperceptible motion, and soon fills the descending valleys with a stream or river of ice. As snow is added at the top, it sinks down to the bottom, and when it becomes ice, is drawn off, as rivers run out of lakes. This ice river flows slow, but is subject to all the laws of flowing water. It widens, it contracts, it deepens where the flow is slowest, and its motion increases where the mass passes over rapids. As it crawls down in its slow, irresistible motion, dirt bands are formed along its margins, stones and great masses of rock roll down upon it, the bottom and sides of the channel are grooved, planed and striated by the mighty power of the grinding, rubbing ice, and all the material accumulated is carried eventually to the lower end of the glacier, and there dumped off in terminal moraines and huge piles of gravel, bowlders, and other drift materials. In the case of the Alps, the glaciers melt when they reach the plain and before they find the sea, and glacier-born torrents begin where the ice ends, and the materials borne thither by the ice are further moved and assorted by the muddy, rushing waters which take their place. The struggle of the snow-flake has ended, and the struggle of the rain-drop now begins. Both are trying to get back to their mother, the sea. It is true the ice river flows infinitely slow, but in comparison with the river of water it moves infinitely strong. The Mississippi, if it were a glacier instead of a water river, could bear upon its back bowlders and whole ledges of stone as readily as it now floats a feather or a saw log. What it lacked in motion, it would make up in the slow, irresistible and mighty force of its all grinding, all consuming procession. Such is a glacier in the Alps, and these glaciers are kneading certain parts of Italy over now as in past time they kneaded North America. Over the new Wrangell's Land and in Greenland the same forces of the ice are in active operation, only to a much greater extent. All upland Greenland is one vast *mer de glace*. But the Greenland glaciers, instead of melting in intermediate sunny valleys, push down into the sea itself, and after crawling along its bottom in the indenting bays and fiords, keep breaking off great masses, which float away in the deep blue waters until they are caught by wind currents and gulf streams, to be borne by them as icebergs and ice floes, whither the drift of the ocean carries them. And thus they float, until warmer seas cause them to melt in sunnier climes, and the floor of the ocean is strewn with their adhering dirt and stones. Certain iceberg paths in the sea already are accumulating at the bottom of the waters fields of bowlders and huge windrows and beds of gravel and dirt. Baffin's Bay, Hudson's Bay, and other northern seas and bays thus become nests of icebergs, and these icebergs before reaching the water, were glaciers, and these glaciers, at their origin, were the arctic snows of Greenland. Thus Greenland, like all other polar and circumpolar lands, is shipping her bowlders and her gravel to the bottom of distant oceans, and these, at some time in the future eternities of God, will become the face of continents. But we will come down to the prairies of Illinois. Starting with the bowlders in the neighborhood of Lake Superior, we trace them south and west to the Missouri river. These crystalline sandstones, flame-colored granites and black-trap rocks, can be traced back to their parent ledges about the starting point. As we advance away from the parent ledges, the bowlders become smaller, and the drift materials towards the Missouri river are only gravels and drift clays. On seeing these curious water-worn stones strewn over the face of the country, the most ordinary mind at once concludes that they did not grow there, but were brought there from some other place. They are nigger heads, lost rocks, wanderers away from where they originally existed. They are entirely unlike any rocks outcropping round them, or in that region, and it is no great task to trace back the track over which they came. The world was lately excited over the Cardiff Giant, but men went to work and soon traced it back thousands of miles to its original bed in the gypsum quarries of Fort Dodge. In the same way they trace the bowlders back towards Lake Superior and Greenland, and could find the origin of each one if a few thousand dollars, or a large humbug, were involved. In some parts of Iowa these loose stones, from the size of a man's fist to that of a shock of wheat, lie so thickly strewn over the ground and accumulate round the margin of the lakes to such an extent, that in the one case parties might walk over them, stepping on the bowlders alone; and in the other, they have given rise to the superstition or belief in walled lakes. In looking over a field of these bowlders once upon a time, my companion, who was somewhat irreverent, exclaimed, that it seemed to him as if the devil, when he sifted the soils down out of his great sifter, had emptied with a jerk the accumulated stones over this particular field. If he had named the Creator, instead of his satanic majesty, I would have thought the comparison a good one. Now, I believe the ice cap which covers Greenland at the present time once extended down into the middle regions of North America. Agassiz, some years ago, demonstrated to the satisfaction of the scientific world, that a great ice cap did cover the drift regions of the American continent. The carboniferous summer slowly ended, and the glacial winter as slowly came on. An entire change of the flora and fauna of these parts of the earth took place. Glaciers covered our land in every favorable locality. Seas of ice accumulated in the basins. Stones were torn away from the outcropping ledges: ledges were ground into sand and clay; motion took place in various directions; but the general movement was towards the south and west. As the climate again grew warmer, the ice cap slowly melted, commencing at the south and melting the ice towards the north. Basins became filled with water, and lakes and seas existed, into which glacial-born currents of muddy water poured, and in which icebergs and floes floated, as wind or currents drove them. And we thus have the compound forces of the glacier, the iceberg, and the water torrent in vigorous operation. These causes, added to and coming after the peaceful agencies and influences, spoken of in the early part of these remarks, explain all that we see, while examining the drift formations, with which our Illinois rocks are covered. The peaceful causes which worked before the drift have also worked since the drift period, and produced some of the later phenomena observable. On pages 392 and 393 will be found a geological map of Iowa, Missouri, Illinois, Indiana, Ohio and Kentucky, and on pages 396 and 397 a geological map of Minnesota, Wisconsin and Michigan, which will present a fair view of the geological formation of an important region of the great Mississippi valley, comprising as it does the great grain, grass and stock region of the United States. The explanation of the geological terms used are as follows:

Alluvium. Deposits of earth, sand, gravel, and other transported matter, made by rivers, floods, or other causes, upon land not permanently submerged beneath the waters of lakes or seas.

Tertiary. The first period of the mammals, or of the cenozoic era.

Cretaceous. Having the qualities of chalk; abounding in chalk.

Coal Measures. Strata of coal with the attendant rocks.

Subcarboniferous. Carboniferous formation, the series of rocks (including sandstones, shales, limestones, and conglomerates, together with beds of coal), which make up the strata of the carboniferous age or period. The prefix Sub signifying under or below, and includes in the map the millstone grits.

Devonian. Pertaining to certain strata which abound in Devonshire, Eng.; of, or pertaining to their age or formation.

Silurian. A term applied to the earliest of the Palæozoic ages, and also to the strata of the age. The stratigraphical and palæontological break at the top of the Water-lime making two great divisions of the American Silurian, Upper and Lower.

Metamorphic. Pertaining to, or exhibiting, certain changes which minerals or rocks may have undergone since their original deposition.

Triassic. Pertaining, or corresponding to the saliferous beds or new red sandstone of Great Britain.

Eozoic—Azoic. The age preceding the existence of animal life, or anterior to the Silurian.

Igneous. Resulting from the action of fire; as lavas and basalt are igneous rocks. (See also article Soils.)

GERANIUM. Geraniums have come to be as indispensable bedding and decorative plants, as they are beautiful in their variety of rich bloom, in the garden and green house. They are now broken up into so many ornamental varieties, single, semi-double and double, and in the rich variety of coloring of the leaves, or in grateful odor of some of the scented leaved varieties, that there is now a broad field to choose from. Their ease of cultivation, adaptability to many soils—liking best, however, a rich, rather porous loam—has rendered them universal favorites with the masses, either for summer or winter bloom. At the time of frost they may be taken up, heeled in, in boxes, and kept over winter in a light cellar that does not freeze, and the next spring, after all danger of frost is over, set out in the border, to again bloom through the summer. When taken up they should be cut back, fully half the wood,—sometimes more—being cut away. During the winter they should have but little water, only just enough to keep the soil about the roots from becoming completely dry. Those intended for winter blooming, should be taken up about the first of August, cut back to within three or four inches of the earth, carefully potted, and watered until they make new wood, and then be removed to the house before frost. A better way, however, is to strike from cuttings, early in the spring, and by pinching back, induce a stocky growth for winter blooming. The varieties now embrace every variety of shade, from white, through pink, salmon and red, to the deepest purple, and each year brings an endless variety, as candidates for popular favor. In speaking of white geraniums, we may qualify the statement by saying that we have never seen a white that would retain its purity, in the open air in the full glare of the summer sun; but when grown in the conservatory, or in partial shade, they retain their purity of color fairly well.

GERM. The vital part or embryo.

GERMEN. The seed vessel, ovarium.

GERMINATION. The physical changes during the germination of seeds has long been a careful study by students of vegetable physiology. In the germination of seeds heat, moisture, and air are requisite. As each species of plants have their zero at which they are killed, so each has its temperature at which it germinates most kindly. Thus the glacier produces a so-called red snow, from minute species of algæ, which grow at far below the freezing point, and are killed when the temperature is raised to the melting point of snow. To plants flowering in extreme cold succeed vegetation flowering almost as soon as the frost is out of the ground. Next come hardy plants that endure the frosts of our severest winters, and start into life with the first warm days of spring. Half hardy plants follow still later, and tender plants do not begin to grow until all danger of frost is over, to be again cut down with the first frosts of autumn. The pea requires forty to fifty degrees of sun heat for its vegetation; corn, fifty to sixty degrees, and cucumbers sixty to seventy degrees as the lowest heat at which they germinate. The range for plants, hardy and tender, being from about 34° to 140° as the lowest germinating heat, and the highest degree of sun, they will bear. Added to this, moisture at the roots must always be present. Indeed, many plants can not exist in a dry atmosphere at all. Some plants, as many northern ferns, require a moist, cool heat, and also shade, while tropical ferns, as well as many other tropical plants, require not only a high heat, but an atmosphere constantly saturated with moisture, or nearly so. And most of them require a strong heat, hence the necessity of artificial houses for their propagation and care, in the temperate zone. In the article Botany, the germination of the acorn is illustrated. The two lobes of the fruit do not perform the office of leaves as in the bean, but nevertheless serve to nourish the young plant. Above we illustrate, Fig. 1, the growth of the young maple. Here

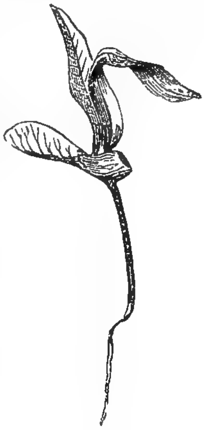


Fig. 1.

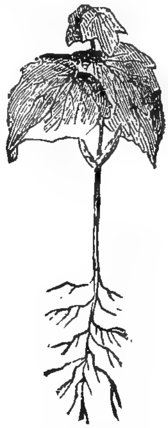


Fig. 2.

the two cotyledons escape from the shell, change color and become the first pair of leaves, of the plant, or seed leaves as they are called. The radicle, in its first growth, sends out the root, which pierces the soil, and the plumule (the bud above the leaves), puts forth true leaves. Fig. 2 shows the process of growth, the young rootlets, feeding from the soil, and the true leaves elaborating the sap furnished. It is now a true and independent plant, which in process of time will, if no disaster happens to it, form one of the monarchs of the forest. Fig. 3 shows the seed of wheat in the process of germination. Here the seed remains in the earth and, by its change and decay, nourishes the plant until its roots can draw nourishment from the soil. The starch of the grain (*a*) is chemically changed to this end as in other seeds, and as in all the grasses, the radicle strikes root, and the spire rises, independently of the seed, above ground to elaborate the juices sent up by the root. Prof. Poey, in an article on Meteorology as Applied to Agriculture, some time since collected a mass of information from the most eminent investigators, at home and abroad. From this we condense the following interesting data in relation to the vital forces of plants: From the highest antiquity innumerable theories have been proposed explaining the vitality which precedes the development of the germ, the reproduction and organization of living beings, animal and vegetable. That action has been successfully attributed to an entity, a principle, an agent, or a force, acting on organic matter exteriorly or interiorly, or in both cases at the same time. Prof. Joseph Henry, deceased, and during his life secretary of the Smithsonian Institution, thought that vitality is a directing principle and not a mechanical power, the expenditure of which does work. This principle, as an engineer, directs the power which is given out when a part of the oxygenized molecules runs down into inorganic matter, namely, carbonic acid and water, etc. By the term running down he means to indicate the passage of molecules from a state of less chemical stability to one of greater, which is the case in the passage of organic matter into inorganic matter. It is well known that organic matter is in a very soluble condition, while carbonic acid and water, into which it passes, possess a high degree of stability. Dr. William B. Carpenter believes that what the germ really supplies is not the force but the directive agency; that rather resembling the control exercised by the superintendent builder who is charged with working out the design of the architect. The vital force which causes the primordial cell of the germ first to multiply itself, and then to develop itself, is directly and immediately supplied by the heat which is constantly operating upon it, and which is transformed into vital force by its passage through the organized fabric that manifests it. Thus heat, acting through the germs, supplies the constructive force or power by which the vegetable fabric is built up. There is evidently in this hypothesis of Dr. Carpenter a double error of idea and of facts. If the germ supplies not the force, but the directive agency, how can the force-heat supply to the germ the constructive force necessary to build up the vegetable fabric, unless the germ in itself could partake of the force of that heat? It would be, in other terms, a force acting on another force, without the latter being influenced by the first force. It is, in one word, an impossibility. As to the question of fact, the production of heat in the germ is, from its origin, at the same time, a cause and an effect, consequently it can not be the primary cause of its development. The decomposition, for example, of the carbon from the grain and its reconstruction in carbonic acid can not take place without a chemical action and a reaction, which, in both circumstances, produces heat. Which is the force that precedes here; is it the chemical, or the calorific action? We could just as well say that the chemical action is the constructive force of germs, and in that case we should come near the running down of Prof. Henry, which is nothing but a purely chemical operation. That which proves the non-identity between the vital force and heat, electricity or magnetism, is the experiments of Dutrochet on the circular movement of the sap in the cellules of the *chara*. He found that heat and electricity act on the circulation of the *chara* in the same manner as other forces called exciting, in diminishing its velocity, causing it to cease altogether, and establishing it anew But the magnetic force, even when it is prodigious, does not exert any influence. From this, Dutrochet concludes that no relation exists between the vital force which produces the circulation of the chara, and that of heat, electricity, or magnetism. Dr. Joseph Le Conte has published ideas very similar to those of Prof. Henry, with which he was acquainted before the issue of that gentleman's memoir, though he has made no mention of it. He advances the idea that the composition of the carbon of the seed and its combination with the oxygen of the air, to form carbonic acid, sets free a force by which germination is effected, and which suffices to organize the rest. By the formation of carbonic acid, he says, the seed loses weight, and decomposition and loss of weight is absolutely necessary to develop organizing force—the loss of weight being, in fact, the exact measure of that force. If an insoluble food be found capable of conversion into soluble form without loss of carbon, then germination of the seed might take place without loss of weight, by the direct conversion of the heat into vital force. Other authors, as Newport, consider light as the primary source of all vital and instinctive power. Fowler thinks that not only vitality has correlation with all physical forces, but it is the artist of its own cause. Paget advances that every impregnated germ has in itself, and in the properties with which it is endowed, the power to develop itself, according to a law, into the perfection of an appropriate specific form, when the germ is placed in favorable conditions. Of its action, he says, we may specialize it as the germ-power, in consideration of its having its apparent origin and intensest action in the germ. The great doctrine of correlation and equivalency of physical forces, as applied to vital forces, is not yet clearly understood. We must first bear in mind that the laws which preside over vital phenomena, moral or social, differ from the laws of physical and cosmological phenomena only in a higher degree of complexity, always increasing from nutrition to innervation and intelligence. They are only less and less simple, less and less

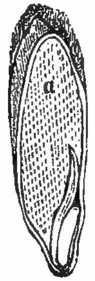


Fig. 3.

general, and more and more subordinate to the action of a suitable medium. But these three orders of laws, physical, vital, and social, are by no means identical, and there is not even a gradation, nor an insensible transition from one to the other, as Darwin has supposed in his series of animals and vegetables. The elementary properties of matter, according to circumstances, manifest themselves everywhere simultaneously, obeying the universal law formulated by Auguste Comte, of the equivalence between the action and reaction, the manifestation of one exciting the manifestation of the other or of many others of the same kind. This law is already foreshadowed, and it is the one which we study to-day under the name of the law of the conservation, correlation, and equivalency of forces, or of the mechanical equivalency of heat, etc. Experience shows us to-day that from all the bodies which form the inorganic world there are but four principal ones which enter as integral parts of the weft of living beings, and these are oxygen, hydrogen, carbon, and nitrogen. But the fact that living beings are only formed of cosmical elements leads us to an important view in philosophy, that vital force is immanent to organized matter and inherent to the elements which enter its composition, on the same ground by which gravitation, heat, etc., are inherent. One objects in vain that in the vitality of the germ the physical or chemical elements introduced in organic combination acquire new properties which they did not possess previously, as in the case of sulphuric acid, which shows properties different from those which belong to oxygen and sulphur. This objection would stand good if the new compound, sulphuric acid, should manifest properties different from the chemical one. But it is only a transformation of the elements into another chemical element more complex. The same, the elements susceptible of organization, show but equal vital properties in the transformation into other vital elements more complex and less unstable to form vegetable and animal organisms. Consequently, we can not say, as Dr. Carpenter would do, that heat is transformed into vital force by its passage through the organized fabric. Müller has very well shown that in the germ the force of evolution reaches its highest power; the nearly microscopic impregnated ovale becomes a body considerably larger; when it leaves the bosom of its parent the evolution is much less rapid; it is still less from infancy to puberty; at the adult state evolution arrests itself, and only makes up its own losses, and finally it ceases to compensate these losses; organic degeneration commences, until it becomes an impossibility to be, according to the philosophic expression of Fontenelle. As observes Littré, this evolution can be well represented by the curve of a projectile, whose movement is most rapid at the moment of departure, decreases gradually, and ends by stopping altogether. As the force of projection has space for its domain, and the projectile is aimed at a certain point, the force of life has time for its domain, and the germ is aimed at a certain term of duration. The duration of life is further subjected to the physical laws which govern our projectile; for it is an axiom in physics that movement once begun would last forever if it were not at last destroyed by the resistance it encounters. The vital force or the life also would last indefinitely if it were not destroyed by its resisting medium. This medium is the molecules which are constantly added to and taken from the organism, and which constitute nutrition in the double motion of composition and decomposition, thus offering to us the true definition of life. But this medium being double, that of the cosmological world affects principally our physical organization, and the other in the social world influences principally our moral nature. So the cause of natural death is the resistance of the molecular medium. The source of life is also the source of death. Of the three fundamental activities of matter, nutrition, mobility, and sensibility, a great number of living beings, such as vegetables, do not possess the two last, and still die by natural death. The phenomenon of natural death is then exclusively affixed to the phenomenon of life by the movement of composition and decomposition which constitutes nutrition. It may still be objected that if vitality consists in the immanence of organic matter itself, why does not life spring from all the possible combinations of that matter. It is in this capital question that the immense influence of the medium on the development of the germ is shown by the following solution: An isolated inorganic molecule does not manifest certain essential properties; for example, does not show any electric or magnetic action unless it is placed beside another molecule, under the conditions of influence and reciprocity necessary to those effects. Similarly, in the state of isolation, another molecule will not seem to own any affinity of combination without the required contact, immediately on which the chemical action appears. It is exactly what happens with the isolated organic molecule, which will not develop its vital forces unless it be placed in a convenient medium for this new manifestation. The duality, says Littré, brings in evidence properties immanent to matter, and does not create them. In the supposition of Dr. Carpenter, the germ would have created a new force, at least a new property, by the transformation of the calorific into vital force. The principle of the transformation of forces was not thoroughly well understood by a great number of philosophers, for, strictly speaking, there is no transformation of forces, but a dynamic equivalence of all the various forces of nature. The properties of life are essentially chemical, as they consist in a continuity of composition and decomposition, the same, at the moment when any chemical combination takes place, a change happens analogous to life. The only difference is, that in chemical action the phenomena are instantaneous, and the body becomes again completely inert, while in every organism it renews itself as long as the movement of composition and decomposition lasts. All organized bodies placed in a suitable medium present the double movement which characterizes life, by the increase (nutrition) and decrease of its anatomical elements. So the vital force is not a cause; it is, on the contrary, an effect, a *modus operandi*, an immanence, in one word, the law of organic matter, as universal attraction is an immanence and the law of inorganic matter. The phenomena of vitality are therefore but properties of tissue, which are reproduced afterward in each anatomical element. In fact life seemingly complex, is yet in reality simple.

GESTATION. The gestatory term in quadrupeds is much regarded by their bulk. In the elephant it is about 20 months, in the camel between 11 and 12, in the mare and ass the same. According to the observations of M. Teissier of Paris, in 582 mares, which copulated but once, the shortest period was 287 days, and the longest 419; making the extraordinary difference of 32 days, and of 89 days beyond the usual term of 11 months. The cow usually brings forth in about 9 months, and the sheep in 5. Swine usually farrow between the 120th and 140th day, being liable to variations, influenced apparently by their size and their particular breeds. In the bitch, on the contrary, be she as diminutive as a kitten, or as large as a boarhound, pupping occurs on or about the 63d day. The cat produces either on the 55th or 56th day. The true causes which abridge or prolong more or less the period of gestation in the females of quadrupeds, and of the incubation of birds, are yet unknown to us. Many persons are also unacquainted with the proper age for reproduction, and the duration of the power of reproduction, and other conditions even of the domesticated animals. It can not, therefore, but be interesting to find in the following table the results of observations made on this subject by the best ancient and modern naturalists. The development of the reproductive powers of farm animals differs widely, both as to the age, when they begin to breed, as well as their time of carrying their young. The sow will breed at one year old, the period of gestation being 113 days. The ewe breeds at fifteen months, and carries the young 152 days. The cow will breed at two years old, and if well kept may be put to the bull at fifteen months of age, since she carries young nine months. The mare is usually not bred until the age of four years, but if to be kept as a breeder it is better that she drop her first colt at three years old, and then rest one year, so as to produce the next colt at five years of age, and yearly thereafter; and since the mare goes with young eleven months, care must be taken that she does not go over the first heat before being again served. Most mares will receive the horse on the ninth or tenth day after foaling, and this period should never be allowed to pass over without her being shown the horse. Some of these results do not altogether coincide with the results of observations in England, where, for example, July, the season of copulation for the cow, is considered too late. That period would produce late calves in the following year. November is stated to be the best season for the ewe; for the black-faced ewe it is, but for the Leicester, and, in many situations, for the Cheviot ewe, it is a month too late. The duration of the power of reproduction accords with our experience as respects the mare and stallion; but 13 years of age for the cow, and 8 for the bull, is too young a period for old age in them, fine animals of both sexes, of a valuable breed, having been kept in a useful state to a much greater age. I have seen a short-horn bull in use at 13 years, and a cow of the same breed bearing calves at 18; but if the ages of 8 and 13 respectively refer to the usual time bulls and cows are kept for use, the statement is not far from the truth. From some carefully collected and very extensive notes made by Lord Spencer on the periods of gestation of 764 cows, it resulted that the shortest period of gestation, when a live calf was produced, was 220 days, and the longest 313 days, but he was not able to rear any calf produced at an earlier period than 242 days. From the result of his experiments, it appears that 314 cows calved before the 284th day, and 310 calved

Kinds of Animals.	Proper Age for Reproduction.	Period of the Power of Reproduction.	Number of Females for one Male.	The most Favorable Season for Copulation.	Period of Gestation and Incubation.		
					Shortest Period.	Mean Period.	Longest Period.
		Years.			Days.	Days.	Days.
Mare	4 years	10 to 12		May.	322	347	419
Stallion	5 "	12 to 15	20 to 30				
Cow	3 "	10		July.	240	283	321
Bull	3 "	5	30 to 40				
Ewe	2 "	6		November.	146	154	161
Tup	2 "	7	40 to 50				
Sow	1 "	6		March.	109	115	143
Boar	1 "	6	6 to 10				
She-Goat	2 "	6		November.	150	156	163
He-Goat	2 "	5	20 to 40				
She-Ass	4 "	10 to 12		May.	365	380	391
He-Ass	5 "	12 to 15					
She-Buffalo					281	308	335
Bitch	2 "	8 to 9		February.	55	60	63
Dog	2 "	8 to 9					
She-Cat	1 "	5 to 6			48	50	56
He-Cat	1 "	9 to 10	5 to 6				
Doe-Rabbit	6 months	5 to 6		November.	20	28	35
Buck Rabbit	6 "	5 to 6	30				
Cock	6 "	5 to 6	12 to 15				
Turkey, sitting on the eggs of the Hen					17	24	28
Turkey, sitting on the eggs of the Duck					24	27	30
Turkey, sitting on the eggs of the Turkey					24	26	30
Hen, sitting on the eggs of the Duck					26	30	34
Hen, sitting on the eggs of the Hen		3 to 5			19	21	24
Duck					28	30	32
Goose					27	30	33
Pigeon					16	18	20

after the 285th; so that the probable period of gestation ought to be considered 284 or 285 days. The experiments of M. Teissier on the gestation of cows, are recorded to have given the following results. 21 calved between the 240th and 270th day, the mean time being 259½ days; 544 calved between the 270th and 299th day, the mean time being 282 days; 10 calved between the 299th and 321st day, the mean time being 303 days. In most cases, therefore, between nine and ten months may be assumed as the usual period; though, with a bull-calf,, the cow has been generally observed to go about 41 weeks, and a few days less with a female. Any calf produced at an earlier period than 260 days must be considered decidedly premature, and any period of gestation exceeding 300 days must also be considered irregular; but in this latter case, the health of the produce is not affected. Mr. C. Hilliard, of Northampton, Eng.,states that the period of gestation of a cow is 284 days, or, as it is said, 9 calendar months and 9 days; the ewe, 20 weeks; the sow, 16 weeks; the mare, 11 months. The well-bred cattle of the present time would seem to bring forth twins more frequently than the cattle did fifty years ago, probably the result of better care and feeding. The males of all animals, hares excepted, are larger than the females. Castrated male cattle become larger animals than entire males.

GIBBOSE. Irregular, humped.

GIBBOUS. Protuberant, convex.

GIDDINESS. (See Epilepsy.)

GILL. The quarter of a pint.

GILLS. These organs in fishes answer the purpose of lungs. The plaits under mushrooms of the genus *agaricus* are called gills.

GIN. Distilled spirit, flavored with juniper berries. In machinery, an arrangement for tearing green seed cotton wool from the seeds. It consists of a cylinder closely set with saws, which pass through a grating in an inclined side-hopper, and thus drag off portions of wool, which are conveyed half round the cylinder, and then cleared off by a revolving brush, while the freed seeds slide through to the bottom of the hopper and escape. (See Cotton.) It is also a machine used for raising great weights, driving piles, etc. It usually consists of three long legs or spars, which support a pulley at the top, round which a rope is passed for elevating the weight.

GINGER. *Zingiber officinale.* This plant is a native of Hindostan, but also cultivated in the West Indies, in China and other warm countries. The root is a rhizome, similar to that of the flag; perennial, but the leaves annual.

GINGLYMUS. The hinge joint in animals; as the knee and elbow.

GINSENG. *Aralia quinquefolia.* The root is fleshy, from one to three inches long, and about as thick as a finger, of a yellow color, and somewhat resembling in flavor licorice. The plant is an herbaceous perennial, growing abundantly in the hilly and woody regions of the Northern, Middle and Western States, where it is gathered for shipment.

GIRDER. In architecture, a principal beam in a floor for supporting the binding or other joists, whereby their bearing or length is lessened. Perhaps so called because the ends of the joists are enclosed by it.

GIRDLER TWIG. (See Twig Girdler.)

GIRDLING. (See Wringing)

GIZZARD. A strong muscular stomach in birds, for the purpose of grinding their food with pebbles. It answers the place of teeth.

GLACIERS. Immense masses of ice produced from the snow of mountains occupying the valleys of Switzerland and countries equally elevated. In geology, the study of glaciers is peculiarly interesting; many are ten to fifteen miles long by two broad, and from three hundred to six hundred feet high. (See Geology.)

GLAND. In anatomy, organs such as the liver, spleen, etc., which consist of an immense development of blood vessels, and secrete a peculiar fluid, as bile, urine, etc. They are often microscopic, as the mucous glands of the intestines, and Peyer's glands. Sometimes they receive the specific name of the secretion they produce, as mucuous glands, sebaceous glands, lymphatic glands, etc. In botany, small lumps near leaves, or oval spots on the trunks of trees; they are unimportant except as a means of recognizing species.

GLANDERS. (See Farcy.)

GLASS. That used for conservatories should be of the greatest clearness. The nature of the substance differs with the kind of glass, for flint glass is a mixture of sand, red-lead, and fourteen per cent of potash. Crown, or window glass, contains soda, with sand and lime. The silicate of potash or soda in these cases is very insoluble, and the effect produced can not be considerable unless a large dose is added. Pounded feldspar would form as good a manure. The pounded refuse is also used by glass-makers, and called cullet. The finest powder is used in making sand paper. Glass may be converted into soluble silicate of potash by fusion with its weight of potash or soda in a crucible.

GLAUBER'S SALT. Sulphate of soda. A saline purge used for horses and cattle. The dose is one quarter of a pound or more.

GLAUCOLITE. A mineral, containing four and one-half per cent potash, with silica, alumina, and eleven per cent lime.

GLAUCOMA. A disease of the eye, in which it becomes of a bluish color.

GLAUCOPIS. A genus of passerine birds. Some of the species have wattles at the root of the beak.

GLAUCOUS. Sea-green, like the cabbage-leaf, having a light, bluish tint.

GLEANING. Collecting the refuse of the harvest.

GLEBE. A tract of land belonging to the church.

GLEDITSCHIA. (See Locust.)

GLENOID. The articular cavities of bones.

GLIADINE. A name given by Taddei to the portion of gluten soluble in alcohol. Albumen.

GLIRES. The Linnean name for *Rodentia*, from *glis*, a dormouse.

GLOBULAR. Spherical. *Globose*, resembling a sphere or globe.

GLOBULINE. A rather indefinite term used by botanists to describe spherical particles in plants, whether they be of coloring matter or starch. In physiology, it is the white albuminous substance forming the interior of the blood globules.

GLOMERATE GLAND. Any gland which discharges at once into a duct without having any cavity.

GLOMERULUS. A small capitulum, usually axillary, an old name for an inflorescence. When many branches terminate by little flower heads.

GLOSS ANTHRAX. (See Blain.)

GLOSSO. A prefix to muscles, nerves, etc., attached to the tongue.

GLOTTIS. The upper opening of the windpipe. It is protected with a membrane called the *epiglottis*.

GLUCINUM. The metallic base of *glucina*, a rare earth, existing in the beryl, emerald, and euclase.

GLUCOSE. Grape sugar, starch sugar, sugar of diabetes, of honey. It is difficult to crystallize; exists in fruits, young stems; is readily fermentable; can be procured from starch by the action of dilute sulphuric acid and heat. It differs from cane sugar in containing more water.

GLUE. Lat. *gluten.* Is prepared from the chippings of hides, hoofs, etc. The refuse matter of the glue-makers, according to Mr. Miles, is an excellent manure for turnips.

CASHMERE GOAT.

GLUME. The husk or chaff of wheat and grain plants. The awn is called an *arista. Glumosus*, furnished with glumes.

GLUTÆUS. The name of some of the muscles of the buttocks.

GLUTEN. Lat. The viscid elastic substance which remains when wheat flour is wrapt in a coarse cloth, and washed under a stream of water, so as to carry off the starch and soluble matters. Gluten, when pure, is inodorous, insipid, tenacious, adhesive, and elastic. It is insoluble in water, but soluble in hot alcohol. It is also soluble in a dilute solution of potash. When kept moist and warm, it ferments. Gluten exists in grains, and occasionally in other parts of vegetables; but it is a characteristic ingredient in wheat, giving wheat flour its particular toughness and tenacity, which particularly fits it for the manufacture of bread, and for viscid pastes, such as macaroni and vermicelli. There is generally more gluten in the wheat of warm climates than of cold; hence the excellence of that grown in the south of Europe for the manufactures just mentioned. Gluten seems also to constitute the essential part of yeast. Its uses as a varnish, a ground for paint, etc., pointed out by Cadet, likewise deserve attention. Gluten was discovered in 1742 by Beccaria, an Italian philosopher, to whom we are indebted for the first analysis of wheat flour. The number of plants containing gluten is very considerable. Proust found it in acorns, chestnuts, rice, barley, rye, peas and beans, and in apples and quinces. He found it also in the leaves of the cabbage, cress, hemlock, borage, saffron, etc., and in the sedums; in the berries of the elder, the grape, etc.; in the petals of the rose, etc. Gluten has been shown to resemble albumen so closely that they can hardly be considered as distinct principles. Gluten contains nitrogen, and has, consequently, been called the vegeto-animal principle, on this account. It yields ammonia, when subjected to destructive distillation; and the vegetables which contain it give out a peculiarly disagreeable odor during their putrefaction. M. Magendie, after feeding animals upon different kinds of food, states that gelatine, fibrin, albumen, when taken singly, do not possess the power of nourishing animals for any length of time; they always die. The reverse is the case, however, with gluten, upon which animals thrive well and long.

GLYCERIA FLUITANS. Water fescue, an indigenous grass growing on the margins of lakes and rivers, resembling the water rice.

GLYCERINE. A gelatinous body of a sweet taste. It acts as a base in fats and oils, which are indeed salts of glycerine, stearates, oleates, or margarates, of that body. In soap-making the potash or soda combines with the oily acid, and separates the glycerine.

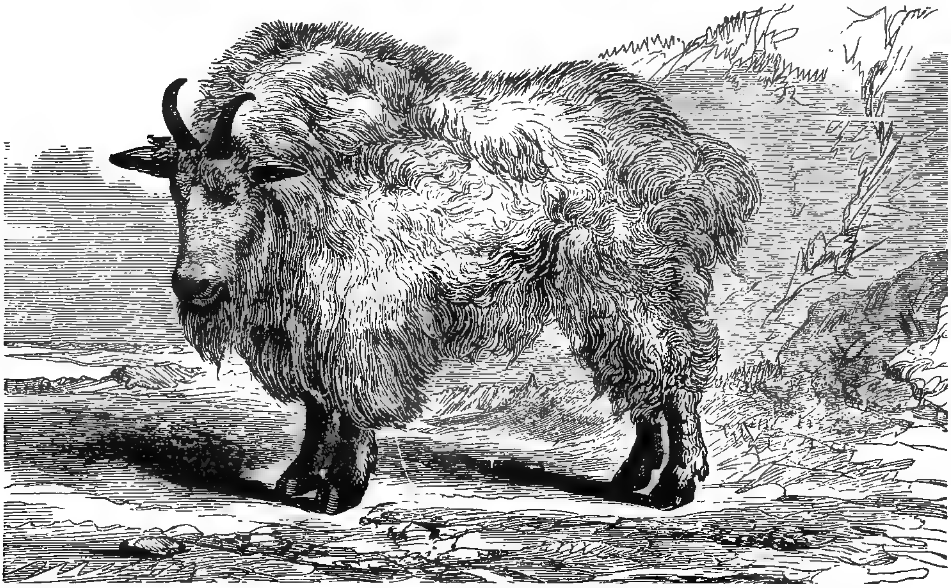
GLYCODEN. This is a term generally applied to animal starch, so-called, discovered by Virchow. He found it in generated liver and spleen; also in diseased kidneys, brain granulations, and concretions of the prostate gland. He says such tissues assume a reddish-brown, or more rarely a dirty brown violet color, where treated with tincture of iodine; when treated with oil of vitriol and iodine in succession, the granulations acquire a green color, changing to a dirty violet or sometimes blue.

GLYCYRRHIZA. The generic name of licorice.

GLYCYRRHIZINE. Glycion. Sugar extracted from licorice and some sweet woods; it has the peculiarity of combining with acids and bases. It is neither crystallizable nor fermentable.

GLYPH. In architecture, a vertical groove.

GNATHIDIA. In ornithology, the lateral parts or rumi of the mandible or lower jaw, which are joined to the cranium behind, and meet in front at a greater or less angle.



ROCKY MOUNTAIN GOAT.

GNATHOTHECA. In ornithology, the horny or cutaneous integument of the beak.

GNATS. Insects of the family *Culicidæ*. Their bites are best treated with lard or olive oil, mixed with a little ammonia.

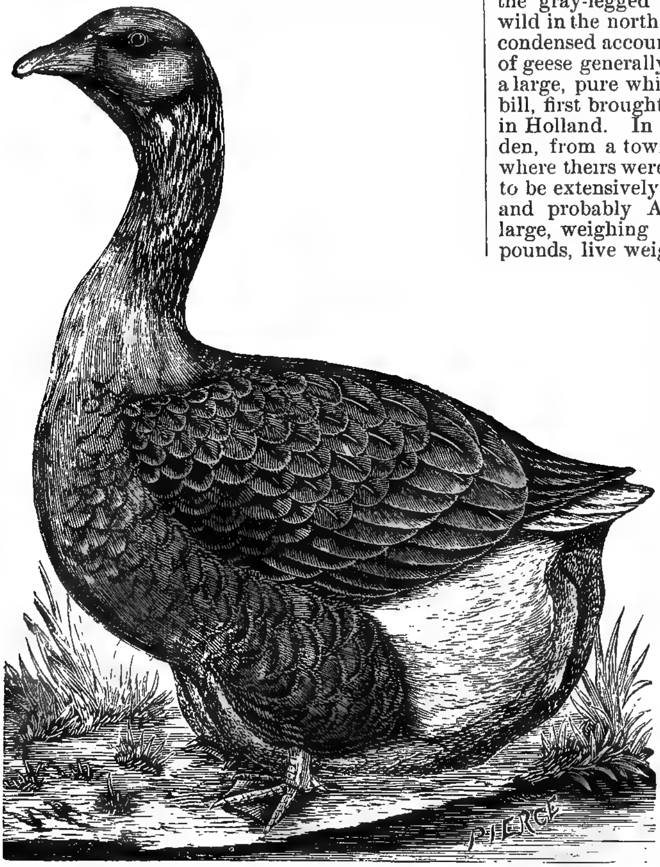
GNEISS. A stratified primary rock, composed of the same materials as granite, but the mica is somewhat distributed in layers, which give it a striped aspect. The gneiss rocks are remarkably rich in metallic ores.

GNOMON. The inclined rod or style on a sun-dial, the shadow of which marks the time. Their elevation depends upon the latitude. Gnomonics is the art of constructing dials.

GOAT. As a food animal, neither the common goat or its kids are much esteemed in the United States. As for their milk, we seldom see them kept, except occasionally for the use of invalids. In many countries however, as in some mountainous sections of Europe and Asia, it is different. Large flocks are kept, not only for their milk, but especially for the manufacture of cheese. This is especially true of Switzerland. In Mexico and New Mexico large numbers are kept. In some portions of Texas, and in California, they are more or less found. In Alpine regions where subsistence may scarcely be had for cattle, the goat may eventually find a place in the United States. Such, however, has not yet been the case with the exceptions named. Here and there a goat is kept about stables for their supposed (?) good effect on the health of the horses. Of the other varieties of goats introduced into the United States, at different times, there has been great confusion of names. Thus, it has been said, the Cashmere, Persian, Angora, and Circassian goats are the same, only modified by altitude where raised. This is undoubtedly a mistake. The foregoing cut exhibits the Cashmere goat. The Cashmere and Thibet goats are the same, and in their native country are said to yield only about three ounces of the precious down per fleece, of which the costly Cashmere shawls are made. In France the introduction of the Cashmere goat in 1819 did not prove profitable, the yield of down being too small. In 1822 a cross was made between the Cashmere and Angora goat, which brought the yield of down from three ounces to thirty-three ounces per fleece. In 1849 the first introduction of Cashmere goats was made into the South. Other importations into other States have followed, notably to New York and California. They are now found in nearly every State in the Union, principally through their crosses on the common female goat. They are hardy even in Wisconsin, yet they have not proved profitable to their owners, even in mountain districts, and their breeding has pretty much been abandoned, except in some portions of the South, Utah, and California. Above is shown the wild species of the United States, *Aplocerus Montanus*, the illustration being reproduced from a cut of an animal captured in Montana. They are shy, seldom seen and scarcely ever captured alive, but seem well fitted to defend themselves against such carnivorous animals as they may meet in their native haunts, yet it never fights if it be possible to escape by flight.

GOAT'S BREAD. *Tragopogon pratensis* Salsify (*T. porrifolius*) is sometimes so called.

GOLD. Gold coin may always be proved, if any counterfeit be suspected, by its great gravity of 17.157. Pure gold has a specific gravity of 19.3; the reduced weight of the coin is due to the alloy. Aqua Regia is the solvent of gold.



TOULOUSE GOOSE.

GOLDEN ROBIN. (See Oriole.)

GOLDEN ROD. *Solidago virgaurea.* A common weed, found on poor neglected fields. Both the flowers and leaves produce a yellow decoction with water.

GOLD OF PLEASURE. *Camelina sativa.* A cruciferous small annual, bearing pale yellow flowers. It is cultivated like flax, prefers a light soil, and will yield two crops in the year ; the seeds yield a sweet oil, and ripens in about ninety days. Called also False Flax.

GOLD THREAD. *Coptis trifolia.* A small evergreen, indigenous to Canada and the Eastern States. It grows in dark, shady, Alpine swamps. The root is tonic.

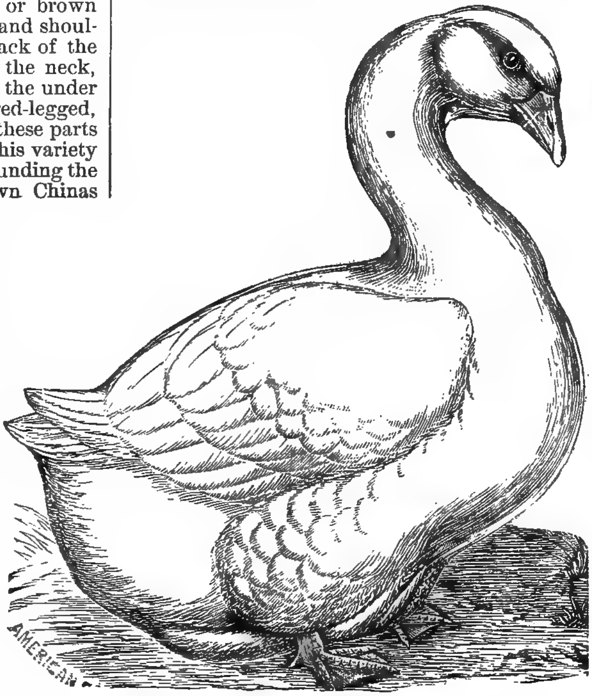
GOMPHOSIS. In anatomy, a juncture of bones similar to that of the teeth in the jaw bone.

GONIOMETER. An instrument to measure the angles of crystals.

GONYS. In ornithology, the inferior margin of the symphysis (union of bones by cartilage, etc.) of the lower jaw.

GOOSE. *Anser.* Of the eight sub-varieties of the goose family supposed to have descended from three distinct wild species, the common gray or white goose, the Bremen or Embden, and the Toulouse, are supposed to have come from the gray-legged goose (*Anser ferus*), still found wild in the north of Europe. The following is a condensed account of some of the principal breeds of geese generally disseminated. The Bremen is a large, pure white goose, with brick-red legs and bill, first brought to this country from Bremen, in Holland. In England they are called Embden, from a town of the same name in Holland, where theirs were first obtained. They are said to be extensively bred in Germany and Prussia, and probably Austria. These geese are very large, weighing from twenty-two to twenty-six pounds, live weight, and occasionally full thirty pounds when in high flesh, as seen at exhibitions, and though so large, they are well proportioned, hardy, healthful, and very showy. They are quiet and peaceable, and take on flesh very rapidly with extra feed. They also supply a superior quality of feathers in very large quantity. The female lays about the same number of eggs as the common goose, but usually commences much earlier in the spring. The Toulouse constitutes the third sub-variety, and was brought to this country from the south of France. It is distinguished from the common gray goose by the uniformity and constancy of its color, which is alike in both sexes, and darker than in the common goose, and by its very large size being as heavy as the best bred Bremen. They are rather short-legged, have round, compact bodies, and a large development of the abdominal pouch, which, in the common goose, is a mark of considerable age, but commences its appearance in this variety when but a few months old. Like the Bremen, they lay early in the spring, are very quiet, fatten readily, and have excellent flesh. Our common geese cross freely with the Bremen and the Toulouse, the first cross yielding birds nearly or quite as large as either parent, but the results of the cross rapidly degenerate by breeding among themselves. To keep up the size, the cross birds should be bred to one of the larger geese. The cross between the Bremen and the Toulouse is even larger than either parent, but deteriorates by breeding-in. The time of incubation of these three varieties is from twenty eight to thirty days. The continents of

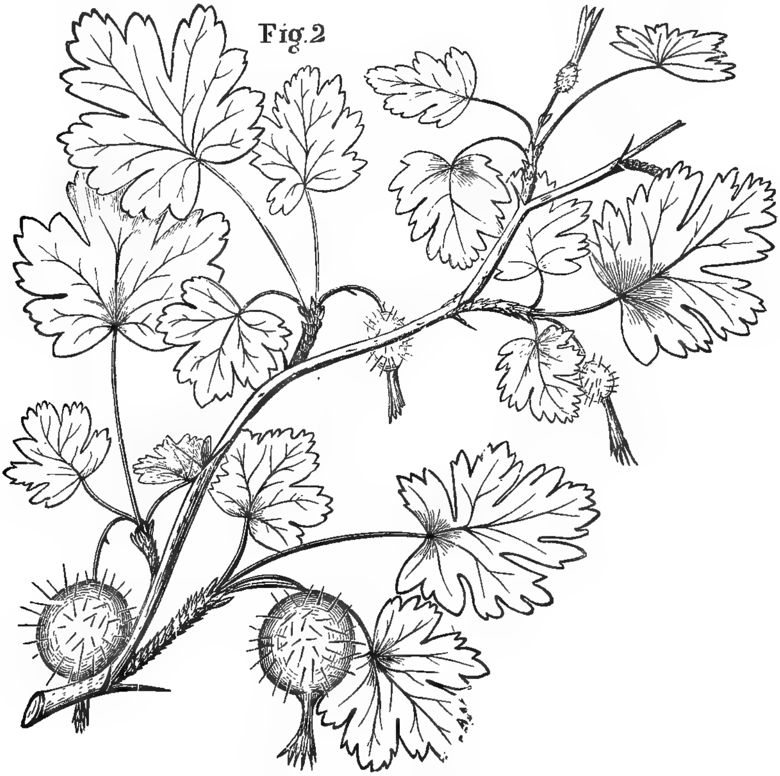
Asia and Africa have furnished us with the next family of geese, consisting of four sub-varieties, three of which are called China geese, while the fourth is known by the name of African or Hong Kong. These are all specifically, if not generically, distinct from those previously described. They are all distinguished by a large knob or excrescence on the top of the bill next the head, that increases with age ; beak strong and high ridged ; their attitudes graceful and swan-like on the water, but stiff and usually quite erect on land; voices harsh, loud, and frequent; while their wings and tails are short, rendering it difficult for them to fly. Time of incubation, thirty-three to thirty-five days. There is generally great dissimilarity in size, the ganders being much larger than their mates. The three strains denominated Chinese geese are named the red-legged, the black-legged, and the white Chinese goose. The first two have dark gray or brown plumage covering the wings, back, and shoulders, the longitudinal stripe on the back of the neck almost black, while the front of the neck, breast, and flanks are fawn color, and the under and hind parts grayish white. In the red-legged, the bill, knob, and legs are red, while these parts are black in the black-legged, and this variety has usually a narrow white stripe surrounding the feather side of the knob. These brown Chinas are both beautiful little birds, the ganders being about the size of the common kind, while the geese are smaller. The white Chinese goose is considerably larger than the brown kinds, less erect, a long, thin neck, bright orange-colored bill with large projecting knob, and legs but a little darker. It is often called the White Swan goose. All the Chinese geese are excellent layers, producing about twice as many eggs annually as common geese, commencing laying very early in the season. The fourth kind, usually called African or Hong Kong, is colored the same as the brown Chinas, with bill, knob, and legs a dull black, while in size it has no superior. It is also distinguished by a large fold of loose skin under the throat that increases with age, called the dew-lap. The American wild goose (*Anser Canadensis*) is too well known to need a description. It is a distinct species. In a state of domestication the female does not breed until two years old. The gander will mate with the common goose, but their young are mules, and will not breed. Some flocks in the country are so thoroughly domesticated that they do not require to be pinioned, though it is generally safer to remove the first joint when young. There are several purely fancy varieties of geese that are kept to some extent, as the Barnacle goose, the White Canada or Hudson Bay goose, the Brant or Brent goose, the White-fronted or Laughing goose, the Bean goose, and the Egyptian goose. It should be known that geese may be profitably kept on any farm where there is a pond or running stream of water, and plenty of grass range in summer; on this they will pretty much get their living. Where more confined they soon kill the grass by biting close, tramping, and especially from their dung. At night they must have a clean, dry piece of ground upon which to rest, and in winter their quarters must be both dry and warm. The late C. N. Bement, who gave much attention to geese and other farm fowls, wrote upon their management, from which we extract: In selecting a situation for a goose-house or pen, all damp must be avoided; for geese, however much they may like to swim in water, are fond at all times of a clean, dry place to sleep in. It is not good to keep geese with other poultry; for when confined in the poultry-yard they become very quarrelsome, harass and injure the other fowls; therefore it is best to erect low sheds, with nests partitioned off, of suitable size, to accommodate them; and there should never be over eight under one roof; the large ones generally beat the smaller, in which case they should, of course, be separated, one from the other, by partitions extending out some distance from the nests. Nests for hatching should be made of fine straw, of a circular shape, and so arranged that the eggs can not fall out when the goose turns them. From thirteen to fifteen will be as many as a large goose can conveniently cover. The ganders remain near when sitting, and seem to watch them as a kind of sentinel; and woe be to man or beast that dares approach them. They seem very anxious to see the young ones, that are to be born, make their appearance. Incubation lasts from twenty-eight to thirty days, and not two months, as some state, and the goose should have water placed near her, and be well fed as soon as she comes off the nest, that she may not be so long absent as to allow the eggs to cool, which might cause her to abandon her task. After twenty-eight or twenty-nine day's incubation, the goslings begin,



EMBDEN GOOSE.

but frequently at an interval of from twenty-four to forty-eight hours, to chip the shell. Like turkey chickens, goslings must be taken from under the mother, lest, if feeling the young ones under her, she might perhaps leave the rest of the tardy brood still unhatched. After having separated them from her, they must be kept in a basket, lined with wool and covered with cloth; and when the whole of the eggs are hatched, may be returned to the mother. The male seems to evince the same solicitude for the young as the mother, and will lead and take equal care of them. On the second day after they are hatched they may be let out after the dew is off, if the weather is warm, but care must be taken not to expose them to the scorching rays of the sun, which might kill them. All authors seem to agree on the proper food to be given them, which is coarse barley meal, bruised oats, bran, crumbs of bread soaked in milk or curdled milk, lettuce leaves chopped fined, or crusts of bread boiled in milk. In this country Indian meal moistened with water is generally given; but in our experience we have found it too laxative, and to counteract the effect we have moistened it with boiled milk, and occasionally added chives chopped fine. It is our opinion, however, that more goslings are killed by over-feeding than by starving. A person who is curious in these affairs informed us that he had been most successful when he let the goslings shift for themselves, if the pasture was good. We tried a brood that way and succeeded well. Grass seems to be their natural food, and by following nature in all cases with dumb animals, and more especially with fowls, we have generally succeeded best. After they are three or four weeks old they may be turned out into a field or lane containing water. If their range is extensive they must be looked after, as the goose is apt to drag the goslings until they become cramped or tired, some of them squatting down and remaining at evening, and are seen no more. After the goslings are pretty well feathered they are too large to be brooded under the mother's wings, and will sleep in groups by her side, and must be supplied with good and renewed straw to sit on, which will be converted into excellent manure. Being now able to frequent the pond and range the common at large, the young geese will obtain their own living; and if favorably situated, nothing more need be allowed them excepting the vegetable produce of the garden. We have, however, found it a good practice to feed a moderate quantity of solid food to the young and store geese, by which means they are kept in a growing and fleshy state, and attain a larger size; the young ones are also forward and valuable for breeding stock. Besides, feeding them, especially in the evening, on their return, attaches, them to their home. In relation to the diseases of geese, colds and fogs are extremely against geese; therefore, when young, care should be taken not to let them out but in fair weather, when they

Fig. 2

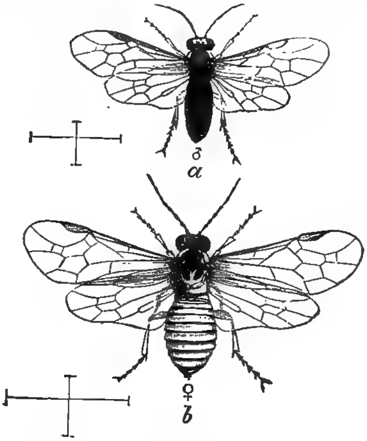


WILD GOOSEBERRY.

can go to their food without a leader. They are particularly subject to two diseases; the first a looseness, or diarrhœa, for which Main recommends hot wine in which the parings of quinces, acorns, or juniper berries are boiled. The second is like a giddiness, which makes them turn round for some time; they then fall down and die, if they are not relieved in time. The remedy recommended by Main is to bleed the bird with a pin or needle, by piercing a rather prominent vein situated under the skin which separates the claws. Another scourge to goslings are little insects which get into their ears and nostrils, which fatigue and exhaust them; they then walk with their wings hanging down, and shaking their heads. The relief proposed is to give them on their return from the fields, some corn at the bottom of a vessel full of clear water; in order to eat it, they are obliged to plunge their heads in the water, which compels the insects to fly and leave their prey. It is the same with the goose, says Main, as with every other bird that is fattened up; that moment must be laid hold of, when they come to a complete plumpness, or they soon get lean and die if they are not killed. Meal and skimmed milk will soon do the business; after ranging in the grain stubbles but little else will be required. These are called green geese, and are most esteemed by the epicure; they will then be about six weeks old, tender and fine. Steamed potatoes, with four quarts of ground buckwheat or oats to the bushel, mashed up with the potatoes, and given warm, it is said, will render geese, cooped in a dark place, fat enough in three weeks. The French method of fattening consists in plucking the feathers from under the belly; in giving them abundance of food and drink, and in cooping them up more closely than is practiced with common fowls; cleanliness and quiet being, above all, indispensable. The best time is in the month of November, or when the cold weather begins to set in. When there are but a few geese to fatten, they are put in a cask, in which holes have been bored, and through which they thrust their heads to get their food; but as this bird is voracious, and as with it hunger is stronger than love of liberty, it is easily fattened, provided they are abundantly supplied with the wherewithal to swallow. The Romans considered the liver of the goose a great dainty, and to increase its size they fed them sixteen days on a paste of Turkey figs, stamped and beaten up with cream; their livers would thus be brought to table, each weighing three or four pounds. Equal parts of the meal of oats, rye and peas, mixed with skimmed milk, form an excellent feeding article for geese and ducks. The grand object of preparing, not geese only, but all kinds of poultry for market in as short a time as possible, is effected solely by paying unremitting attention to their wants; in keeping them thoroughly clean, in supplying them with dry, soft, and green food, water, exercise ground, etc. They should be fed three times a day.

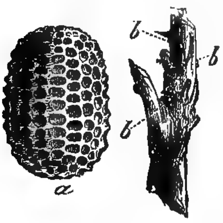
GOOSEBERRY. The original plant of the cultivated Gooseberrry of Europe is said to be *Ribes uva-crispa*. It is found wild quite plentifully, and sometimes side by side with the cultivated varieties, also run wild from gardens. In England many varieties of the cultivated fruit are known, but in the United States but few varieties of the English gooseberry can be grown on account of the tendency of the fruit to mildew. In the West this disposition to mildew is so great that their cultivation is not attempted, except occasionally in the gardens of amateurs, who are sometimes rewarded with a fair crop for their care and pains. On the other hand our small native variety, improved by cultivation and selection from seed, may be grown in every garden, on account of their freedom from mildew. The principal varieties are American seedling Downing's seedling, Houghton's seedling, and Mountain seedling originated from the wild gooseberry of the United States, *Ribes hirtellum*, a cut of which is given. The bushes of our native varieties should be planted four by four feet or, better, five by three and a half feet, for ease in cultivation. All that is required is to keep the plantation free from weeds, the superabundant wood to be cut away each fall. This, with the addition of a dressing of compost each autumn, will ensure uniform crops of fruit. The

GOOSEBERRY SPAN WORM.

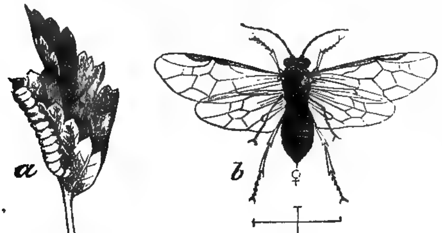


EUROPEAN CURRANT SAW FLY.

cultivation of the European varieties is identical with the last, except, that the soil should have a slight dressing of salt each year. The spaces between the rows and about the plants should also be heavily mulched, since it has been found that mulch is a preventive of mildew. If mildew attacks the fruit, dusting with sulphur when the dew is on is one of the best remedies. The insects attacking the gooseberry feed also on the currant. In the article Currant Worm, we have given some of these. The principal species not given there are as follows: The Gooseberry Span worm, more generally called the Currant Span worm (see cut); *a*, *b*, larvæ, *c*, pupa, should not be confounded with the Saw fly given below. The perfect insect is a small moth, while the Saw fly is a two-winged fly. The Span worm, spins down when disturbed, and either of the species should be carefully hand picked. The egg, enlarged at *a*, and natural size at *b*, is also shown. The Span worm appears with the first leaves, while the Saw fly comes in May and June. On page 409 are cuts of European Saw fly, *a*, male, *b*, female; the cross lines showing natural size. Below is given cut of the Native Saw fly and larva. The larva of the European species is much larger. The larvæ of the native species, according to the late Dr. Walsh, are grass green worms, half an inch long with black heads, the heads becoming green after the last molt, but with a lateral brown stripe meeting with the opposite one on top of the head, where it is more or less confluent. They spin their cocoons on the bushes on which they feed, and the fly appearing about two or three weeks after, or about the middle of August in the North. The larva of the imported Saw fly is larger, distinctly spined, and covered with minute warts, which the native worm does not have. Many persons use Paris Green and London Purple for dusting both currant and gooseberry bushes to kill the worms. It should never be allowed on plants bearing fruit above ground after the fruit is set. White hellebore powder, however, is innocent to human life, and an effectual insecticide.



EGG OF GOOSEBERRY SPAN WORM.



NATIVE SAW FLY.

GOOSEBERRY MIDGE. (See Midge.)

GOOSEBERRY WINE. (See Gallizing.)

GOOSEBERRY WORM. (See Currant Worm and Gooseberry.)

GOOSEFOOT. The goosefoot family (*chenopodium*) is named from its more or less cleft leaves, somewhat resembling a goose's foot. The more common and best known is the pig weed or lamb's quarter (*C. album*) sometimes used as greens. Another variety is the maple-leaved goose foot (*C. hybridum*) a common weed with a heavy odor of stramonium. A southern variety, the so-called Mexican tea (*C. ambrosioides*), and, as stated by Gray, the variety (*C. anthelminticum*). the latter known as wormseed, are both well known as vermifuges. The varieties of this genus are all comparatively worthless, and should be eradicated wherever found.

GOOSE GRASS. Several species of *Galium* are so-called from being eaten by geese.

GOPHER. The striped and spotted squirrel found all over the West is incorrectly called Gopher. The gray squirrel of the prairies is also sometimes confounded with this species. The two-pouched gopher (*Gemys bursarius*) is entirely distinct, and, where it abounds, so destructive as to call forth the most persistent efforts from the farmer in its destruction. The true gopher is found in some parts of Indiana, Michigan and Wisconsin. South and east of the Illinois river it is abundant, but between the Illinois river and the Mississippi it is comparatively rare. In Missouri, Iowa, parts of Kansas, Nebraska and in Minnesota it is common. So, also, it is found in the valley of the Red river of the North up to Pembina. Its true habitat is on the prairie, where there are abundance of roots upon which it can feed. The late Robert Kennicott describes their manner of excavating burrows as follows: On the wild prairie the gopher throws up a mound of earth of considerable size, frequently ten feet in diameter and from one and a half to two feet in height, being highest in the low ground liable to inundation. In this mound is his nest, in which the young are bred, and from it endless galleries are excavated in various directions, a foot or two below the surface. These are complicated, frequently intersecting and running together, and, in short, forming a complete network of underground roads through which these strange animals can travel for miles. In digging them the gophers run up shafts at irregular intervals from two to ten feet apart, which open to the surface usually a little at one side of the main gallery, and from each of these side cuts they throw out the earth brought from the main gallery below, to the amount of from a quart to one or more bushels, and thus form little piles of earth by which the general course of the burrow may be traced. They have a remarkable antipathy to the light, and these side cuts are usually closed again with earth after they have served their first purpose; and, if a hole be opened into any part of the burrow, it is closed as soon as observed by the inmates. Only a portion of the earth taken by the gopher from his main highway is carried to the surface, much of it being used in filling the side cuts, into which it is packed, sometimes even more closely than the surrounding soil, and in digging about their burrows I have thus been able to trace these cuts. The galleries are also apparently enlarged by pressing aside the earth. These are of greater dimensions than would seem necessary for the accommodation of an animal of this size. The main galleries are about four inches in diameter, and the side cuts from two to three inches. I am informed that, in digging wells, shafts have been found sunk by gophers to a depth of ten or twelve feet, with water at the bottom. The opinion of those who have observed such holes usually is, that they are dug so as to procure water. The proper food of the gopher consists of roots, which are usually obtained without leaving his underground roads. Though he sometimes comes to the surface to feed upon the leaves and seeds of plants, this does not appear to be his principal means of subsistence. The manner in which he naturally procures food is by approaching it from below, without coming above ground at all. He lays up stores, apparently at all seasons. Considerable quantities of the roots of the rosin-weed (*Silphium laciniatum*), wild artichoke, or wild sunflower (*Helianthus*), spike flower (*Liatris*), and various other plants, are collected in its burrows on the prairies; while, in cultivated fields, the roots of the grasses, potatoes, and other vegetables, are found in its holes. Wherever they exist on cultivated land, the gophers are very injurious. No animal is more complained of by our prairie farmers. Scarcely a crop escapes their ravages. They desert the wild prairie to inhabit cultivated hay-fields; and they particularly delight in clover and timothy meadows. Here they not only do mischief by devouring the roots of the plants, but impede the mowing and raking of the hay, by inequalities of surface caused by their mounds. Grain fields are much injured by them while the plants are growing; and, when the stacks are left standing after harvest, the gophers burrow from below, and frequently cut up and drag into their holes, or otherwise completely destroy, entire sheaves. All root-crops suffer severely from them. In passing below the surface, they gnaw off the bottom of carrots, beets, turnips, and other tap-rooted vegetables, without disturbing the tops or coming above ground. In fields of common and sweet potatoes, they work under the hills and remove the tubers, and thus sometimes destroy half or more of the crop before the dying vines give evidence of the mischief. Instances are related in which potato heaps, covered with earth and left out during winter, have been entered by the gophers and the tubers carried off. They sometimes enter melons, pumpkins, and squashes, through holes at the bottom, and eat out all the fleshy part, and then fill the hollow rind with earth, leaving it in a condition to create much astonishment when harvested. They also feed upon the bark of the roots of trees, as well as upon the fleshy roots of herbaceous plants. Some farmers are greatly injured by their destruction of Osage Orange hedges. No small item of their injury is the gnawing and cutting off the roots of fruit-trees. A considerable portion of all the trees have been killed annually in some young orchards in Iowa and Illinois; and several fruit-growers inform me that thay have seen as many as a dozen large bearing apple-trees killed by them in a single orchard. Forest trees, six or eight inches in diameter, have died in consequence of their roots being cut. Trapping is the most successful mode adopted for capturing this animal. A hole being opened into a gallery known to be traveled by him, a small steel trap, covered slightly with loose earth, is placed in the track, in such a position that, when he comes to shut out the unwelcome light, he must unavoidably be caught. It is not necessary to bait a trap thus used. The gopher can very readily be poisoned by strychnine or arsenic in pieces of vegetables placed in their burrows, as is sometimes practiced with the California species. There could be no danger attending this, and the probability is that the method would be highly successful. In Georgia and Florida, another species of this genus (*Gemys pinetis*) is found, where it is known under the name of Salamander, whereas a terrapin, or fresh-water turtle, is called gopher. The pouched rat of Arkansas is also called Salamander. The name gopher is derived from the appellation of *gauffre*, given these animals by the Canadian voyageurs. It is stated that, on the Upper Missouri, they are sometimes called mulos. Twelve species of gophers inhabiting the United States are described in Baird's General Report on Mammals in the Pacific Railway Survey. Of these, only the present species and that of Florida are found east of the Mississippi. The Californian species (*Gemys bulbivorus*) is even more destructive than the eastern gopher.

GOSSYPIUM. The generic name of the cotton plant.

GOULARD'S EXTRACT. A concentrated solution of sugar of lead in water; it is used, diluted, as an application to galls and external inflammations.

GOURD. *Cucurbita lagenaria.* Calabash. Annuals readily cultivated, requiring a deep soil. Many varieties exist. The pulp is purgative in most varieties.

GOVERNOR. In machinery, an arrangement for regulating the speed of machines.

GRACILE, GRACILIS. Slender.

GRACKLE. The purple or crow blackbird. It has the reputation of being one of the greatest pests of the Western farmer. In regions where they flock, after nesting time, they undoubtedly do extensive mischief to the ripening grain, especially to oats, and later to corn. The remedy, however, is not difficult: Three or four days persistent shooting, especially early in the morning when they are flocking out, and at evening as they are returning to their roosts, will send them to other feeding grounds. At all other seasons of the year they are indefatigable hunters of the seeds of weeds, and in the breeding season, of insects. It is still an open question among farmers whether they do more injury than benefit. It is more than probable that to the farmer they are of more benefit than injury. The red-winged black bird is far more destructive to grain, and the Grackle is often confounded with this bird when young, their size and plumage then being similar to the ordinary observer. The red-winged species is quite destructive in new settlements, sometimes so much so, during the ripening of small grain, and later, of corn, that organized efforts must be made by shooting or otherwise driving them away, in order to save the crops. The generic name of the Boat-tailed Blackbird of the Southern States is *Quiscalus major*, found near the sea coast, on the streams. *Q. versicolor* is the Purple Grackle or Crow Blackbird of the North, and *Q. ferruginus*, is the Rusty Blackbird of the North; both of the latter migrating to the South in the winter.

GRACULA. The genus of jay birds. They are insectivorous.

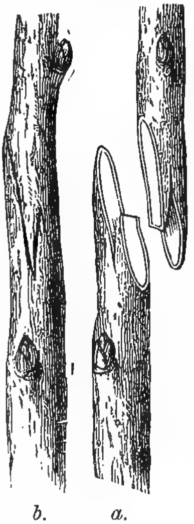
GRADATORY. A term applied to those animals which have legs nearly of the same length, so that they can walk on the four. Birds which have the lower portion of their legs covered with feathers.

GRADE CATTLE. Grade cattle may be defined as the descendents of any pure breed crossed upon the native or mixed breeds of a country. In the mixed farming of the older settled States the three purposes of beef, milk, and working cattle are desired. Hence the grades are made up of Short-horn or Hereford blood for, beef, of Devon or Hereford for working cattle, and of Dutch, Ayrshire, or Jersey, bred with the native cattle of the region, according as beef, labor, or milk is desired. In the vicinity of large cities, where large quantities of fresh milk is consumed, the Ayrshire and Holstein (Dutch) cattle are much used, while, when quality and not quantity of milk is especially desired, the Jerseys are the favorites. The adaptation of grades to the wants of the community, therefore, determines the breed to be used. In New England, New York, Pennsylvania, and northern Ohio, Illinois, Wisconsin, and Iowa, and other dairying sections the milk breeds predominate, the old style Short-horns forming the basis of the stock worked upon. In all the more settled grazing regions of the country the Short-horns predominate, though of late years, from their fine constitutions, early maturity, and superior beef, the Herefords have successfully competed, and, since 1876, large numbers of Short-horn and Hereford bulls have been shipped to the immense grazing grounds east of the Rocky Mountains and the great valleys interlaced within the Rocky Mountains, for the purpose of breeding grades for the eastern and European markets. Grade Short-horns and Herefords have been fed to a weight of 3,500 pounds, live weight, and at the stock yards at Chicago it is not unusual to find many that will average from 1,800 to 2,000 pounds.

GRADIENTS. On railways, the ascending planes.

GRADUATED. Marked into regular divisions; increasing in equal measures, as a scale for weighing quantities.

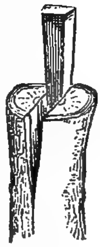
GRAFTING. Grafting is the uniting of a shoot or scion containing one or more buds to a stock or root with a view, by their union, to produce a superior fruit upon the inferior stalk. There are a number of ways of grafting, cleft grafting being the mode usually adopted. This is simply splitting a stock, first sawed off square, and inserting on each side a scion tapered down to a thin, wedge-shape, with a sharp knife, so the inner bark of the scion and stock will just meet. To insure this meeting at some point the top of the graft is sometimes carried in slightly. The whole is then covered with grafting wax to exclude moisture and air, and the grafts usually take kindly, if the grafting be done at the right season of the year, that is in the spring before the leaves appear. Root grafting is performed in precisely the same manner as stock grafting pieces of root being used as the stock. This may be done late in winter, the roots having been carefully saved in moist earth in a cool cellar for this purpose. The grafts may be cut any time in mild weather in winter, tied in small bundles, and kept in moist sand until wanted. The only tools for grafting, on the farm, is a sharp, panel saw, a keen pocket knife, for paring the stocks and sharpening the grafts, a butcher knife, and a mallet for splitting the stocks, and grafting wax for spreading over the mutilated parts. Saddle grafting is used only with stocks of a size corresponding nearly with that of the grafts. The accompanying cuts will show this manner of grafting; *a* being stock and graft pared to fit each other, b showing the same united. Sometimes the stock is simply pared to a thin wedge and the scion simply split and wedged on, but this is a very crude and shiftless way of operating. In either of the operations of grafting described the whole exposed surface should be well waxed with grafting wax, to keep out water. Another common mode of grafting is by approach, or in arching, as it is termed. A modification of this is practiced where the bark of a valuable tree has been injured or gnawed by mice. The injury is pared smooth at the edges of the bark down to the live wood, and a piece of healthy bark fitted accurately thereto, and covered with grafting wax until it is healed; or scions set close together and brought fresh bark to fresh bark at top and bottom, and securely fastened. Dr. Warder, in American Pomology, in relation to grafting old orchards, and upon root grafting, writes: Old orchards of inferior fruit may be entirely re-made and re-formed by grafting the limbs with such varieties as we may desire. A new life is by this process often infused into the trees, which is due to the very severe pruning which the trees then receive; they are consequently soon covered with a vigorous growth of young healthy wood, which replaces the decrepid and often decaying spray that accumulates in an old orchard, and the fruit produced for several years by the new growth is not only more valuable in kind, according to the judgment used in the selection of grafts, but it is more fair, smooth and healthy, and of better size than that which was previously furnished by the trees. Certain varieties are brought at once into bearing when thus top-grafted, which would have been long in developing their fruitful condition if planted as nursery trees. Others are always better and finer when so worked, than on young trees. In renewing an old orchard by grafting its head, it will not be a good plan to attempt the whole tree at once; the pruning would be too severe, and would be followed by a profusion of succulent shoots breaking out from the large branches, such as are called water-sprouts. Those who have practiced most, prefer at first, to remove about one-third of the limbs for grafting, and those should be selected at the top of the tree. The new growth thus has an open field for its development, and the lower limbs will be invigorated, while they tend also to preserve the equilibrium of the tree in a double sense, physically and physiologically. The next year another third of the limbs may be grafted, and the remainder the year following, as practiced by Mr. Geo. Olmstead, of Connecticut, who, on the sixth year from the first grafting, harvested

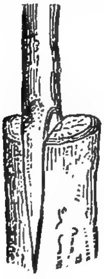


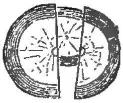
twenty-eight and one-half bushels of choice apples from a single tree that was seventy-five years old, and which before only produced inferior fruit. J. J. Thomas recommends to give a well-shaped head to such newly formed trees, and to prevent the branches from shooting upward in a close body near the center of the tree, that the old horizontal boughs should be allowed to extend to a distance in each direction, while the upright ones should be lopped. The same writer also advises, instead of cutting off large branches and grafting them at once, it is better to prune the top in part which will cause an emission of vigorous shoots. These are then either budded, or grafted. And as the grafts gradually extend by growth, the remainder of the top may, by successive excisions, be removed. The illustrations we give will show the series of operations in grafting in its various stages: *a* is a stick of buds ready for working; *b*, section of graft pared; *c*, stock cleft and wedged open with wooden wedge; *d*, same, with graft inserted; *e*, stock with graft set on each side; *f*, cross section of stock and graft showing exact meeting of inner bark, a most essential qualification. Grafting in the nursery is, or should be, either done at or near the collar of the stock, or it is performed in-doors upon the roots or sections of roots of young stocks. The latter may be first described, as it constitutes the most extensive means of multiplying fruit trees. It is a sort of machinery, with division of labor, and appliances, that enable the operators to turn out immense numbers. Machinery has indeed been applied to the business; we have grafting apparatus to facilitate the work. The Minkler machine consists of a frame or gauge which regulates the angle of the slope, which is cut with a broad chisel that reduces the roots and scions to a condition for putting them together; by its use an immense number of grafts can be cut, and another hand binds them together with the waxed thread, without any tie. Mr. Robey's machine consists of a complicated shears to cut the slope and tongue at one operation, preparing the pieces for whip grafting. Mr. S. S. Jackson, of Cincinnati, has also invented an apparatus for this purpose, which proves to be very useful. In root grafting the methods of performing the operation vary somewhat, but all agree in the object to be attained: the co-aptation of the scion with a piece of root. Some grafters use only the upper portion of the root, thinking the original collar of the seedling stock the only point at which the most perfect and successful union between the aërial and terrestrial portions of trees should or can be effected —theoretically this may be very well, but the practice constantly pursued, in myriads of cases, abundantly proves that the grafting need not be restricted to this part, and that a perfect union may be effected at any point of the root, and that this may even be inverted. The common practice has been to take two or more cuts from the root, when of sufficient size and length. For root grafting, thrifty stocks are wanted of one or two years' growth, the smoother and straighter the roots, the better. These should be taken up from the seed-bed in the fall, selected, tied in bundles, and stored in the cellar or cave, or buried in the soil where they shall be accessible at any time, and where they will be kept fresh and plump. The roots and scions having been prepared and under shelter, the work of grafting may proceed at any time during the winter. The stocks, if not clean, should be washed, and one hand trims off the side rootlets. The grafter cuts a hundred scions of the appropriate length, which he puts into a shallow box on the table; he takes up a stock, cuts the slope near the collar, and a dextrous hand will at the same time make the sloping cut to receive the first graft and also the tongue, if that style of grafting is to be done, as is usually practiced. He then picks up a scion, from a lot which himself or another hand has already prepared with a slope and tongue, and adapts it to the root, the tongue keeping the two together; a portion of the root is then cut off with the graft, and the process is repeated upon the next section. Two or three or more grafts, are thus made from one seedling root; the length of the sections vary from two to four inches, according to the fancy of the operator, or of his employer. Some persons recommend a long scion with a short root and others prefer to reverse those terms. The whole root graft should not be more than six or seven inches long. When any given number of scions are fitted to the roots, a boy completes the process of grafting, by applying melted wax with a brush, in which case they are dropped into water to harden the wax, or they are wrapped with

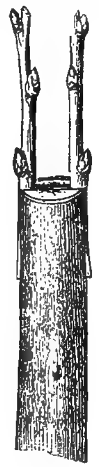
a.

b.


c.


d.


f.


e.

waxed strips of muslin or paper, or, better still, they are tied with waxed thread. No. 3 cotton yarn is drawn through a pan of melted wax, and wound upon a reel placed at the other side of the room, so that the wax may harden, This makes a convenient tie; the graft being held in the left hand, the thread is quickly and easily wound.

GRAFTING WAX. Grafting wax is variously made. It usually consists of rosin, tallow, and beeswax. Sometimes they are mixed in equal parts; but this mixture is hardly adhesive enough; more rosin increases its tenacity. A cheap and useful compound, but sometimes found rather inconveniently adhesive to the fingers, is made of four parts of rosin, two of tallow, and one of beeswax. A coat of the wax, about one-twentieth of an inch thick, spread over muslin, calico, or tough and flexible paper, makes an excellent plaster for out-door grafting; or, if spread half as thick on paper, is well adapted to root-grafting. In either case, the strips should be narrow, that they may be easily wrapped around the graft till it is well covered, when the rest may be torn off. In making the plasters, it is essential that the ingredients of the wax should be thoroughly stirred together before it is spread. A paper, soft, thin, and tough,is used for wrapping. For out-door grafting, in cool weather, a furnace of lighted charcoal is sometimes necessary to soften the wax, but all out-door grafting should be done when the temperature is mild enough to keep the wax soft enough to work.

GRAIN. A term applied to the cereals, as wheat, corn, rye, barley, oats, and buckwheat, or to any seed used as food for man or beast, after being threshed or shelled. For descriptions see the several titles as they occur.

GRALLÆ. The tribe of long-legged wading birds, as the cranes, flamingo, etc.

GRAMINACEÆ. Grain plants. Grasses. Endogenous plants, in which the parts of fructification are essentially perfect, although they are in a very unusual state in what may be called their accessory organs. They have neither calyx nor corolla; but in lieu of them, imbricated scales, called paleæ and glumes: the latter of which give rise to the name glumaceous, often applied to these plants. Grain of all kinds, the bamboo, the sugar cane, many kinds of pasture plants, and reeds, belong to different species of Graminaceæ. They constitute the most valuable family of plants for the sustenance of men and animals. They are developed from the frigid zone to the equator, increasing in size as they proceed south.

GRAMME. The unit of French weights, equal to 15.434 troy grains. The following is their decimal system. Thus, a milligramme is equal to ,001 gramme or, ,01543 troy ounces. The gramme equals the weight of the hundredth part of a cubic metre of distilled water at 32° Fahr. The kilogramme is used for the heavier weights, and is equal to two pounds, three ounces, and 4.428 drachms avoirdupois.

	Grammes.	Troy grams.
Milligramme	,001	,01543
Centigramme	,01	1,5434
Decigramme.	,1	1,5434
Gramme.	1,	15,434
Decagramme	10,	154,34
Hectogramme.	100,	1543,4
Kilogramme.	1000,	15434
Myriagramme	10000,	154340

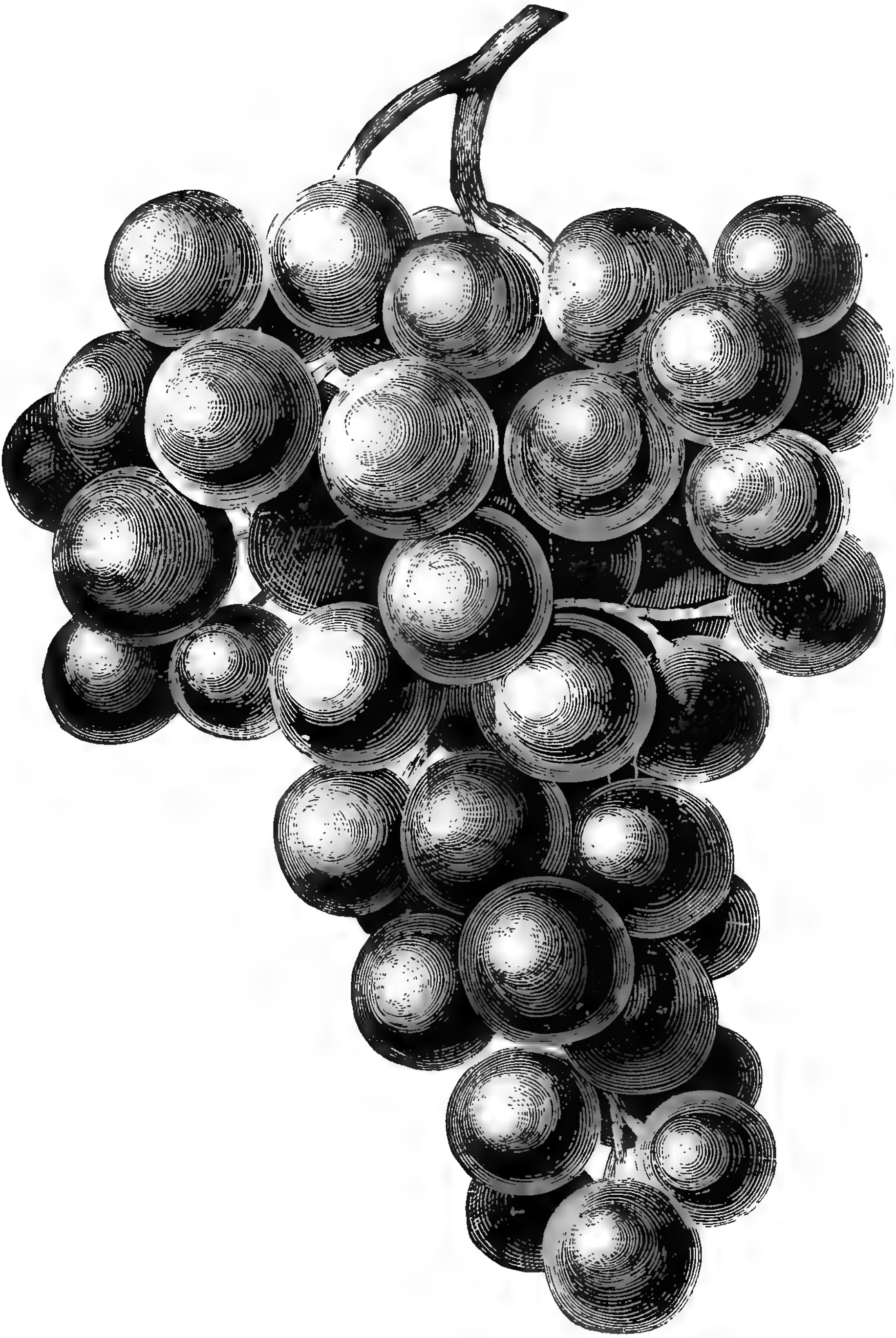
GRANARY. A building adapted to the keeping of grain dry and safe from the depredations of vermin. On most farms the granary is often a series of bins in the barn, sometimes with no attempt to keep them secure from rats and mice. The proper place however, for the granary is a building by itself, raised on posts, capped with large, stout, inverted tin pans, or large, smooth, flat stones. Thus we have a most perfect protection against loss, and if the grain be dry when put in, and properly cleaned, it will always come out sweet and in the best condition for market or seed. In building a granary it should always be with reference to a passage way through the centre, and with doors at each end. The sides should flare somewhat, and the eaves project, so as to keep the sides as dry as possible from storms. Great care should always be taken to have the building strong, that there may be no danger of the weight of grain pressing out the sides. If properly tied to the posts by timbers, and if the siding be made of inch and a half stuff, planed and grooved, put on inside the scantling and firmly nailed, there will be no danger of its being pressed out by the weight of the grain inside. Each bin should have its capacity in bushels plainly marked on it. The number of bushels in the bin should also be plainly marked on a piece of blackboard attached to each bin. This may be a silicate painted directly on each bin, at the time of building. Thus when grain is taken out it may be deducted from the amount previously put in, and at a glance the quantity of grain on hand can be easily figured.

GRANIVORÆ. Birds, including the incessores, which eat grain. Granivorous is used to designate grain-eating animals.

GRANULATE. To form into grains, or become covered with minute granules.

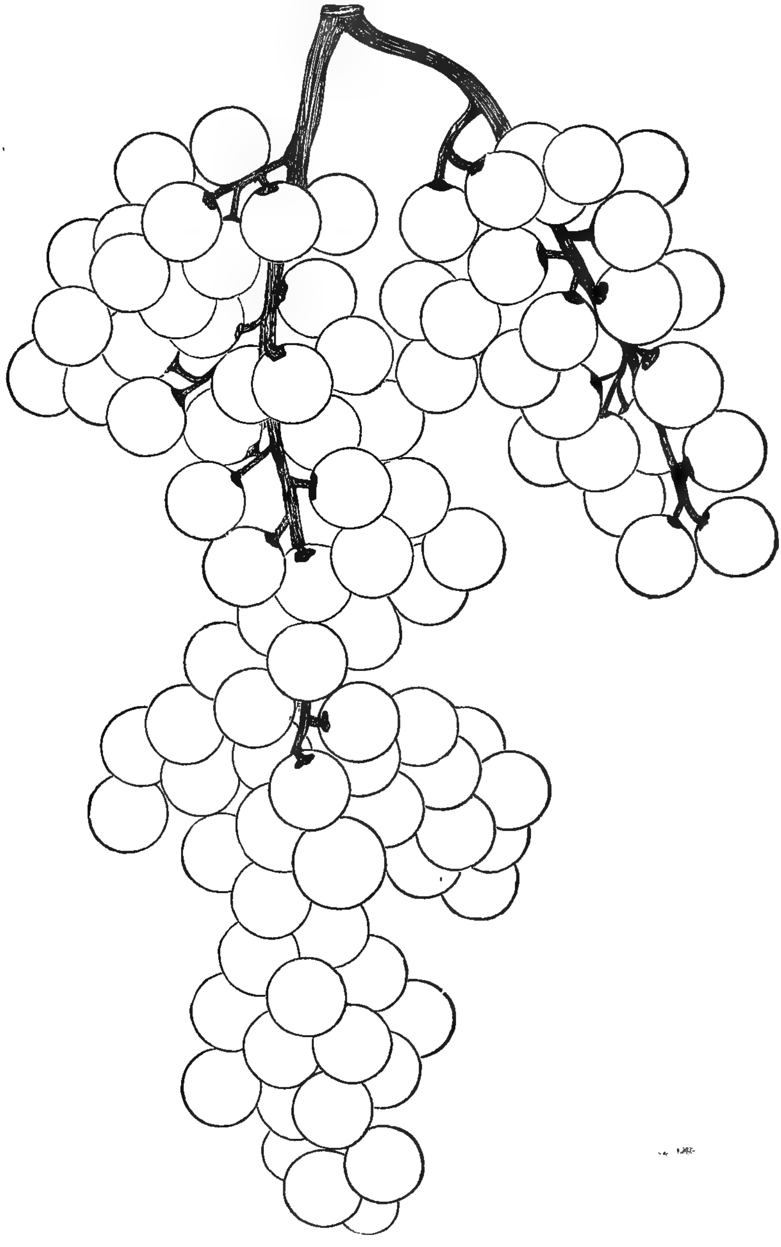
GRANULATION. In chemistry, the reduction of metals into smaller parts; it is performed by pouring small portions of the molten matter into water, and sometimes first passing it through a wire sieve. In surgery, the production of granules of flesh on the surface of wounds.

GRAPE. The grape, during the last ten years, has come fairly to contest the palm, during its season, with the other fruits bought for use by all classes in our principal markets. Since we have ceased to be guided by a hot-house standard, as to what constitutes a palatable grape, and have thrown over the opinions of sybaritic guides, the masses are supplied with this most health-giving fruit in abundance. The Concord grape may be ripened anywhere in the United States up to the Canada line, and also well up into Canada. Along the shores of Lake Erie and Ontario, and west of Lake Michigan, even up to Minnesota, it flourishes everywhere, and may be grown almost as easily as Indian corn. Occasionally a theorist remains who will declare that severe pruning and constant pinching back is necessary to produce fruit. The many get it simply by tying the vines to light posts not extending more than five feet above ground, the laterals being pruned to three or four buds each, the summer pruning consisting simply in taking away the superabun-



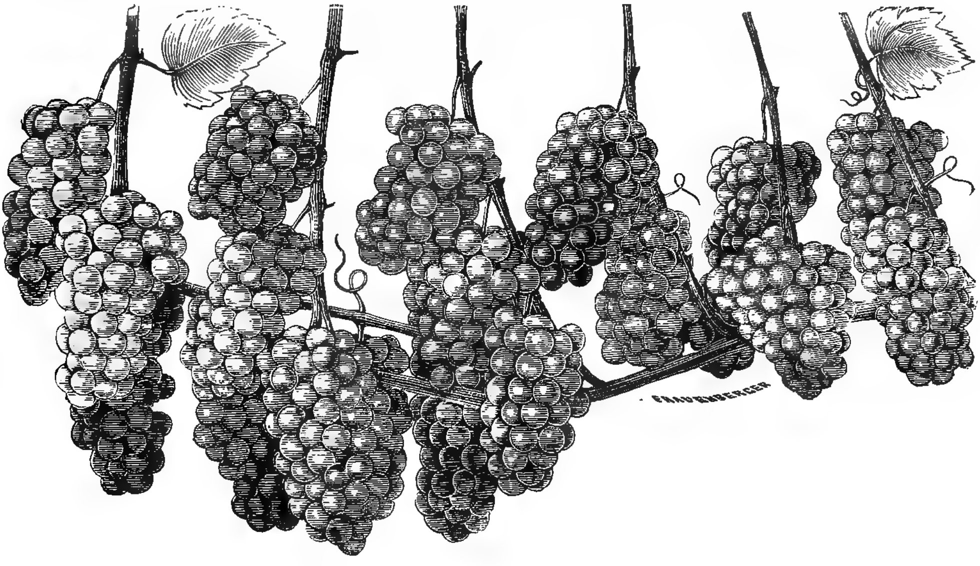
VITIS LABRUSCA—VARIETY CONCORD.

dant wood, up to almost the first or the middle of July, and then letting the vines pretty much take care of themselves. A curious part, not only of grape culture, but of small fruit culture generally, is that the majority of farmers, who should have an abundance of these fruits for daily use in the family during their season, have less than any other of the middle classes of society, forgetting that $50 worth of labor on an acre of land in vegetables and small fruits would return them more healthful and delicate food for the family than could be bought for the produce of twenty-five acres of corn. Yet it is too often the case that, even of grapes, one or two rambling and neglected vines, only, are to be found near the farm house, when every farmer's homestead should have a vineyard of from thirty to sixty vines, the majority of which for the North should be Concords, with a few vines of other reputable sorts for experimental culture. The illustration will show the Concord bunch full size, the Concord being of the Northern Fox-grape family.



VITIS ÆSTIVALIS—VARIETY, DEVEREUX.

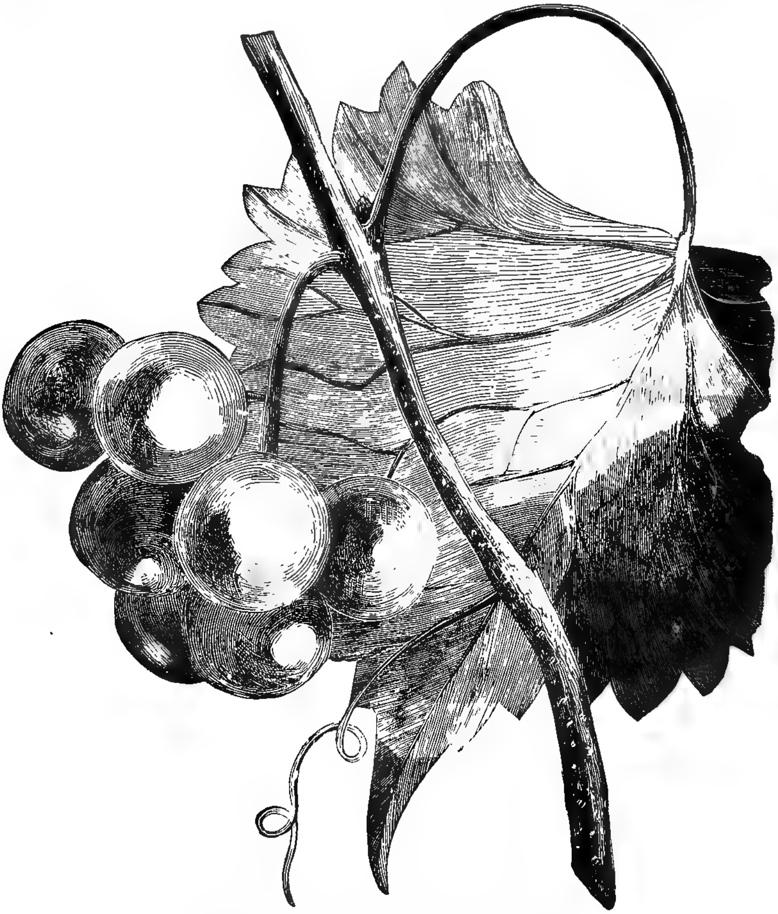
The grape is easily raised from cuttings or layers. One year old vines are the best for transplanting, whatever interested parties may say to the contrary, and any soil not sodden with water in the spring and early summer, and rich enough to raise a fair crop of corn, is good enough to raise those varieties of American grape in common cultivation. The rows for grapes should be eight feet apart, whether the system of cultivation be on trellis or stakes. For Concord, or other strong growing varieties, eight feet should also be allowed in the row. Delaware, and other comparatively weak growing varieties, may be six feet apart in the row. Vigorous varieties, as those like Concord, Diana, and Roger's Hybrids; Delaware, Martha, and this class of grapes, are comparatively weak growers. The cultivation may mostly be done with a five-tooth cultivator, working shallow, but close, next the vines, and deep near the middle of the rows. Thus very little hoeing will be necessary. Whatever the training, whether by winding about stakes, tying them bow fashion back and forth, training for shape or trellising, the annual pruning should all be finished early, and this principally by pinching. The later pruning—and the less the better—is simply clipping off the ends of too rampant and straggling vines. The fall pruning should leave the side shoots cut to about three buds. The Concord, as we before stated, does well on a variety of soils. Delaware likes a rather compact soil, but one not wet; no grape, however, will stand a sodden soil. Perkins is one of the earliest grapes. Hartford seems to like a rather light soil, since on heavy and rather wet soils it is inclined to drop its fruit. Of varieties, every person, except as to Concord, should select those best adapted to his soil, location and system of cultivation. This can only be determined by experiments with sorts that do well on similar soils and locations. The advice in this direction of some practical cultivator nearest you will be of importance in an economical sense.



PRENTISS GRAPE.

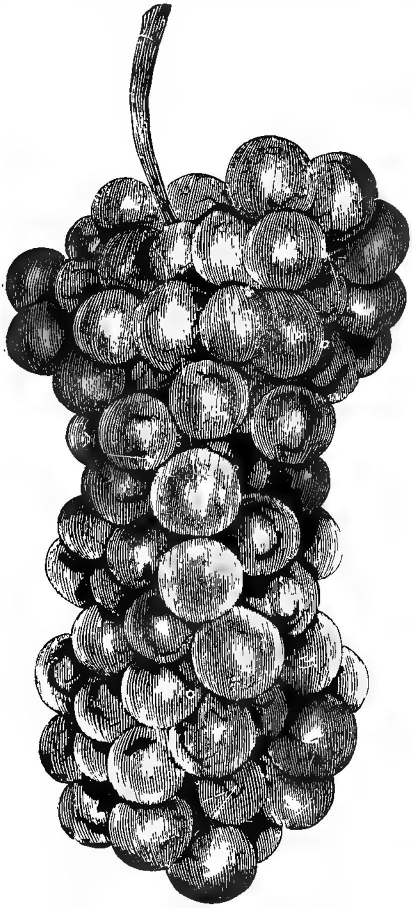
Of the new grapes, candidates for the popular favor, within the last two years the Prentiss has claims worthy the attention of amateurs, and is of the Labrusca family that has given us so many good grapes. The cut, below, shows not only the great weight and compactness with which the grape may be grown, but is a good showing of the Prentiss as we saw it in 1879 and 1880. The branch is twenty inches long, trained laterally and holding a weight of seven pounds of grapes on laterals bearing two and three bunches each. The description is as follows: Bunch large, not often shouldered, compact. Berry medium to large, yellowish green, sometimes with a rosy tint on side next to sun; skin thin but very firm. Flesh tender, sweet, melting, juicy, with a very pleasant and musky aroma; free from foxiness; little if any pulp; seeds few and small; very similar to Rebecca in quality but vine a vigorous grower, and foliage very distinct from Rebecca. Foliage healthy, thick, resembling Diana or Isabella, showing its native origin. Vine a good grower, productive, said to be inclined to overbear. The following is the classification of grapes with full size illustrations of American species: *Vitis labrusca,* see illustration page 415, variety Concord; *V. æstivalis,* see page 416, variety Devereux; *V. cordifolia,* page 419, variety Clinton; and *V. vulpina,* page 418, variety Scuppernong. Upon these species of American grapes we give the following notes: Vitis labrusca furnishes by far the largest number of varieties. The superior size attained both in bunch and berry, the hardiness and productiveness of the plants, and the fair qualities of the fruit, in many of the varieties, have, no doubt, encouraged the production of seedlings from this section. The Catawba belongs to this class and was brought into cultivation more than half a century ago, and the estimation in which it is still held is proved by the fact that the highest recommendation which a new variety can receive in a published list is that it is as good as a well-ripened

Catawba, and this can be truthfully said of only a very few of even the most popular varieties. The fact that the Catawba suffers so frequently from fungoid and other diseases, and the lengthened season that is required for the perfection of its fruit, have caused it to be in a great degree superseded by varieties inferior in quality but hardier and healthier, and of earlier maturity. For table use, the species in its improved varieties, will probably always occupy a prominent position in a large portion of the Eastern and the Middle States, as well as in the northern sections of the Western States; and in those regions where the climate will not favor the maturity of the best varieties of this class, the inferior kinds will occupy their place. Vitis æstivalis is pre-eminently the wine grape of the Atlantic States Owing to the fact that none of the varieties except the Elsinburgh will ripen north of the parallel of 40°, unless it may be in some peculiarly favored situation, they have not been extensively planted, and their superior qualities are but little known. The berries are destitute of pulp, and the juice contains a larger percentage of sugar than any other improved American species. The foliage is not so liable to disease as that of the fox grape, and rot in the berries is comparatively unknown. Some of the best wines made in this country are produced from varieties of this family. The distinction, so well understood and acted upon in Europe, between grapes for table use and those for wine, must also be recognized here sooner or later, if the wine interest is to be brought up to any great degree of excellence, and maintained as a source of national industry and wealth. The mountain slopes and plateaux in Virginia, North Carolina, Tennessee, Arkansas, Missouri, and other Southern States must be looked upon as the great producing regions of this continent for a certain class of the wines, not excepting California and other favored sections of the Pacific coast. It is well understood that warm, dry countries produce high wines of much spirit, but greatly deficient in the delicate aroma, exquisite bouquet, and healthful tonic properties possessed by wines produced in climates having a long season of comparatively equable temperature, which have in all ages been renowned for their super-excellent qualities. Vitis cordifolia represents the most healthy grapes of the Northern States. The foliage is rarely attacked by mildew,



VITIS VULPINA—VARIETY, SCUPPERNONG.

although the leaves, possibly owing to their smoothness, are occasionally injured by insect punctures. The fruit is not subject to rot, and is noted for keeping well after being gathered from the plant. It is late in maturing, and seems to reach its highest condition by remaining on the vine until the thermometer indicates proximity to the freezing point, when, even in northern localities, it proves to be a fruit of fair quality either for table or wine. Of course its quality is greatly improved by the length and geniality of the season of growth; for example, those who are familiar with the fruit only as a production of Massachusetts would not recognize its flavor and vinous character as ripened in southern Maryland or Virginia. The greatest objection to it as a wine grape is that of having too much acid. The fruit is not so deficient in sugar as is generally supposed, having enough of this important ingredient for a good wine. The grapes of this class have been condemned, it may be with undue haste, as wine grapes, on account of their acidity. Analysis shows that they have a sufficiency of sugar, and it seems probable that the wines only require age to develop their qualities. It is known that wines from the Clinton variety, when kept in a suitable cellar from four to six years, assume a very fine character. There is abundant evidence to favor the belief, that if as much time and care had been devoted to the improvement of this species as has been given to the Fox family, we should now be in possession of a good northern red-wine grape. Vitis vulpina is strictly confined to the Southern States, not growing north of Virginia, and in foliage and wood is very unlike any other grape, either native or foreign. It is peculiarly adapted to a low, warm country, flourishing well in rich alluvial soils, and on the low banks of streams. It is entirely exempt from mildew, rot or any of the diseases so disastrous to some northern species. As a wine grape its unequaled bouquet (perfume) is the principal recommendation. It is deficient in sugar, and the juice is usually gallized, fortified by the addition of alcohol, or otherwise manipulated. In sheltered places, more particularly in cities, many varieties of the foreign grape, *Vitis vinifera*, flourish for a time, and this isolated and partial success maintains a lingering hope in the minds of some persons that the difficulties pertaining to the general field culture of this species in the Atlantic States may ultimately be overcome. There would seem to be, however, no real encouragement for such hope. So many experiments have been made with numerous varieties previous to and during the present century, all ending with the same disappointing results, that we are forced to the settled conviction, that they are not adapted to the climate of this country at least east of the Rocky mountains. On the western coast, in the Pacific States, they form the staple crop of the vineyards and succeed equally as well as in the best locations in Europe, and far better than in some of them, The only cause of failure is that of fungoid growths, or mildew, on the young fruit and foliage. Both the length and warmth of our summers are sufficient to ripen them over a large extent of territory. In Europe they are cultivated from the twenty-first to the fifty-second degree of latitude. The question of grape culture in the United States and Canada is an important one, for not only those who make a business of grape culture are interested but every farmer is interested as well in the raising of those varieties adapted to his soil and cultivation. Where only one variety is to be cultivated the Concord will, of course, be taken, and for the reason, more than once given in this work, that it succeeds almost everywhere where Indian corn will ripen, and in any soil (not subject to long inundation,) adapted to Indian corn. In the tables following will be found varieties adapted to every portion of the United States and Canada. Where it is desirable to cultivate a number of varieties, the reader should find no particular difficulty in selecting from the varieties given. In the far North the variety second to Concord may be Clinton, and then Delaware, if the vines are to be covered in winter, another point well-worthy of reiteration, down to and even below the latitude of 42°, and for the reason, that thus the vines are assured from winter killing. In this connection it should also be remembered, especially in the West, where the summers are steadily warm and rather dry, that, many varieties that would certainly be winter killed, not only as to the buds, but the entire wood if left exposed, yet, laid down and with not more than four inches of earth covering during the winter, they



VITIS CORDIFOLIA VARIETY, CLINTON.

will come out all right in the spring, and perfect their fruit during the summer and fall. Among these varieties may be mentioned all those which survive the winter without protection, from 200 to 300 miles south of a line where they are considered not hardy. In fact, many varieties generally grown in graperies, with glass covering, will perfect their fruit during the hot summers of the West if only the vines can be preserved during the winter as we have designated above. Another thing which should be generally known by those not conversant with the fine art of grape growing, is, that European rules in relation to pruning, especially summer pruning, should be avoided. If the reader will recollect what we have said on this head, he will avoid close summer pruning. To recapitulate, pinch so the side shoots will show three buds in the fall, and after the first of July cut out only superabundant growth. In the fall, before laying down, prune out all superabundant wood that may have been left. Thus your vines may be covered in properly for the winter, and will come out in the Spring ready to tie to stakes. The following is the list of grapes as recommended by the American Pomological Society for different latitudes in the United States, with size, form, color, quality and season of ripening; also, a list of the more valuable foreign grapes for cultivation in the grapery or greenhouse. The columns explain as follows: Size—with reference to the berry; l., large; m., medium; s.,

GRAPES—NATIVE.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Form	Color.	Quality.	Use.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
1	Adirondac	m.	m. r.	b.	v. g.	T.	E.	Am.	..	..	*	..
2	Agawan (Rogers' No. 15.)	l.	s. r. o.	r.	g.	F. M.	M.	Am.	..	..	**	*
3	Alvey	s.	m. r.	b.	v. g.	T.	E.	Am.	..	..	..	..
4	Barry (Rogers' No. 43.)	l.	r.	b.	g.	T. M.	M.	Am.	..	..	..	..
5	Catawba	l.	m.r.o.	r.	b.	TMW	L.	Am.	..	..	..	..
6	Clinton	s.	m. r.	b.	g.	T. W.	L.	Am.	*	..	..	..
7	Concord	l	l. r.	b.	v. g.	TMW	M.	Am.	*	..	*	**
8	Creveling	m.	m.r.o.	b.	v. g.	T.	E.	Am.	..	..	*	*
9	Croton	s.	l. r. o.	g.	b.	T.	E.	Am.	..	..	..	..
10	Delaware	s.	s. r.	r.	b.	TMW	M.	Am.	*		**	**
11	Diana	m.	s. r. o.	r.	v. g.	T. M.	L.	Am.	*	..	*	..
12	Elsinburgh	s.	m. r.	b.	v. g.	T.	E.	Am.	..	..	..	..
13	Essex (Roger's No. 41.)	l.	r.	b.	g.	T. M.	M.	Am	..	..	..	..
14	Eumelan	m.	r.	b.	v. g.	T.	M.	Am.	..		†	..
15	Goethe (Rogers' No. 1.)	l.	l. r. o.	g.	v. g.	T. W.	L.	Am.		..	..	..
16	Hartford prolific	l.	m.r.o.	b.	g.	M.	E.	Am.	*	..	*	**
17	Herbemont, Warren, etc	s.	m. r.	b.	v. g.	T. W.	L.	Am.	..	..	..	..
18	Iona	m.	m.r.o	r.	b.	TMW	L.	Am.	..	..	†	..
19	Israella	m.	s. r. o.	b.	v. g.	T.	M.	Am.	..	..	..	..
20	Isabella	l.	m.r.o.	b.	g.	T. M.	L.	Am.	*	..	..	..
21	Ives	m.	m.r.o.	b.	g.	M. W.	M.	Am.	..	..	..	..
22	Johnson (S. C. Seedling.)	....	......	......	......	......	......	......	..	..	..	..
23	Lindley (Rogers' No. 9.)	m.	m.r.o.	r.	g.	F. M.	M.	Am.	..	..	*	..
24	Massasoit (Rogers' No. 3.)	l.	m. r.	r.	g.	F. M.	M.	Am.	..		..	..
25	Martha	l.	s. r.	g.	g.	M. W.	M.	Am.	..	..	..	..
26	Maxatawney	m.	m.r.o.	g.	v. g.	T.	M.	Am.	..	..	..	..
27	Merrimack (Rogers' No. 19.)	l.	s. r.	b.	g.	M.	M.	Am.		..	**	*
28	Norton's Virginia	s.	m. r.	b.	g.	W.	L.	Am.	..	..	..	..
29	Perkins	l.	r.	r.	g.	T. M.	E.	Am.	..	..	..	..
30	Peter Wylie (Doctor Wylie.)	m.	r.	w.	v. g.	T.	......	......	..	..	..	.
31	Rebecca	m.	s. r.	g.	v. g.	T.	M.	Am.	..	..	*	..
32	Salem (Rogers' No. 22.)	l.	r.	b.	g.	M.	M.	Am.	†	..	**	*
33	Scuppernong	l.	r.	r.	g.	W.	M.	Am.	..	..		..
34	Telegraph (Christine.)	l.	m.r.o.	b.	v. g.	T. M.	E.	Am.	..	..	*	..
35	Union Village (Ontario.)	l	s. r. o.	b.	g.	M.	M.	Am.	..		..	..
36	Walter	m.	s. r.	r.	b.	TMW	M.	Am.	..	..	†	..
37	Wilder (Rogers' No. 4.)	l.	l. r.	b.	v. g.	T. M.	M.	Am.	..	..	**	*

1 Unreliable.
3 Too small.
5 Suited only to clayey loams and certain localities.
6 Hardy everywhere.
7 Succeeds everywhere.
8 Bunches loose.
9 A promising white variety.
10 Wants rich soil and high culture.
16 Liable to drop from the bunch.

small. Form—with reference to bunch and berry; s. r., short bunch, round berry; l. r., large and round; m. r. o., medium bunch, roundish oval berry; m. r., medium bunch, round berry. Color—b., black, or nearly so when fully ripe; r., reddish or coppery-brownish red; g., greenish-white or yellowish. Quality—g., good; v. g.. very good; b., best. Use—T., table; M., market; W., wine. Season—E., early; M., medium; L., late. Origin—Am., American. * One star signifies doing well; ** two stars, doing very well; † a dagger signifies on trial. As the foreign grapes are for cultivation under glass, they are not subject to those variations induced by climate or soil, and therefore they may be regarded as equally adapted to all localities. Very few of the local committees have made any report in reference to these grapes. The list below contains such as have been already adopted by the Society, with a few others very generally esteemed. In California, Utah, and sections of the Southern States, they require no artificial protection or heat; it has, therefore, been thought unnecessary to tabulate the States and Territories relative to them; but, taking the old catalogue, and simply adding to it a column relative to variety as adapted to a cold house, or its want of fire heat, in our Northern States, the old form is continued. The columns explain: 1st—The color of the fruit; 2d—flavor; 3d—season of maturity; 4th—cold, for a variety that does well without fire heat—hot, for a variety

GRAPES—NATIVE.

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland & D. C.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Missi-sippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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7	*	**	*	**	**	*	**	**	*						**	**	**		**	*		**	*	**	**	**	**	**	**	**	**					**	*	**	**			*	*	*		
8	*	*			*	*	*	*							**	*	*		*					*						*						*	*	*	**							
9		†	*		†		†									†						*	†				†	†	†	†	†		†		†		*									
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37		*	*		**	*	*	**								*			*					**	*		*												*							

17 Makes the finest of white wine.
18 Unreliable except in a few locations.
20 Valueless at the West.
21 Valued for dark wine.
26 Vines require age to give perfect fruit.
34 The more known the better liked.

wanting fire heat. In flavor, the only distinction is between those that are simply sweet, as the Chasselas or Hamburgs, and those having a distinct musky aroma, as the Muscats.

No.	FOREIGN GRAPES.	Color.	Flavor.	Season.	Vinery.
1	Barbarossa (Prince Albert, Brizola.)	Black.	Sweet.	Very Late.	Hot.
2	Black Champion	Black.	Sweet.	Early.	Cold.
3	Black Damascus	Black.	Sweet.	Late.	Cold.
4	Black Frontignan	Black.	Muscat.	Late.	Cold.
5	Black Hamburg	Black.	Sweet.	Medium.	Cold.
6	Black Prince	Black.	Sweet.	Medium.	Cold.
7	Black July	Black.	Sweet.	Early.	Cold.
8	Bowood Muscat	White.	Muscat.	Medium.	Hot.
9	Buckland Sweetwater	White.	Sweet.	Medium.	Cold.
10	Calabrian Raisin (Raisin de Calabre.)	White.	Sweet.	Late.	Hot.
11	Cannon Hall Muscat	White.	Muscat.	Late.	Hot.
12	Chasselas Musque, or Joslin's St. Albans (Muscat blanc Hative ?).	White.	Muscat.	Early.	Hot.
13	Duc de Magenta	Black.	Sweet.	Early.	Hot.
14	Early Silver Frontignan	White.	Muscat.	Early.	Hot.
15	Golden Hamburg (Stockwood G. Homburg.)	White.	Sweet.	Late.	Hot.
16	Golden Champion	Amber.	Sweet.	Medium.	Hot.
17	Grizzly Frontignan (Red Frontignan, Red Constantia.)	Red & Yellow.	Muscat.	Medium.	Hot,
18	Gros Colman	Purple.	Sweet.	Late.	Cold.
19	Lady Downe's Seedling	Black.	Sweet.	Very Late.	Hot.
20	Muscat of Alexandria	White.	Muscat.	Late.	Hot.
21	Muscat Hamburg	Black.	Muscat.	Medium.	Hot.
22	Mrs. Pince's Black Muscat	Black.	Muscat.	Late.	Hot.
23	Queen of Nice	White.			
24	Red Chasselas (Rose Chasselas.)	Red.	Sweet.	Medium.	Hot.
25	Red Lombardy	Red.	Sweet.	Medium.	Hot.
26	Rio Virgin				
27	Royal Muscadine	White.	Sweet.	Early.	Cold.
28	White Nice	White.	Sweet.	Late.	Hot.
29	West St. Peter's	Black.	Sweet.	Very Late.	Hot.
30	Wilmot's Black Hamburg (Dutch Hamburg.)	Black.	Sweet.	Medium.	Hot.
31	White Sweetwater (Dutch Sweetwater.)	White.	Sweet.	Early.	Cold.
32	White Frontignan (White Constantia, Muscat blanc.)	White.	Muscat.	Medium.	Hot.
33	Zinfindal	Black.	Sweet.	Medium.	Hot.

GRAPE INSECTS. Grape vines are attacked by numerous insects, on leaf and root, and also by borers. The most devastating and dreaded of late years is the grape Phylloxera, which, having devastated the vineyards of France and other principal vine growing districts of Europe, are now giving vinegrowers in the United States, and especially in California, much trouble. This insect is especially troublesome in the lighter classes of mucky soil and in loams. In gritty soils, or soils containing much sand, the Phylloxera is less dreaded. Dr. C. V. Riley, Chief of the Entomological Commission of the United States, has spent much valuable time in the careful investigation of this enemy of the vine, both in France and in the United States. A synopsis of his investigations will be accepted as correct and valuable both by the scientific and the general reader. Extracts are from the report of the Commissioner in the United States Geological Survey, containing valuable matter in relation to the Rocky Mountain Locust, and other insects. This destructive insect was first found in this country, and was described by Dr. Fitch, in 1856, under the name of *Pemphigus vitifoliæ*. Its proper name is *Phylloxera vitifoliæ*, though most authors speak of it as *Phylloxera vastatrix*. It exists in two forms, one raising irregular galls on the leaves, and the other forming small swellings on the rootlets. The root-form is both wingless and winged, the latter very rare. The leaf-form is said to be always wingless. The wingless female of the leaf-form lays, on an average, 200 eggs, and sometimes 500. There are perhaps five generations in a year. This leaf-form produces round, irregular galls, sometimes as large as a pea, but it does little damage compared with the root-form, which is much more abundant than the leaf-form, especially on native vines, in France, where its ravages have been so alarming that the French government has offered a reward of 300,000 francs for a simple available remedy. The leaf-form descends to the roots in the autumn, and there hybernates. The larvæ of the root-form are at first smooth and like the young of the leaf-form, but afterward molt and become warty, so as to become readily distinguishable from them. Prof. Riley and certain French observers have lately proved that the gall-producers, or the leaf-form, come from the impregnated or winter egg. The winged females begin to appear in July, but are most abundant in August and September. Like the wingless females, they reproduce by budding (parthenogenesis), the eggs not being fertilized by males, no males being in existence. Having issued from the ground while in the pupa state, they rise in the air, and spread to new vineyards, where they lay two or three, sometimes eight eggs. These eggs are of two sizes; and, in about a fortnight, from the larger eggs are hatched wingless true sexual females, and from the smaller eggs wingless males. The abdomen of the female, after impregnation, enlarges somewhat, and she is soon delivered of a solitary egg; which differs from the ordinary eggs of the parthenogenetic mother, only in becoming somewhat darker. Fig. 1, Type *Gallæcola*; *a*, *b*, newly-hatched larva, ventral and dorsal view; *c*, egg; *d*, section of gall; *e*, swelling of tendril; *f*, *g*, *h*, mother gall-louse, lateral, dorsal and ventral views; *i*, her antenna; *j*, her two-jointed tarsus. The figure on the side of each enlarged drawing represents the natural size. This impregnated egg gives birth to a young louse, which becomes a virginal, egg-bearing, wingless mother, and thus recommences the cycle of the species' evolution. But one of the most important discoveries of Balbiani is that, during the latter part of the season, many of the wingless, hypogean mothers perform the very same function as the winged ones; i. e., they lay a few eggs, which are of two sizes, and which produce males and females, organized and constructed precisely as those born of the winged females, and, like them, producing the solitary impregnated egg. Thus, the interesting fact is established that even the winged form is by no means essential to the perpetuation of the species; but that, if all such winged individuals were destroyed as fast as they issue from the ground, the species could still go on multiplying in a vineyard from year to year. We have, therefore, the spectacle of an underground insect, possessing the power of continued existence, even when confined to its subterranean retreats. It spreads in the wingless state from vine to vine, and from vineyard to vineyard, when these are adjacent, either through passages in the ground itself or over the surface; at the same time it is able, in the winged condition to migrate to much more distant points.

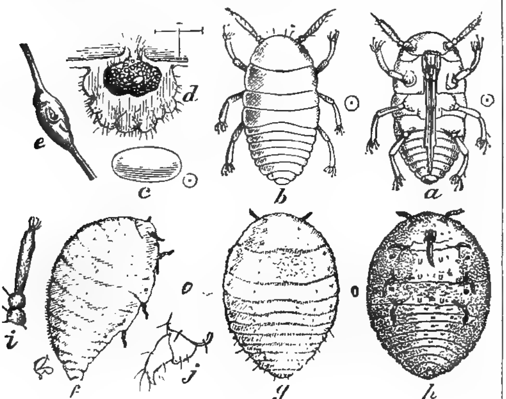


Fig. 1.

Fig. 2, Type (root-form) *Radicicola;* *a*, roots of Clinton vine, showing the relation of swellings to leaf-galls, and power of resisting decomposition; *b*, larva, as it appears when hybernating; *c*, *d*, antenna and and leg of the same; *e*, *f*, *g*, forms of more mature lice; *h*, granulations of skin; *i*, tubercle; *j*, transverse folds at border of joints; *k*, simple eyes. The solitary egg above referred to is the winter egg. As autumn advances, the winged individuals become more and more scarce, and only eggs, newly-hatched larvæ, and a few wingless, egg-bearing mothers are seen. The latter are said to die during the winter, and consequently the species in winter is represented by the larvæ and a few eggs. In spring the larvæ molt their winter coat, and, after attaining maturity, lay eggs. The eggs laid by the winged females are placed in the down of the leaf of the vine, but more commonly in the earth around the roots. Fig. 3, Type (root-form) *Radicicola;* *a*, *b*, pupa and imago of a problematic individual, or supposed male; *c*, *d*, its antenna and leg; *e*, vesicles found in the abdomen. As to remedies, one hundred and forty have already been proposed in France, but none are infallible. The best general remedy is flooding the vineyards in autumn or winter. The best specific application has been found to be the bisulphide of carbon, two ounces to be placed in a hole near the root, the earth becoming impregnated, the insects are killed.

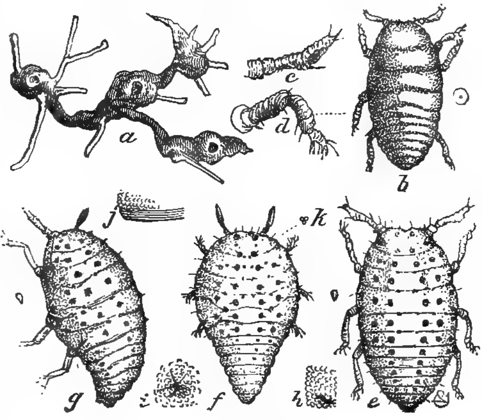


Fig. 2.

Dr. Riley has strongly urged the use of those American vines which resist the attacks of the Phylloxera, as one of the best measures to prevent the attacks of this dreaded pest. Dr. Riley supplements the natural history of this insect, showing the means he employed to carry out the rearing of the perfect insect, saying: The results of these endeavors to supply the winged mothers as nearly as possible with the natural conditions have been satisfactory, and they prove that, as was surmised, the eggs are laid in crevices of the ground around the base of the vine, but still more often on the leaves, attached generally by one end amid the natural pubescence, or rather down, of the under surface; and while heretofore all efforts to artificially hatch the progeny from these eggs have, for the most part, failed, I have this year succeeded in hatching them without difficulty. (The illustrations given will show the various stages of the insect, so as to make the whole clear.—Ed.) I have also succeeded in getting both sexes of the American Oak Phylloxera, and in thus completing the natural history of both species. Though this true sexual form of vastatrix, from the winged and agamous female, has never before been carefully observed and described, it was nevertheless anticipated by Balbiani in his studies of the European Oak Phylloxera (*Phylloxera quercus* Fonsc.) and by myself in my studies of the American Oak species (*P. Rileyi*). Balbiani had also obtained what is evidently the same from eggs deposited by wingless, hypogean mothers late in the sea-

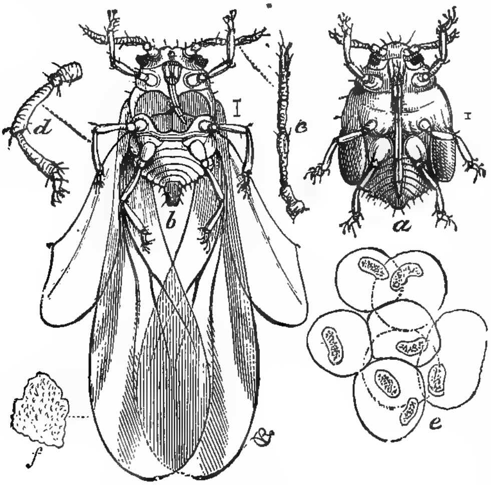


Fig. 3.

son, and after the winged mothers cease to fly. The winged females carry in the abdomen from three to five and sometimes as many as eight eggs. These eggs are of two sizes—the smaller, which produce males, about three-fourths the size of the larger, which produce females. As the whole organization of these aërial mothers—with the stout proboscis and ample wings—indicates freedom and nourishment are needed to bring the eggs to perfection and cause their proper oviposition. In confinement in small vessels, where these requisites are not easily furnished, the eggs are generally voided, with the death of the parent, on the sides of such vessels; and those freely laid are with the greatest difficulty brought to the hatching point. Only in two instances did I succeed in doing this last year. These failures in the past find their explanation not so much in the difficulty of supplying the natural conditions, as in lack of experience as to what these conditions were. The accompanying illustration, Fig. 4, shows Sexed Phylloxeræ: *a*, female *vastatrix*, ventral view, showing egg through transparent skin; *b*, do., dorsal view; *c*, greatly enlarged tarsus; *d*, anal joints shrunken as they appear after oviposition; *e*, male *caryœcaulis*, dorsal view—the dots in circle indicating natural size. Whether owing to the want of down on the Clinton leaf, or that the minuteness of the eggs makes it about as difficult to find them on a square four feet of earth surface as the proverbial needle in a haystack, the eggs found on the vine in the aforementioned muslin enclosure were very few compared to the number of winged insects which must have come out of the ground. It was also next to impossible to find, and quite impossible to follow, the sexed individuals after hatching. In the prepared jars, where the tomentose leaves of Labrusca were kept, I obtained more satisfactory results; for, while a few eggs were laid on the surface of the ground, especially in the space between the earth and the glass, and a few others on the upper side of the leaves, by far the larger number were attached to the under surface, generally by one end and thrust between the natural down of the leaf—evidently showing that this is the natural nidus chosen. The winged mothers die soon after ovipositing and their shrivelled and decaying bodies adhere to the leaf-down. By taking a leaf bearing eggs that are eight or nine days old and enclosing it in a smaller, tightly corked tube, the sexed individuals hatch freely, and are easily watched. This hatching takes place on about the tenth day after deposition, with our late September temperature. The egg perceptibly enlarges during this time, a fact that might be explained by endosmosis of the leaf-juices were it not known that the same fact holds true of many soft insect eggs that are not attached to succulent leaves or other living vegetation. The red eyes are seen through the delicate egg-shell early in the development of the embryo, and just before hatching the joints of the body are perceptible. The egg-shell is so delicate that in the process of hatching it is usually pushed back in folds, and is left as a little wrinkled, whitish mass; occasionally, however, it more nearly retains its original form. The sexed individuals are at once distinguished from all the other forms which this interesting species assumes by the obsolete mouth-parts, the sexual organs and the more highly developed nervous system; otherwise, in size, in smoothness and in obsoleteness of the basal joint of tarsus, they most closely represent the newly hatched larva. The next cut, Fig. 5, Grape Phylloxera; *a* shows a healthy root; *b*, one in which the lice are working, representing the knots and swellings caused by their punctures; *c*, a root that has been deserted by them, and where the rootlets have commenced to decay; *d*, *d*, *d*, shows how the lice are found on the larger roots; *e*, female pupa, dorsal view; *f*, the same, ventral view; *g*, winged female, dorsal view; *h*, same ventral view; *i*, magnified antenna of winged insect; *j*, side view of the wingless female laying eggs on roots; *k*,

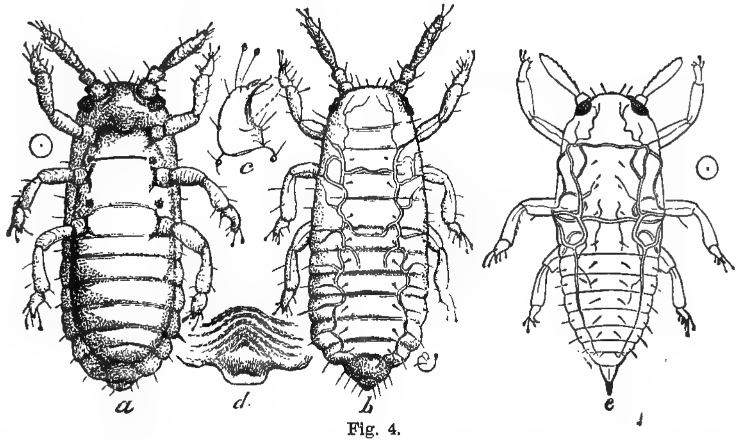


Fig. 4.

shows how the punctures of the lice cause the larger roots to decay. Where this egg is naturally laid I have not yet ascertained, but in all probability it is carried into or near the ground by the impregnated parent. The young hatching from it is the normal agamous female: for, though I have not yet hatched this impregnated egg of vastatrix, I have succeeded in doing so with that of Rileyi, and Balbiani long since did so with that of quercus. I am led to think that, once impregnated, the female carries her egg into the ground, because in 1873 I found females whose abdomens, instead of being filled with numerous small eggs, were distended with a single large one; and, though I was puzzled to interpret the fact at the time, I have no doubt now that I then had under my eyes the true, impregnated female here described, and that I overlooked the obsolete mouth. The habits of these sexed individuals, as I have been able to observe in both the Grape and American Oak species, are similar to those recorded by Balbiani of the European Oak species. The male is quite ardent, more active than the female and somewhat longer-lived. The complete natural history of the Grape Phylloxera may now be considered established. A full biological view of the species exhibits to us no less than five different kinds of eggs: 1st, the regular ovoid egg, 0.25 mm. long and half that in diameter, of the normal, agamic and apterous female, as it is found upon the roots; 2d, the similar, but somewhat smaller egg of the gall-inhabiting mother; 3rd, the ♀ egg from the winged mother, rather more ellipsoidal, and 0.50 mm. long when mature; 4th, the ♂ egg from same, one-fourth less in length and rather stouter; 5th, the impregnated egg, just described, 0.32 mm. long and still more ellipsoidal. We have also the singular spectacle of an egg from the winged mother increasing from 0.34 mm. (its size when laid) to 0.40 mm. (its size just before hatching) giving birth to a perfect insect 0.40 mm. long and this in turn without any nourishment laying an egg 0.32 mm. long. A being is thus born, and, without food whatsoever, lays an egg very nearly as large as that from which she came. From observations here recorded I would draw the following conclusions: 1. We can no longer really entertain the hope of any practical good from the knowledge of the nidus chosen by the winged mothers, as the destruction either of these or of their eggs—scattered as they are on the leaves all through a vineyard—is out of the question. The objects are too small to be practically searched for, and it is virtually impossible to prevent the spread of the disease in this stage. We might almost as well try to prevent mildew

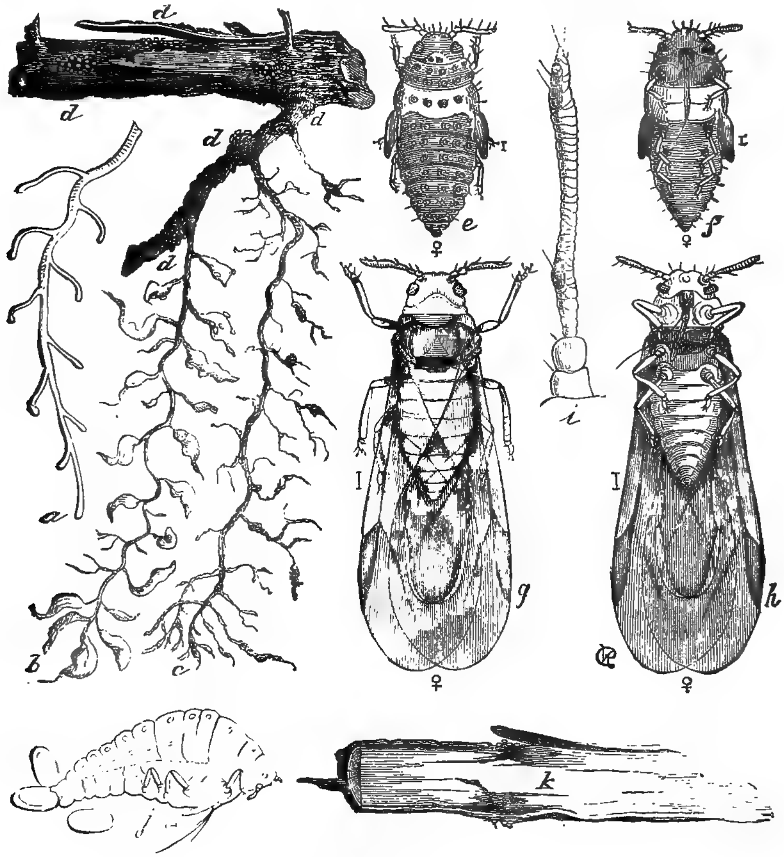


Fig. 5.

by the destruction of the invisible floating spores that must at times pervade the atmosphere of a vineyard. The hope entertained by Lichtenstein that the winged mothers would congregate and be attracted to some particular plant must, it is thought, be abandoned. 2. The only preference shown in this respect would seem to be for those leaves that are most downy or tomentose; and from this view of the case we get another probable reason why the varieties of Labrusca which are characterized by an abundant downiness on the under surface of the leaves suffer most from the insect. 3. Having already had the young from the impregnated egg of Rileyi hatch in about a fortnight after it was laid; having shown in previous writings that this species winters in the larva state, and not in the impregnated egg as does the European quercus; remembering, further, that vastatrix resembles Rileyi in wintering as larva, it is safe to conclude that the impregnated egg of vastatrix will hatch the same season that it is laid, and that we can not apply to it the term winter egg which Balbiani applies to the impregnated egg or quercus. It is not unlikely that, since a few of the winged females issue as late even as the latter part of October, some few also of the latter produced impregnated eggs may pass the winter unhatched; if so, they may be considered exceptions to the rule. In the same way, a few of the more common eggs from the agamous male may be exceptionally found on the roots in winter, though as a rule only the hybernal larva is found. Concluding, Dr. Riley states that a succeeding year's study of both Vastatrix and Rileyi confirm him in the opinion, maintained in a previous report, that the term pupa, as applied to the sexed eggs by Lichtenstein, is quite unwarranted, and that the egg-covering, thin and plastic though it is, can in no sense be likened to a cocoon, and still less to a silken cover. The fact of its shrivelling up makes it none the less an egg-shell, for this shrivelling process occurs in all eggs with very delicate and plastic covering, and may, indeed, be witnessed in the gall-inhabiting form of vastatrix, though no one has thought of questioning the ovarian nature of the eggs found in those galls. The foregoing, given at considerable length, will be found important to vineyardists. Another destructive insect, infesting the grape, is the Red Shouldered Synoxylon (*Synoxylon basilarie*), Fig. 6—*a*, larva; *b*, pupa; *c*, perfect insect or beetle; a blight insect boring under the bark, as well as in the heart of the stems. Its depredations are not confined to the grape, for it also attacks the apple, and the hickory, boring straight to the heart of the tree. Infested twigs should always be burned. The Grape Forester may also be mentioned here as eating the leaves of the grape. The miller has a black hue with two large spots on each of its wings. Those on the forewings white and those on the hindwings yellowish, (see illustration given below, Fig. 7), *a*, caterpillar, *b*, side view magnified, *c*, moth. The caterpillar is banded with whitish-blue with black lines, and on the middle of each square is a broad, orange-yellow band dotted with black. Hand picking is the remedy. Of the four next beetles figured, the Editor of the Report on the Rocky Mountain Locust, says of the grape-vine colaspis, that it is one of the worst of the forty or fifty different insect enemies of the grape-vine. The beetle ranges from New York to Illinois and Missouri. It is cream-colored and black, with long club-shaped feelers nearly a fifth of an inch long; the head and prothorax are reddish-yellow, while the wing-covers are black. Hand picking is the best remedy. The cut, Fig. 8, shows at 1, beetle; 2, natural size; *a*, larva, *b*, end of body enlarged, the hair line showing the natural size. The larva has been found by Prof. Riley to feed on the roots of the strawberry. It transforms in the ground. Of the Vine-Leaf Hopper, he says it abounds East, when the grapes are ripening, is pale yellow, with two broad red bands and a third dusky one at the apex. It is a little over a tenth of an inch long. It swarms on the leaves in August, puncturing them with its tiny beak, and drawing out the sap until the leaves turn yellow and become dry and stiff

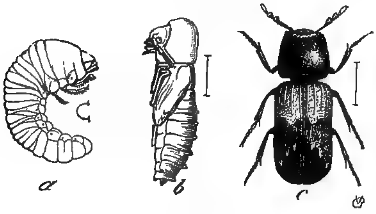


Fig. 6.

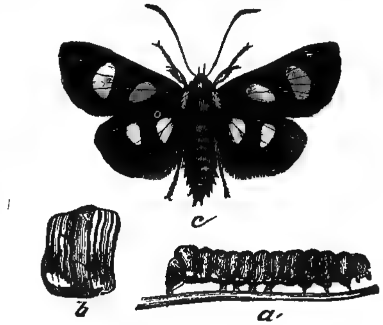
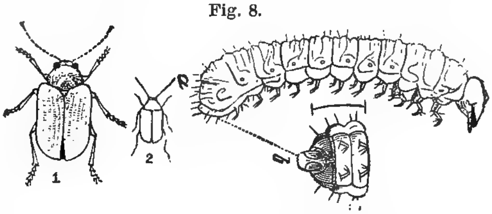


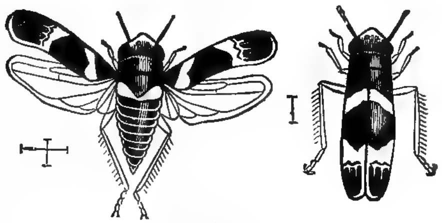
Fig. 7.

Fig. 8.



GRAPE-VINE COLASPIS.

Fig. 9.



VINE-LEAF HOPPER.

The young appear in June, and the leaves are thus depleted for a period of nearly three months. They wither, and hence the plant becomes enfeebled, little new wood is formed, and the canes do not ripen well, and the fruit is stunted and easily mildews, while in a few years the vine become exhausted and barren. The leaf-hoppers hybernate, and lay their eggs in the spring As a remedy, wash the vines with soap-suds in June, and, if possible, fumigate the leaves with tobacco. These are among the worst of the insects attacking the grape. Another insect, rather rare, but destructive, is the Broad-necked Priornus. This is, however, a general feeder working in a number of trees, and will be treated of under its proper name.

GRAPERY. A house similar to a green house, but devoted to the raising of exotic grapes. They are of two kinds; those depending entirely upon the spring, summer and autumn's sun for ripening the fruit, and those heated artificially, for winter forcing. Since the introduction of ripe grapes from California, graperies are becoming less and less used in the United States by the wealthy. But in England they are still extensively used for forcing grapes, since the heat of the climate of Great Britain will not ripen any variety of cultivated grape without more or less artificial forcing.

GRAPE SUGAR. *Glucose.*

GRAPHOMETER. A name for the semicircle of land surveyors.

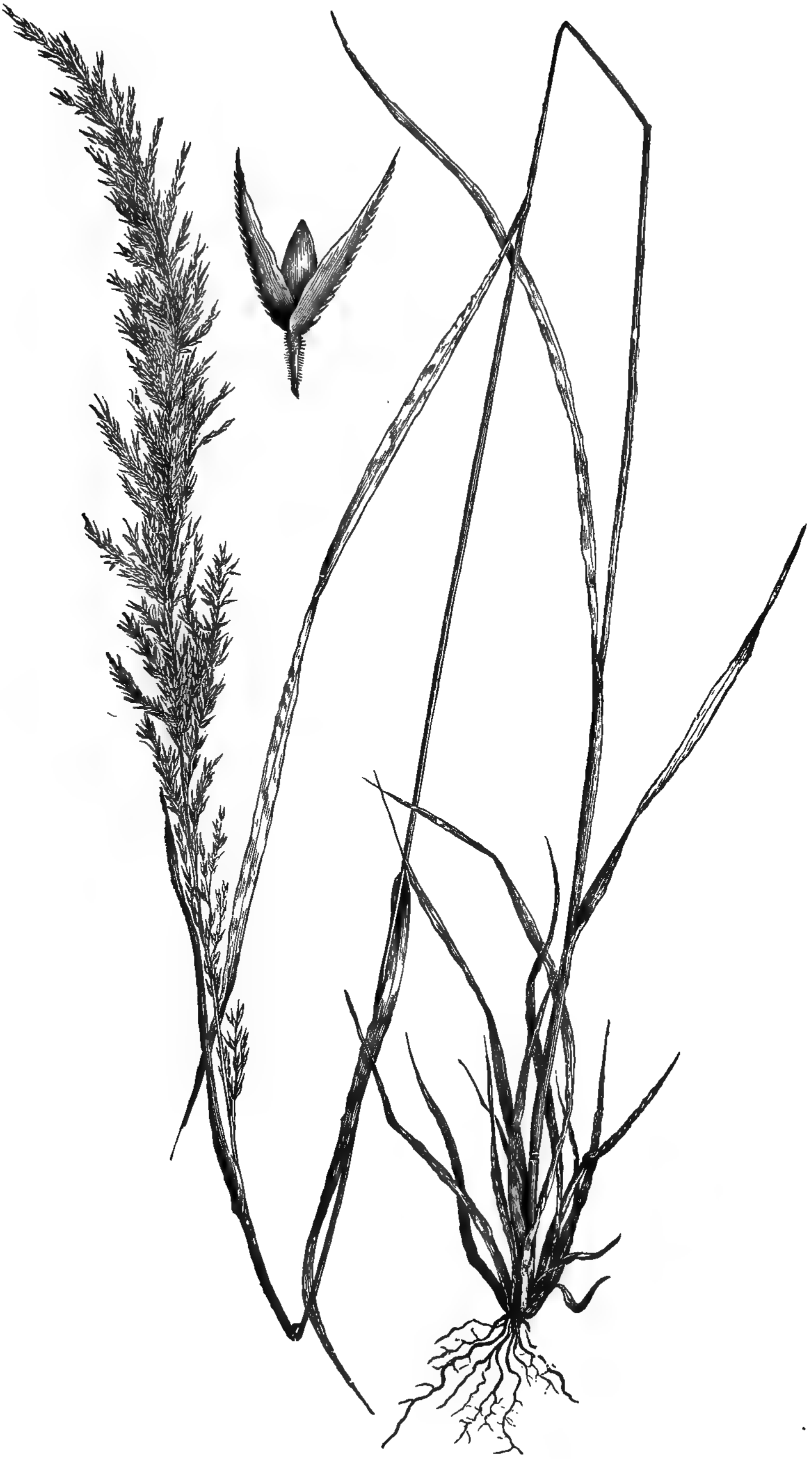
GRAPHITE. Plumbago, black-lead. The coarse kinds are used in making crucibles.

GRASSES. The great order of plants included in the Gramineæ, or true grasses, are described botanically as having mostly hollow stems (*culms*) which are cylindrical and jointed, closed at the joints (*nodes*), leaves alternate, two-ranked, parallel-nerved, the dilated petiole (*sheath*) surrounding the culm and split open on the side opposite to the blade, and furnished at the junction of the blade with a more or less manifest scarious appendage (*ligule*). Flowers perfect, polygamous or monœcious (rarely diœcious), imbricated with two-ranked glumes or bracts, the outer pair (glumes), substituting a spikelet of one or several flowers, the inner pair (*paleæ*), enclosing each particular flower which is destitute of a proper perianth. Stamens one to six, usually three anthers, versatile. Ovary one-celled, one-ovuled, usually with two or three scales (*squamulæ*) at base. Styles mostly two or two-parted; stigmas plumose or hairy. Fruit a seed-like grain (*caryopsis*); embryo small at the base and on the outside composed of copious farinaceous albumen. Annuals or perennials, with fibrous roots, often *cæspitose.* Spikelets paniculate or spiked, upper (inner) palea two-nerved or two keeled. This vast order—comprises some two hundred and thirty genera, and perhaps not less than three thousand species, says Dr. Darlington, and is probably the most generally diffused and the most important to man, of all the families of plants. The seeds, and herbage, furnish a principal portion of the food of the human race, and of the more valuable domestic animals. A great number of the grasses, however, are little better than weeds, on a farm, and some of them exceedingly annoying. Those which the American agriculturist is more immediately interested in knowing, are here given. Those specimens with which the farmer and planter are most intimate may be composed in the Poa Sub-family, the Phalaris Sub-family and the Panicum Sub-family, and are as follows: I.—Poa Sub-Family contains 1. Leersia. 2. Oryza. 3. Zizania. 4. Alopecurus. 5. Phleum. 6. Agrostis. 7. Muhlenbergia. 8. Calamagrostis. 9. Cynodon. 10. Eleusine. 11. Dactylis. 12. Glyceria. 13. Poa. 14. Festuca. 15. Bromus. 16. Phragmites. 17. Arundinaria. 18. Lolium. 19. Triticum. 20. Secale. 21. Hordeum. 22. Avena. 23. Arrhenatherum. 24. Holcus. II.—Phalaris Sub-Tribe contains 1. Anthoxanthum. 2. Phalaris. III.—The Panicum Sub-Tribe: 1. Paspalum. 2. Panicum. 3. Setaria. 4. Cenchrus. 5. Tripsacum. 6. Zea. 7. Saccharum. 8. Andropogon. 9. Sorghum. Of the last Sub-family we shall only notice those adapted to cutting green for forage, and those adapted to the pasture and meadow. Grass is the prime integer in all farming. The hay crops of the United States are the most valuable single crops cultivated, and grass for summer pasture ranks higher than any. It makes pasture in summer, and forage in winter, and all farm stock in any country are dependent upon it almost exclusively for food, for even in fattening with grain—corn, oats, barley, etc.,—we depend upon the seeds of this beneficent family of plants. The Cruciferæ which includes cabbage, rape, mustard, turnips, etc., are valuable in England. The Cucurbitaceæ, which includes pumpkins, squashes, etc., find a large place in feeding stock in many portions of the United States. The composite family, the largest of the natural families, furnish artichokes and a few others seldom used; but it is remarkable in its lack of useful species although wonderful in ornamental ones. The night-shade family gives us the potato. The parsley family gives us the carrot, the parsnip and some others of value, and the goosefoot family furnishes the sugar beet and mangelwurzel, valuable for feeding in the West. Nevertheless, all placed together are of but little account in comparison with the great grass family, which includes our cereal grains. In fact, grass is of more value to man, than all other plants combined. Vastly more than half of all vegetation—as to its value to man—is contained in this family. In 1870, the hay crop alone of New York, exceeded seventy-seven millions of dollars; in Pennsylvania, over thirty-five millions; in Ohio, over twenty-one millions, and in Illinois, more than twenty millions of dollars. The truth of the text, All flesh is grass, will thus readily be understood, and also the statement that Grass is King among the crops of the earth. Prof. W. J. Beal, of the Michigan Agricultural College, one of the most accomplished botanists in the United States, describes the botany of grasses, in the following simple and common-sense language: The term grass, as used in common every-day life by many people, is applied to all those plants which are used for pastures and meadows. This is a classification founded upon use alone, disregarding all the other features of the plants. It is like calling every thing a fish, because it lives in the water, or birds and insects because they can fly. These are superficial or artificial classifications, and have no scientific value whatever. In like manner a great variety of grasses and other plants are known by the same name in different parts of the country, or one plant is known by a half a dozen or more names; so such names often are very puzzling, and afford very little guide as to what is meant. If one asks about drop seed, or blue grass, or fox-tail, or fowl meadow grass, or wire grass, or red top, we must first know the Latin name of the grass, or we are by no means sure that we understand each other. The trouble is greatest among plants like grasses, where the resemblance is often very close to inexperienced eyes. I believe there is little or no prospect that people will ever agree on the common names of many of our grasses. Our first lesson in botany will be to learn how to distinguish true grasses when we see them. Take in your hand a straight stalk of Indian corn—for this is a true grass—the leaves are on the alternate sides of the stem, one at each solid joint, making two ranks or rows from top to bottom. As you look at a straight stem of grass, the leaves may appear to you right and left, or they may appear on the side of the stem next to you and away from you. The leaves have no teeth or notches along their edges. They can be stripped into many fibrous threads, i. e., the veins are nearly parallel with each other. Observe further that the lower part of each leaf forms a sheath which surrounds the stem. This sheath may overlap, but never grows fast to the stem, except at the joint, nor does it close opposite the main part of the leaf so as to form a tight tube. It is naturally split down to the joint, and may be unrolled like a scroll without tearing away part of it. In botany, it does not generally do to put very much stress upon the structure of the leaves, but in this case it is of much importance. If you understand me so far, and can apply the knowledge, you can never be deceived as to what is a grass, and what is not grass, among all our native or cultivated plants. This point gained is well worth an hour of study. All grasses, in their healthy condition bear flowers at some time of their life. The plan of the flowers is well illustrated by a head of chess, or rye, or wheat, or June grass. Usually two or more flowers (sometimes one) are included within two short leaf-like bodies called glumes. Each perfect flower has from one to six (usually three) stamens, with anthers attached by a point (versatile). Outside the stamens are usually two small green leaf-like bodies called palets, one of which has two ribs, with a thin strip uniting them. In the center of the flower is never more than one pistil, making a fruit which is called a grain. The embryo or germ of the plant is just at one end, on the side, and is the part first eaten out by mice and squirrels in Indian corn. This is by no means all that applies to the botany of grasses, but enough for our present purpose. The grasses are much alike, and few botanists know them, as they are thought to be too hard, and the flowers too small, to master without much hard study. In Indian corn the flowers are of two kinds, each incomplete in itself. On top of the stalk the branching tassel produces an abundance of fine dust called pollen. On the side of the stalk are one or more short branches, covered with a cluster of leaves, from the tip of which extend a large number of slender threads. The branches become the ears, the leaves about them the husks; the threads are often called silk. One of these long, delicate threads runs down to each one of the embryo kernels of corn. That each may become a kernel it is first necessary that a grain of pollen from the tassel should fall upon the silk. Hence it grows or thrusts out (the pollen does) a very delicate prolongation all the way down to the young kernel. If the pollen from one variety of corn fall on the silk of another variety, we get a mixture, so our seed will not be pure. In wheat, red top, oats and timothy, the flowers are perfect, having the stamens pistils, the tassels and silk growing from the same flowers. Our new varieties of wheat and oats, doubtless, are produced in a manner similar to the mixing of Indian corn. As the pollen of corn is known to exert a marked influence on the kernels of corn, it probably, also, has something to do with their size and vigor. The pollen should come from large, healthy plants, as well as the ears. Every breeder of animals knows the importance of selecting good males as well as females. The pollen is the male flower, or part of the male flower. To get the best seed it it not enough to select the best ears of a field, but a small patch should be planted, from which the farmer ought to remove, before flowering, all the tassels of the stalks which are not fully developed, or such as are not likely to produce good ears. A similar plan is worth trying to remove wheat, rye, oats and barley, i. e., cut out from a small plat all the feeble heads, to prevent the bad influence of poor pollen. A great deal has been written, first and last, of the value of chemical analysis as a means of determining the value of a soil for certain crops, and also as determining the value of various foods, including the grasses in feeding and fattening animals. This has never been found of special practical value, except in a general way, and our best chemists now acknowledge this fact. It has been contended by theorists that certain grasses, and the hay, could be made available in feeding for growth, while other varieties could be used as a means of fattening the mature animals. In fact this is nonsense. The best success in feeding for the dairy is in those regions adapted to the growth of a great variety of grasses, which will stand year after year as permanent pasture, and become thicker and thicker, the object being not only to get a succession that will continue from week to week during the whole season, but also grasses that are rich, succulent and sweet, and that may be pastured close and that will again spring up quickly. In growing for beef this is not so essential, particularly in the West, where grain food is so abundant and cheap. The object in this case is flush pastures, of nutritious grass where cattle may quickly fill themselves and thus be kept quiet. For the growing animals old, short pastures supplemented with other food, so that the animals may be fully fed for the night, will be indicated, and feeders in each section of country must experiment with varieties for themselves. This is necessary from the fact that in the United States but few experiments have been made in this direction, by the States, or the general government, or by our agricultural colleges, and it is a matter that can only be accomplished in the best manner at public institutions, and for obvious reasons. In England the most careful experiments have been carried on in relation to the value of the various grasses for different soils and situations, and also in relation to their value as to season Thus the feeder for flesh may select: 1, Red clover, (*Trifolium pratense*); 2, White or Dutch Clover (*T. Repens*); 3, Timothy, (*Phleum pratense*) a better name for which would be Cats-tail grass, and, for the reason that in some sections of the country it is called Timothy, as in Pennsylvania, and Herd's grass in New England and New York. Neither of these names give an indication of its characteristic flower-head, while the former names do; 4, Blue grass, (*Poa pratensis*); 5 Wire grass, (*Poa compressa*); 6, Red Top, (*Agrostis vulgaris*). (Here again confusion of names comes in. In Pennsylvania Blue grass is called Green grass, and Red Top is called Herd's-grass.) 7, Orchard grass, (*Dactylis glomerata*); 8, Fowl Meadow grass, (*Poa serotina*); 9, Meadow Fescue, (*Festuca pratensis*) For feeding during droughts, Indian corn, sown at the rate of two bushels per acre, in drills two feet apart, cultivated thoroughly once or twice, and cut when in blossom will make a good reliance, as also will German millet (*Panicum Germanicum*), and common millet (*P. miliaceum*). Here we have nine varieties of grass that do well generally. One, two, three, four, five, and six, constitute the bulk of the grasses cultivated for pasture; and one and three that for hay. Number seven is one of the most valuable in the whole list, and should be tried everywhere, on land not wet. Eight and nine are also well worthy of trial. Fowl meadow grass especially has been found to take the place of blue grass, in those sections of the Northwest where blue grass does not succeed. Especially has this been the case in Wisconsin. It is hoped it may be found so in the Southwest, where blue grass is not natural to the soil. Mr. Frank E. Hoyt, a careful farmer of Wisconsin, in relation to this grass, says he knows of no grass in the Northwest that will compare with it, either for pasturage or the production of hay. It has never been winter or summer killed. and he has found one acre of marsh well set in fowl meadow equal for pasturage to three acres of upland, set in blue grass, and the hay produced the second year after seeding has never failed to pay the entire expense of cultivating and seeding the land. Fowl meadow hay is especially valuable for horses having all the advantages of wild hay, being free from dust, that infests timothy and clover, while it possesses all the nutriment of the best tame hay; and those dairymen who are acquainted with it, pronounce it valuable hay for milch cows. In all new countries the dependence must, of course, be first upon the wild grasses. As a rule these have not been sufficiently appreciated. Many of them are of exceeding value, but, unfortunately are, as a rule, sparse seeders, and hence are apt to be neglected. The trouble is that farmers, as a class, do not investigate and experiment enough for themselves. Thus they are content with the most meagre list of grasses, and as a result, for a good part of the season their stock find insufficient food of proper succulence, and oftentimes are really distressed for subsistence. There are many native and indigenous grasses in the West. A very considerable list of those will ultimately be found valuable. Prof. Beal gives a list of sixty-five true grasses, excluding cereal grains and clovers, found on the Michigan Agricultural Farm, the most of them indigenous. In Illinois, says Prof. I. A. Lapham, there have been 105 native grasses, (none peculiar to the State), eleven introduced, and twelve that are known as they are cultivated; a larger number, in proportion to the whole number of flowering plants in the States, than is usual in the same climate. This is owing to the extent and shape of Illinois, stretching from Lake Michigan to Kentucky. It has all soils, woods, prairie, and borders of lake and river. But it is not to any one species of grass that we should look for the support of our stock. On the native prairies we find many species intermingled, each doing its part, some preferring low, wet situations, others grow only on dry ground; some prefer the shade of forest trees, while others flourish best on the most exposed parts of the broad prairies; some grow only in the water, others along the margins of lakes and streams; some attain their maturity early in the season, others late in autumn. Of the grasses examined by Prof. Beal, we append the following concise and interesting descriptions, with their botanical and common names. It will be found valuable for the notes on pernicious, as well as on valuable species: *Phleum pratense*, called Timothy or Herd's grass in New England and Michigan, but in Pennsylvania they mean *Agrostis vulgaris* when they say Herd's grass. One name is said to have been given to this grass after Timothy Hanson, of Md., who raised it many years ago. Another name comes from Mr. Herd, who is reported to have found it growing wild in New Hampshire, over 100 years ago. In England it goes by the name of cats-tail grass. This grass in many places has become very popular There is reason for this. It is a good grass, and will thrive under a great variety of circumstances. It is easily recognized. Another reason still, which I think is not least, the seeds are quite large, pretty, and easily known, so men know what they are buying. It is fashionable and popular. It thrives on soil dry or moist, light or heavy, particularly the latter—not on sand. It is often sown with red clover for meadows, but flowers considerably later. On account of a bulb or thickening of the stem at the base it should not be cut very near the ground. The second growth after mowing does not start very readily. For pasture it is too coarse, and should not be sown alone. The bulbs are eaten off by sheep. It is not so popular in Europe as here. *Agrostis vulgaris* is known as Herd's grass in Pennsylvania, but in most parts of the country as red top. In Rhode Island it is called Burdin's grass and in other places Red bent grass or Summer-dew grass; sometimes Fowl Meadow grass or small red top; one variety is called Fine-top in Massachussetts. Here you see the absolute necessity of the one double Latin name, *Agrostis vulgaris*, not used for any other plant. It is a valuable grass thriving on moist soils, flowering rather late, with timothy, or later. It makes good pasture, good hay, though rather light for its bulk. It is not very rich in starch, gum, sugar or silex. It is a native perennial, not well adapted to sow for one crop, followed by plowing. Very variable in appearance —not much esteemed in England. *Agrostis alba*, White bent grass, or Fiorin thrives on moist and fertile soil, and varies much in its appearance. The stem bends down and roots at the joints. It is valuable for pasture early and late. Second crop small in meadows; quality good, used for making hats in Europe; a native of Europe, Asia and America; the same as red top. *Agrostis Stolon-*

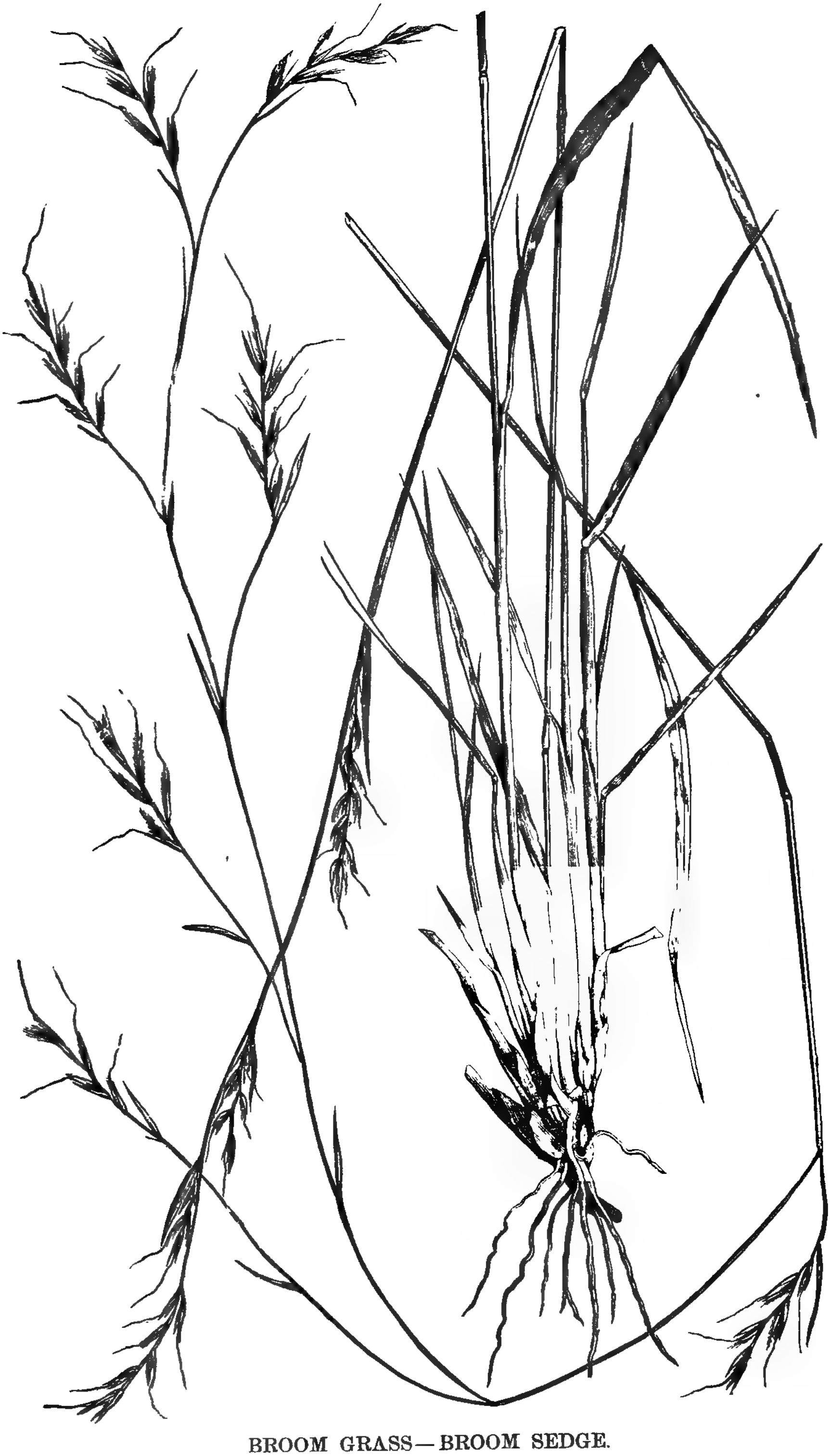
ifera is a variety of the above, about the same quality; thriving on drier land; a foreigner highly praised in Europe. It is hard to kill on account of underground stems which run somewhat like those of June grass. *Agrostis perennans*, Thin grass, grows wild in woods and shaded places. It is rather feeble, yet of good quality, and of some value for seeding in the shade. It is quite pretty. *Agrostis scabra*, Hair grass, has very long branches on the top; leaves shorter than the above; the top more slender and longer; quality much as the last. The long slender tops, when ripe, break off, and are driven to long distances by the wind, rolling them over and over. I have seen them twenty feet high, in the tops of trees, and next to the woods I have been able to gather up my arms full of such tops at a single effort. In this manner the seeds are widely sown. *Poa pratensis*, June grass, Green grass, Meadow grass, Blue grass, Spear grass, Kentucky Blue grass. This grass is widely distributed, both in the old world and in the new. It flowers early in June, thriving on high or low land, but does not seem adapted to thin, poor soil. It is very highly prized in England; also in Kentucky and in many parts of other States; yet in some places it is regarded as a troublesome weed, running and spreading after the manner of Quack grass. It makes excellent rich pasture, and is our best grass for lawns; but for meadows it is rather short. It should not be judged, however, by its short, early flower stalks, but by its long leaves produced in abundance throughout the season. These leaves are frequently two feet in length, when allowed to grow for a time. It is not well adapted to alternate husbandry, as it requires more than one summer to get well established. It is nearly always abundant in all pastures, working, or winning its way where a persistent effort is not made to keep it out. The straw is used for leghorn hats. It is our best grass for pasture, all things considered, milch cows fed on it making excellent butter and cheese; prominent in European pastures and those of the Northern States. *Poa compressa*, Blue grass, Wire grass. Its habit is much like June grass, though it prefers dry soil. The stems are hard, dark green, and easily known by being flat or compressed, remaining green and sweet for a long time after the seeds have ripened. It shrinks the least in drying of any of our grasses. For pasture it is exceedingly rich, and much liked by all kinds of stock. Cows fed on it make excellent butter and cheese. For meadows it is small and wiry; hard to cut, soon gumming the scythe, or knives of the reaper. It is valuable for dairy regions, creeping in old pastures like *Poa pratensis* and white clover, though much less abundant. It does not make much show. *Poa serotina*, False Red Top, Late Poa, Swamp Wire grass was first called Fowl Meadow grass, because it was thought that the seeds were introduced into a meadow by ducks (wild fowl) in Dedham, Mass. The stem is evergreen, like that of Blue grass. It is tall, thriving on low wet land; good for meadow or pasture. The hay is soft and nutritious. A very valuable grass—common on low land. *Poa annua*, Dwarf or Early Meadow grass, is found everywhere in old pastures and about dwellings, making much trouble by constantly springing up in paths and drives. It is pale green, sweet, short, and early, fit for pasture only; also common in Europe. *Poa trivialis* is highly prized in Scotland and England; not much esteemed in this country. *Calamagrostis Canadensis*, Blue Joint, Reed grass. This is a large native, thriving in wet places, giving a big yield of rather coarse hay. Cattle eat it greedily, if cut in the proper season, early. It thrives with Fowl Meadow grass. *Bouteloua curtipendula*, Musquit or Mesquit grass. This is considerably cultivated in the Southern States, and is a favorite grass with many. *B. oligostachya* or Buffalo grass, is said to cover the best portion of Salt Lake Valley and the valleys of the Rocky mountains. It has not succeeded in Pennsylvania It is thin and too short for hay. *Dactylis glomerata*, Orchard grass or Rough Cocksfoot, is a native of Europe, where it has been grown over a hundred years, meeting with great favor as pasture and meadow. It ripens early, about with red clover. It starts very soon after being mowed. It is very nutritious; stock like it; should be sown thickly and cut early. In many places of England it stands highest of all grasses in value. Its growing in tufts, is one objection to it. It thrives very well in shady places. *Alopecurus pratensis*, Meadow Foxtail, is something like Timothy in appearance. It is softer, shorter, earlier, light, sweet, and highly prized in old pastures of England and Scotland. It requires three or four years to get well established. It is not large enough for meadows. At Michigan Agricultural College it ran out on new land, when sowed for pasture with orchard grass, June grass and White clover. It starts well as a second growth; thrives in some parts of Massachusetts; requires a soil of clayey loam. *Cinna arundinaceæ*, Wood Reed grass, Indian Reed grass—Reedy Cinna—thrives in moist woods and swamps, often four feet high. It looks well, though has gained no reputation. *Muhlenbergia glomerata*, Drop seed, though not the one mostly known by the name of Drop seed; thrives in bogs and marshes. It has a hard stem at the base, and a stout rhizome. Cattle like it, but it has not had a fair trial. *M. Mexicana*, thrives in smaller places with the last; is taller and more branching; rootstalks similar. It flowers late; of some value. *M. sylvatica* is found in rocky woods; slender; looks well; stock like it; stout rhizome; worth a trial. *Brachyelytrum aristatum*, Dry, rocky woods; scarce; looks well; is eaten greedily by stock. *Eatonia Pennsylvanica* thrives in moist woods and meadows. It is soft, thin, looks well; cows are voraciously fond of it. It does not seem very hardy. *Eatonia obtusa* grows on dry soil, with qualities much like the last. *Glyceria Canadensis*, Rattlesnake grass, is large, grows in wet bogs, and is of some value. *Glyceria elongata*, grows in the same places and of similar value as last two. *Glyceria nervata*, Meadow spear grass—nerved manna grass; (some call it Fowl Meadow grass, and others Drop seed), it does best in low places; is common, nutritive, and valuable in some places, but of less value than Red top. *Festuca ovina*, Sheep's Fescue, is small, almost insignificant, early, sweet, pretty, and grows in tufts. In the Scotch Highlands, at the altitude of 4,000 feet, it constitutes the greater part of sheep pastures. It does very well in the shade and stands dry weather well; there are several varieties, none of which seem to have much merit for this country. *Festuca elatior*, taller Meadow Fescue, sheep's fescue. It thrives in stiff soils, doing very well in shady places. It is nutritious and early, flowering in June or July. Cattle are very fond of it. It produces well in many places. There are several varieties which run into each other. It has been extensively tried in the old country, and much liked by some farmers. Be sure to cut for hay as soon as in flower. *Bromus secalinus*, Cheat or chess, Willard's bromus, in England called lop; too well known in this country as a pernicious weed in wheat fields. A few years ago the seeds were sold as producing fine meadow grass. A jury of cows did not agree with the great puffs it received in the papers. There are two other species, also of foreign birth, of no value. We have two species that are wild, *Bromus Kalmii* and *B. Ciliatus*, which may be worth trying in dry soils. *Phragmites communis*, reed grass. This grows in both hemispheres; twelve feet high in swamps; the tallest grass as far south as Michigan. *Lolium perenne*, Ray or rye grass, common darnel. Introduced from England, where it is one of the most universal grasses in cultivation. It has often been mistaken for Quack grass, but may be distinguished by its single glume, no rhizomes, and spikelet turned edgewise to the axis which supports it. It has a very high reputation for pasture, lawn or meadow. It needs high culture and a moist climate. After a thorough test in some parts of Pennsylvania, it is much liked. It is early, starts quickly after mowing; the leaves are very glossy; excellent for lawns. *Lolium Italicum*, Italian rye grass. This grass needs rich land. Many people have doubtless failed in its culture by not understanding that it is a biennial. For a single season, no doubt, it is one of the best grasses, and is much used in the old country. Cattle like it; it grows fast, is nutritious, early, and fitted for alternate husbandry. *Triticum repens*, Couch grass, Witch grass, Quitch grass, Twitch grass, Chadler grass, Quack grass. This is productive and nutritious, and would be a valuable grass in many soils were it not so difficult to eradicate when it once gets in. It multiplies rapidly by creeping underground stems. A pernicious weed. It is very nearly related to common wheat. *Elymus Virginicus*, Lyme grass, wild rye. It is coarse and not promising unless in dry soils. *Elymus Canadensis*, Canadian lyme grass. Found on lake shores and river banks. Large and showy. We can not tell what it might do with good culture for a series of years. It is worth trying, as well as many others. *Danthoneæ spicata*, Wild oat grass, White top, Old fog. It grows on dry, sterile soil, is early but poor feed. *Arena*, Oats. There are two wild, and some foreign species. They are worthy of attention. *Aria flexuosa*, Hair grass. Slender; found in woods. Sheep are very fond of it, but it is too delicate. There are three other species quite similar. *Trisetum*. There are two natives and several in Europe. The former have not been tried; the foreign prove to be of some value. *Arrhenatherum avenaceum*, Tall oat grass; ray grass of France. It has been tried and extensively recommended in some parts of Pennsylvania. It is early; cattle and sheep will eat it when they are forced to. It is said to be the most abundant of any grass cultivated in France. Starts quickly after mowing, used for soiling. *Holcus lanatus*, Velvet grass, or soft Meadow grass. It stands droughts well, and has given favorable results after a few trials in this country; some praise it, others call it worthless. *Anthoxanthum odoratum*, Sweet-scented vernal grass. Owing to an abundance of benzoic acid, it is very fragrant, and a general favorite with people about haying time. It is small; it is the earliest grass we have, and also grows till very late in the season. Some think that it adds to the quality of butter, but the late Sanford Howard met this assertion by saying, then we should have the best butter in the New England States, where it is the plentiest. This is not the case; cattle do not like it. Good in lawns, will grow on poor land. *Phalaris arundinacea*, Reed canary grass, is the original of the ribbon grass which is cultivated for ornament. It is large and coarse. Grows on wet land; cattle are moderately fond of it. Some think it promising. Produces a large crop, something like Blue Joint. *Panicum* is a very large genus, containing thirty-three species in North America, and four hundred in all the world. *Panicum crus-galli*, Barnyard grass, is an annual, a coarse, large, sprawling, juicy grass from Europe; it has sometimes been cultivated. Varies much; stock eat it. At best a weed, though called ornamental in some parts of Europe. *Panicum geniculatum*, Hungarian grass, which has had a great reputation in some places. A valuable annual grass if cut when in flower. *Setaria viridis*, Bottle grass, green Fox-tail, wild Timothy. A weed in fields and gardens, from Europe, looking like small Millet. *Setaria glauca*, Fox-tail grass, much like the last. If allowed to ripen, it is good to spread under a shed for fowls, which like the seed. *Setaria italica*, Bengal grass or Millet. It runs wild where sown, like a weed; does not equal oats as a forage plant. Of the far western grasses, the United States Agricultural Report some years ago gave a list of one hundred and forty-three species, including fifty-seven genera of grasses, found native in the region of country lying west of the Missouri river, known as the high plain region of the United States, between the parallels of 35° and 45° north latitude and embracing the eastern water shed of the Rocky mountains between these parallels, including the States and Territories of Nebraska, Kansas, Colorado, New Mexico and the Indian Territory. Of the species given, ninety-one extend across the Missouri river, leaving fifty-two species belonging to the plain and mountain region proper. The remaining eighty-four species could not be considered as belonging more to this region than to the States east. The relative value of these various species as forage grasses differs very widely, a few of them being entirely worthless, and many of them almost valueless as compared with others. The list of these varieties will be interesting, now that this region is so fast settling up. The largest number of the species could be dispensed with, without manifest disadvantage to the grazing interests of the country As a rule farmers are slow to try new species of grass, notwithstanding the fact that, among the greater part of our farmers, clover and timothy form not only the bulk of their meadows, but also their pasture as well. Our agricultural colleges would do a good work if they would try new varieties with a view to their introduction if they proved valuable. The relative value of the twelve most important species is exhibited in the following table of per centum estimates, one hundred representing the aggregate value of the twelve:

Species.	Missouri river region.	Rocky mountain region.
	Per ct.	Per ct.
Adropogon furcatus	40	16
Adropogon scoparius	20	10
Sorghum nutans	20	12
Sporobolus heterolepis	12	1
Buchloe dactyloides	[illegible]	5
Bouteloua oligostachya	0	10
Spartina cynosuroides	2	2
Festuca ovina	0	20
Festuca macrostachya	0	5
Bromus Kalmii	0	8
Poa serotina	0	8
Stipa viridula	0	6

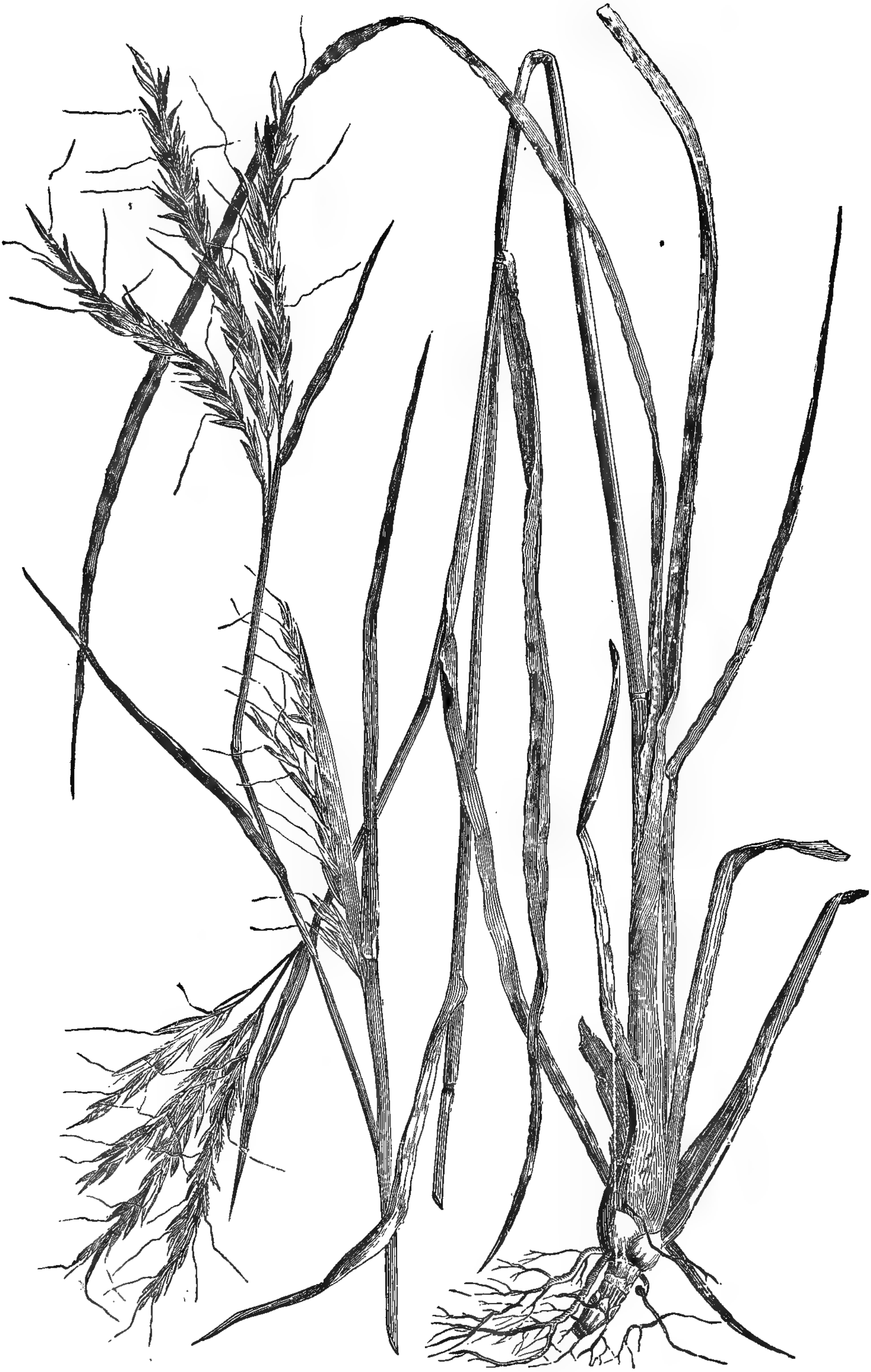
These estimates can only be approximate, of course, but they are believed to be so nearly correct that, as a comparative exhibit of the relative value of the species now comprising the great forage resources of the country, their importance will not be overlooked. The flesh and fat producing qualities of these several species have not yet been sufficiently tested to warrant comparative estimates of their relative value in this respect. *Andropogon furcatus*, *Andropogon scoparius*, and *Sorghum nutans*, by their abundance in all the eastern portions of the district, are the leading species, and at present comprise at least three-fourths of the grazing resources of that portion of the country. Next in importance follows *Sporobolus heterolepis*. This species is peculiarly palatable to cattle, and they are seen roving over rich pasture of other species in search of it. This is also said to be the winter forage species of Kansas, where it abounds, affording the rich winter pasturage of the farmers and herders of that State. It flourishes chiefly on the moister portions of the plains, and many local areas are almost exclusively occupied by it. Many of these far western grasses have yet no common names. These not being given until species are introduced into general cultivation. In the following description of species, descriptive terms that may be readily understood by all, will be used, and from which it is believed the identification will not be difficult to those who do not understand botanical terms. *Andropogon furcatus.* This species, the most abundant over large areas, is distinguished only by its spikes of flowers and fruit from its near relatives, *Andropogon scoparius* and *Sorghum nutans*, with which it often grows. It grows nearly twice as tall as *A. scoparius*, with spikes of flowers longer, and ridged, and two to five together, terminal, and on short branches from the axils of the upper leaves. The spikes are purplish generally, but often entirely destitute of color. It does not fruit every year, nor in all situations. A very favorable season of moisture is required to cause it to fruit abundantly. It is one of the principal hay grasses of the country, and is abundantly cut and cured for winter use. *Andropogon scoparius*, a much smaller plant than the foregoing, and much less abundant, yet apparently quite as valuable for feeding stock. It is known by its numerous slender branches from the axils of all its upper leaves, having its spikes of flowers single and scattered along the branches, very slender and thinly, silky, hairy, and often purplish as the preceding species, and frequently growing with it, and difficult to distinguish from it when not in fruit. This is also one of the hay grasses, and is esteemed of equal value with the foregoing for winter feed. It is singular that these two most valuable western grasses should have been considered remarkably worthless grasses by the learned Dr. Darlington, less than twenty years ago. *Sorghum nutans.* This noble prairie grass is at once known when in flower by its single terminal panicle of sorghum-like spikelets drooping in mature fruit, shining with brownish or russet hairs. This plant has often a peculiar glaucous hue, forming a striking contrast when growing with the form destitute of the glaucous bloom. In many localities it is scarcely less abundant than *Andropogon furcatus*, and constitutes a large portion of the prairie hay. Like the two previously described, it fruits only in favorable seasons, and in the growth of foliage is also much diminished by dry summers. The hay from these three species is considered best when cut just before killing frosts in early autumn. *Sporobolus heterolepis.* This species may be identified by its long, slender leaves, growing abundantly from the base of the plant, gracefully curling and frequently resting their tips on the ground; from its tendency to grow branches or stools, and, when in fruit, from its small panicle of sharp-pointed spikelets and its round seeds. These, when bruised, emit a strong, heavy odor, which has been compared to that of *Eragrostis megastachya* when crushed in the hands; but to most persons it is much less offensive, and to some not at all disagreeable. It attains to the average height of about two and one-half feet in fruit, but in dry seasons large tracts almost exclusively composed of this species are without a single fruiting plant. It is sometimes cut for hay, in the absence of the more productive species, and makes an article of first quality. *Buchloe dactyloides.* This is the noted buffalo grass of the region, and may be recognized at once, and be distinguished from all other species, by its low, dense, tufted growth; also by its stolons, from which it spreads rapidly. It seldom if ever attains to the height of over two or three inches, except with its male flower stalks, which sometimes reach two or three inches above the leaf growth. These have at their summit a few flat spikes of male flowers only. The female flowers are clustered down close to the earth, and nearly covered with tufted leaves. Male and female flowers are borne by the same plants, not by different plants, as was at one time supposed. It grows most abundantly in the central region of the plains, and affords nutritious, but rather scanty grazing for domestic animals; yet its value as a winter forage plant is not to be overlooked, as its stolons remain green during the winter months, and, combined with the dead leaves, afford to closely grazing animals a reasonably good living. In southern Kansas, the plant reaches its eastern limits, about one hundred miles west of Fort Scott. There it first appears in small, distinctly outlined patches, a few feet in diameter, and in narrow strips or lines at the base of low elevations on the large prairies. We were puzzled to understand how this humble plant was holding its place, here in the midst of strong, tall, growing competitors, *Andropogon* and *Sorghum*, surrounding it closely, but not venturing on an inch of its territory; but we soon succeeded in discovering that the phenomenon resulted from local soil conditions. At the depth of half an inch below the surface of those areas, the soil, for an inch or more downward is closely compacted and hardened, so as to prevent the roots of plants from penetrating through it. These areas, being thus unfitted for the growth of deep-rooting plants, had become open for settlement by this humble species, which requires only a shallow soil to sustain it. This hardened condition of soil at the base of these low elevations, is evidently from the agency of alkali, or some related mineral substance, filtering through the soil and cropping out at these places. Not having tested the conditions under which the plant exists in the heart of the plains—the center of its home—we are unable to say whether similar phenomena attend it there; but that an alkaline saturated or tinctured soil is essential to its growth has been disproved by the cultivation of the plant east of the Mississippi, where it flourished finely, but it is unable to compete with its intruding neighbors, and is soon overrun and destroyed. As an instance showing its tenacity of life, we record the fact of its having stood the treading of animals in a farmer's feed lot, where every other green thing had been destroyed. Whether it can be turned to any profitable account in the agriculture of the country remains for future experiment to determine. *Monroa squarrosa.* This comparatively worthless species somewhat resembles the buffalo grass in habit and mode of growth, and might be taken for it by those unacquainted with the latter species, the fascicled and tufted leaves of its prostrate branches resembling the stolons of Buchloe. The plant is an annual, with rigid and rather large foliage, and bears its fruit almost entirely concealed in the sheaths of its numerous leaves. It is rather common in the mountain districts and on the Upper Missouri, but abounds on the richer soils eastward. *Bouteloua oligostachya.* This is one of the principal grama grasses of the plains and mountains, but this common name by no means applies to the species or to the several species of the genus exclusively, but is given by the mountain men to several other species of different genera. It is a most valuable species for grazing purposes but grows too thinly, and too short to be cut for hay. It abounds chiefly in the mountain regions and the adjacent plain districts, and may be readily distinguished from species of other genera by its peculiar spikelets of flowers all arranged on one side of the rachis, and pointing in one direction. It supports on its stalk from one to three or four, and sometimes five of these spikes, which are purplish, or of an indigo-blue tinge. Its general height is about twelve inches, but in sterile locations much less. The leaves and stems are smooth, having no hairs. It is perennial. Much of the beef of the southwest is claimed to be the product of this grass; *Bouteloua hirsuta.* This less valuable species so much resembles the foregoing that some care and close observation are necessary to discriminate between them. The spikes of flowers are shorter, and more curved when mature, and present a bristly appearance, from the numerous rigid hairs that grow from the conspicuous dark glands of the glumes The leaves and stalks are also hairy. It generally grows shorter and prefers more sterile situations, where sand and gravel abound. It is not a perfect perennial, but appears to be a biennial; or something like a winter annual. It is not esteemed as a forage plant. *Bouteloua curtipendula.* This beautiful species is at once distinguished from the other by its long, slender raceme of numerous (twenty to fifty, or more) spikes. These are small horizontally bent or reflexed and sometime, but not always, purplish. It grows two to three feet high, is perennial, but the foliage is scanty, and as a forage plant is not highly valued. It abounds in many localities in the plains and mountains. *Spartina cynosuroides.* The fresh water cord-grass of the whole country abounds also in suitable situations there, and, as in the States east of Missouri, is frequently cut for hay, but it makes only a miserable substitute for that article. No animal will eat it until driven by a degree of hunger approaching starvation. It is to be regretted that this abominable fare is still provided for the faithful beasts that contribute so much to the wealth and happiness of man. The western cities and towns continue to store it largely for feed for horses, simply for the reason that it may be easily obtained, or is cheap—to the exclusion of the nutritious and savory *Andropogon*, *Sorghum*, and *Sporobolus*—which merciless, mercenary practice can not be too strongly condemned. *Festuca ovina.* In the mountain regions, and adjacent plains this species is plentiful, and contributes largely to the general forage crop of the country. It is esteemed a nutritious grass, notwithstanding the hard, wire-like appearance of its leaves and culms. The species is variable, and includes very different forms, arising in part from the conditions of locations. It attains to the height of about two feet, in favorable situations, and grows chiefly in bunches or stools, with erect, straight, stiff culms, long, narrow leaves, of pale green color, and has numerous flat spikes of flowers in a small panicle, often purplish. The several varieties or forms of this, sheep's fescue, grass possess very different constitutional qualities as to naturalization tendencies, some forms being so sensitive to changed conditions, that they can not be made to survive artificial treatment. *Festuca macrostachya.* A valuable mountain annual species in the mountains of New Mexico, of very variable forms. It is one of the grama grasses of that region, from six to eighteen inches high, with a loose, lax panicle of small spikelets, bristle pointed. *Bromus Kalmii.* Chiefly found in the mountain districts. A slender tall growing grass with a graceful panicle of drooping or nodding spikes of flowers. These are long and roundish, or flat when mature; where plentiful it affords excellent pasturage. *Stipa viridula.* From four to six feet high in favorable situations, with a plentiful supply of large flat leaves. A considerable amount of mountain grazing comes from this species. *Poa serotina*, and the other species enumerated in the catalogue, abound plentifully in the high as well as the low districts of the mountains, and are all rich, nutritious grasses, and, where abundant, afford valuable food for all kinds of stock. *Triticum caninum repens* and *æilopoides* contribute largely to the pasturage of some districts, and are not deemed so valueless as in the East, and, with a few other species in particular localities, are the chief reliance for grazing animals in those neighborhoods. The *Cyperaceæ*, sedge grasses, are largely consumed by stock, and are even made into hay where abundant. The large family of *Carex* afford the best species. Though less nutritious and palatable than most of the true graminaceous plants, they are highly valued and largely used in some mountain districts *Carex gayana*, in the mountain valleys and intervales of Colorado, affords the principal hay of the country, but many other species are used for both hay and pasturage. The relative value of the several species depends more on quantity than quality, excluding a few of the coarse aquatic kinds that are quite worthless. The comparatively few species above described embrace the chief grazing resources of the region under consideration, and these resources are conceded by every one to be the principal source of the wealth of the country. The early pioneer, however, has already learned how soon the native grasses are destroyed by the cropping and treading of domestic animals, and he sees with regret their places taken by worthless weeds and grasses that occupy the soil to the exclusion of every profitable production. He sees that, as settlement progresses and domestic animals increase, the natural pastures diminish; he recognizes the inevitable destiny of the grass product, which is the principal resource of his country, unless it can be supplied by cultivated species, and he naturally turns his attention and directs his labors to this task. The test of the experiment alone is to demonstrate the practicability of his work. The settler finds the climate peculiar and extreme; not uniform in its several seasons, yet possessing extreme general characteristics to which he must conform his operations to be successful. Knowing that the greatest wealth of a nation springs indirectly from its agriculture, and that the latter is completely successful only when it adapts itself to existing conditions; that no conquest over nature pays the cost of the warfare with its spoils, and that a persistent antagonism is not profitable to any people; and being without a successful precedent under similar climate and soil conditions in this country, original experiments must form the basis of operations. The test of species by sowing their seeds in plowed land and leaving them without further assistance to establish and defend themselves against the encroachments of native and naturalized foreign worthless weeds and grasses should be the plan of experiment; for, however well a species might succeed in a strong contest with competitors, it can not be profitable as a cultivated grass. From the peculiar character of American climate and soil, or the very unequal powers of our grasses for territorial conquest, we expect to find but one, or, at most, but few species adapted to any locality or situation. We are told that twenty-two species have been counted on a square foot in a rich, old pasture in England Such a result on the plains is utterly impossible. Monopoly seems the law of those species, and only local conditions arrest the domination of the strong, and this for the reason that only species resisting drought can live. It is natural that we should expect to find in some native species of the plains or mountains the successful plant or plants already adapted to the peculiar climatic conditions of the country, but we must remember that soil conditions have also very much to do with the growth of plants, and that settlement and cultivation greatly change the conditions of the soils of any country. With these facts before us, our experimental operations may be more intelligently pursued. The plant required is one that will do for the coarse, open, and arid soil of the plains, which is often dry for a long time, what Blue grass (*Poa pratensis*) has done and is doing for the States east of the Missouri river within the same parallels, one that will not only maintain its footing but will extend its area and overcome competitors as Blue grass has done in several of the States east, and which now forms the best pasture lands in the Union, monopolizing the entire soil product on thousands of acres. This species, however, being adapted only to finely comminuted soils and moist during the period of its growth, does not succeed satisfactorily, though in some localities on the eastern confines of the district it maintains a feeble existence. A strong-growing, coarse perennial, with rhizomes, or underground root-stalks, would suggest itself as a suitable species for trial, or a perennial producing an abundance of radical leaves, and of early growth, that would cover the soil and prevent the growth of annuals. Of this class we suggest the following for experiment: *Elymus Canadensis.* A native over a large area of North America; has been cultivated in Europe, but was soon discarded on account of its coarse character as compared with the pasture and hay grasses of that country. *Elymus Virginicus.* A hardy species of early growth, producing an abundance of large, succulent leaves when young; a widely-distributed species in America. Cultivation greatly accelerates its growth. It is a promising species. *Elymus Sibericus.* Native of Europe and America, in the colder latitudes; would probably succeed well in the northern districts, where it is native. *Elymus mollis.* Grows early and spreads rapidly by its running root-stalks; foliage, when young, tender and juicy. It thrives well in a variety of situations different from its habitats (sandy shores); probably not adapted to a dry soil, but well worthy of trial; leaves broad, rather short, with a beautiful glaucous hue and strong *Triticum* flavor. *Sporobolus heterolepis.* A most valuable native species; should be tried in cultivation for hay, but for pastures would doubtless soon be trod out by animals. Fields of this species, and *Andropogon furcatus*, *A. scoparias*, and *Sorghum nutans*, inclosed from stock, and mowed only after full maturity in autumn, would long remain good natural meadows, and this plan will probably be adopted until the lands advance so much in value that the hay produced alone will cease to be a paying crop. *Ceratochloa grandiflora.* This species inhabits the mountain districts, and has a wide range, reaching the Pacific in some of its forms. It is a large species, growing three feet high, often more in good soils; not a coarse species for its size. Generically, this species is nearly related to *Bromus*, and much resembles *Bromus Kalmii*, but has much larger and broader spikes, not drooping as in that species. From its habit of growing a mass of radical leaves early in its season, preventing the growth of intruding annuals, it maintains its place in localities where there is strong native competition, and even extends its areas by means of its seeds. It is inclined to fall in storms, in rich soil, when in fruit. It should probably be cut for hay before the seed matures, unless the practice should be found to injure the vitality of the root. This species merits thorough trial in all localities. In mountain districts *Poa nemoralis* and *Poa serotina* may prove profitable pasture grasses; both are natives of the region, and worthy of trial in cultivation. *Agrostis vulgaris* is a hardy species, tenacious of life, native of Europe and America, found in wet lands, but will thrive in dry, close soils. It may prove profitable in some localities for pasturage. Of foreign species, perhaps the most promising is *Festuca pratensis*, similar to *Ceratochloa grandiflora*. This species grows an abundance of radical leaves, which retain their vitality through the autumn and into the early winter, and in the southern districts would probably remain green through the year. This is a large tall-growing species, and not a very coarse grass. It is a native of Europe and is there esteemed as a valuable hay and pasture grass. It has been introduced into this country, and cultivated in some localities. *Lolium perenne*, an Asiatic and European species, is esteemed as a pasture grass in some parts of the country, and merits trial. *Phleum pratense* (Timothy) will of course be tested thoroughly, but it is believed to succeed very indifferently throughout the whole extent of this region, on account of the open, light, porous soil not affording its roots the protection necessary to keep the plant from perishing during the summer droughts. Following we give illustrations and descriptions of some of the less known northern and southern grasses, and including some but lately described. The figures and description are as follows: *Agrostis exarata*, mountain Red-top. This may be called Mountain or Northern Red-top. Found in Dunn county, Wis., where the grass is a native of the low grounds. It is more slender in its growth than the common cultivated Red-top (*Agrostis vulgaris*). It is a native of the Rocky mountain region; on the Pacific slope presenting a good deal of variety in form and size, so much so that it has received several specific names, although more extended observations are needed to establish accurately the boundaries of the species. There is thought to be little doubt that this grass would be suited to growth in the northern portions of our country, and on moist meadows and bottom lands would probably prove valuable. *Andropogon scoparius*, Broom grass, Broom sedge. A perennial grass, with tough, wiry stems, growing two to three feet high, with the narrow flower spikes coming out from the side joints, and also at the top. The spikelets are in pairs, on each joint of the slender axis, one of the flowers is sterile and fringed with soft spreading hairs, the other perfect and with a small twisted awn. It grows mostly in dry, sterile soil—a great eye-sore if it takes possession of meadows, but a good pasture grass before it shoots up its culms, after which stock will touch it no more. Mr. C. Mohr, of Mobile, says of it: One of our most common grasses, covering old fields and fencerows, and extensively growing in the dry, sandy soil of the pine woods. Much despised as this grass is as a troublesome, unsightly weed, it has its good qualities which entitle it to a more charitable consideration. In the dry, pine woods it contributes, while green and tender, a large share to the sustenance of stock. *Andropogon furcatus, Andropogon Virginicus* and *Andropogon macrourus* are other species of this genus, which have similar characters with the preceding. In the great prairie region of the West these form an important quantity of the native grasses. Although useful as a resource for stock having a range over uncultivated fields or grounds, their place should, as early as possible, be filled with more valuable grass. *Bromus unioloides*, Schrader's grass, Rescue grass. This is one of the so-called winter grasses; that is, to the Chess or Cheat family. In its early growth it spreads and produces a large amount of leaves; early in the spring it sends up its flower stalks, which grow about three feet high, with a rather large, open spreading panicle, the ends of the branchlets bearing the large flattened spikelets, which, when mature, hang gracefully upon their stems, giving them quite an ornamental appearance. It is not adapted to use in a country with severe winters, and hence did not give satisfaction in all places. Mr. C. Mohr, of Mobile, says of it: Only of late years found spreading in different parts of this State; makes its appearance in February, grows in tufts, its numerous leafy stems growing from two to three feet high; it ripens the seed in May; affords in the earlier months of spring a much-relished nutritious food, as well as a good hay. *Cynodon dactylon*, Bermuda grass. Wire grass. A low, creeping perennial grass, with abundant short leaves at the base, sparingly sending up slender, nearly leafless flower stalks, with three to five slender, diverging spikes at the summit. The flowers are arranged in a close row along one side of these spikes. The spikelets are one-flowered, with a short, pedicelled rudiment of a second flower. The glumes are pointed, but without awns; the lower palet boatshaped. This grass is a native of Europe, and is abundantly naturalized in many other countries. It is said to be a common pasture grass in the West Indies. In the Southern States it has long been the chief reliance for pasture, and has been extravagantly praised by some, and cursed by others, who find it difficult to eradicate it when once established. Mr. C. Mohr says: It thrives in the arid, barren drift sands of the sea shore, covering them by its long, creeping stems, whose deeply penetrating roots impart firmness to a soil which else would remain devoid of vegetation. It is esteemed one of the most valuable of our grasses, either in the pasture or cured as hay. Col. T. C. Howard, of Georgia, says: The desideratum to the South is a grass that is perennial, nutritious, and adapted to the climate. While we have grasses and forage plants that do well when nursed, we have few that live and thrive here as in their native habitat. The Bermuda and Crab grasses are at home in the South. They are not only live, but live in spite of neglect, and when petted and encouraged they make such grateful returns as astonish the benefactor. It seems that it rarely ripens any seed, and the usual method of reproducing it is to chop up the roots with a cutting knife, sow them broadcast, and plow under shallow. Colonel Lane says: Upon any ordinary upland I have found no difficulty by close cultivation in cotton for two years. It requires a few extra plowings to get this sod thoroughly broken to pieces. Prof. Killebrew writes: In Louisiana, Texas, and in the South generally, it is, and has been, the chief reliance for pasture for a long time, and the immense herds of cattle on the southern prairies subsist principally on this food. It revels on sandy soils, and has been grown extensively on the sandy hills of Virginia and North and South Carolina. It is used extensively on the southern rivers to hold the levees and the embankments of the roads. It will throw its runners over a rock six feet across, and soon hide it from view, or it will run down the deepest gulley and stop its washing. Hogs thrive upon its succulent roots, and horses and cattle upon its foliage. It has the capacity to withstand any amount of heat and drought, and months that are so dry as to check the growth of Blue-grass will only make the Bermuda greener and more thrifty, as has often been seen. *Dactyloctenium Ægyptiacum*, Crow-foot grass. This is an annual grass somewhat resembling *Eleusine*, but coarser and stiffer, and of less value. The stems are often rooting at the base, with commonly four acutely pointed stiff spikes at the top of the culm, which are shorter than those of the *Eleusine Indica*. It occurs abundantly in some localities in waste or neglected grounds. The cuts illustrating the more important of these grasses are shown elsewhere. *Eleusine Indica*, Crow-foot, Yard grass, Dog's-tail. This is an annual grass belonging to tropical countries, but now naturalized in most temperate climates. In the Southern States it is found in every dooryard and in all waste places. It does not seem to be very highly recommended for cultivation in the South, although it is said to form good and lasting picking for stock. *Hierochloa borealis*, Vanilla or Seneca grass. This is a grass of northern latitudes, growing in moist meadows near the coast, also in low marshy ground in some parts of Illinois and other States bordering the great lakes, and in the mountains of Colorado and northward. The name *Hierochloa* means sacred grass, so-called because this, among other sweet scented grasses, was strewn before the church doors on Saints' days in the north of Europe. The culms grow from one to two feet high, with short, lanceolate leaves, and an open pyramidal panicle, from two to five inches long. The flowers all with two palets; the two lower flowers staminate only, often around the middle of the back, or near the tip; the uppermost one perfect, short pediceled, scarcely so long as the others and awnless. The spikelets are chestnut colored and rather ornamental. Experiments are wanting to determine the value of this grass in cultivation. *Leptochloa mucronata*, Feather grass. An annual grass, growing from two to three feet high, the flowers arranged on numerous slender spikes in a long panicled raceme. The flowers are minute, three to four in a spikelet, the uppermost one imperfect; the glumes pointed and about equaling the awnless flowers. This is a handsome grass when full grown, the panicles on thrifty specimens sometimes becoming two feet long, the slender branches arranged along the main stem in a feather-like manner, hence the name. Prof. Killebrew says that it grows in fields and pastures and affords a small amount of grazing during the hot months, while the regular pasture grasses are parched up with heat. But it is of no agricultural value in the presence of so many others that are successfully grown. *Muhlenbergia diffusa*, Drop-seed, Nimble Will. This is a low grass, with much-branched stems and narrow, slender panicles of flowers. The spikelets are one-flowered, with very minute glumes, and the lower palet with an awn or beard once or twice its own length. It is a perennial grass, flowering in August and September. Prof. Killebrew, of Tennessee, says: It is hardly more than necessary to mention this grass, which forms, in many sections, the bulk of the pastures of the woods. It does not grow in fields but in woods, where, after rains have set in, it carpets the earth with living green. Various opinions are entertained as to its nutritive qualities. Some farmers contend that their stock are fond of it, and, on sufficient range, cattle, horses and sheep, will go into the winter sleek and fat from this vigorous grass; others regard it as well-nigh worthless. It is said to be an excellent butter-making grass, giving it a particularly fine flavor. *Paspalum læva*, Water grass. There are a number of species of this genus which in general appearance are hardly distinguishable. In the structure of the flowers they are very near to Panicum, from which they chiefly differ in the want of a lower glume. Mr. D. L. Phares, of Mississippi, says of this grass: It is not called water grass because it grows in and about water, for it does not, but probably because it is very succulent. It is troublesome in crops; live stock are very fond of it in all stages of growth and as dry hay. A neighbor has a meadow of it from which he mows every summer about two tons of hay per acre. It is very easy to set land with it; that is, it catches readily. *Panicum crus-galli*, Barnyard grass, Cock's-foot grass. Of this grass Mr. Mohr says: An annual, two to three feet high, bearing its roughly-awned flowers in dense, one-sided panicles composed of numerous crowded spikes; it grows luxuriantly, particularly in the low lands of the coast, is greedily eaten by horses and cattle, and makes a hay of good quality. It is justly regarded as an excellent grass, particularly before it ripens its seed, as in the later stages of its growth the long and stiff awns of its spikes tend to make it somewhat unpalatable. Mr. D. L. Phares, of Mississippi, says of this grass: The hay is very highly esteemed by many farmers. In northern Mississippi I have seen large fields of it mowed. This grass should be cut early, while it is juicy and palatable. This will be at the first appearance of the flowers or soon thereafter. *Panicum filiforme*, Slender Crab grass. This is a native species of southern Crab grass. It is annual, growing with erect, slender culms, which are terminated by three to five slender, erect spikes of flowers. The leaves are one to two inches long, smooth below, sometimes a little hairy above, the lower sheaths hairy. It grows mostly in dry, sandy soil and is of little value, from its scanty foliage and thin, wiry stems. *Panicum jumentorum*, Guinea grass. This is a perennial grass of strong, vigorous growth, a native of Africa, extensively cultivated throughout the tropics. Mr. Charles Mohr, of Mobile, says: It is planted with us in the beginning of April; admits the first cutting during the last week of May; it makes very large bunches and is to be cut before extending to the height of about eighteen inches. In that stage it is very sweet, tender, and easily cured as hay. In moderately fertilized land and favorable seasons



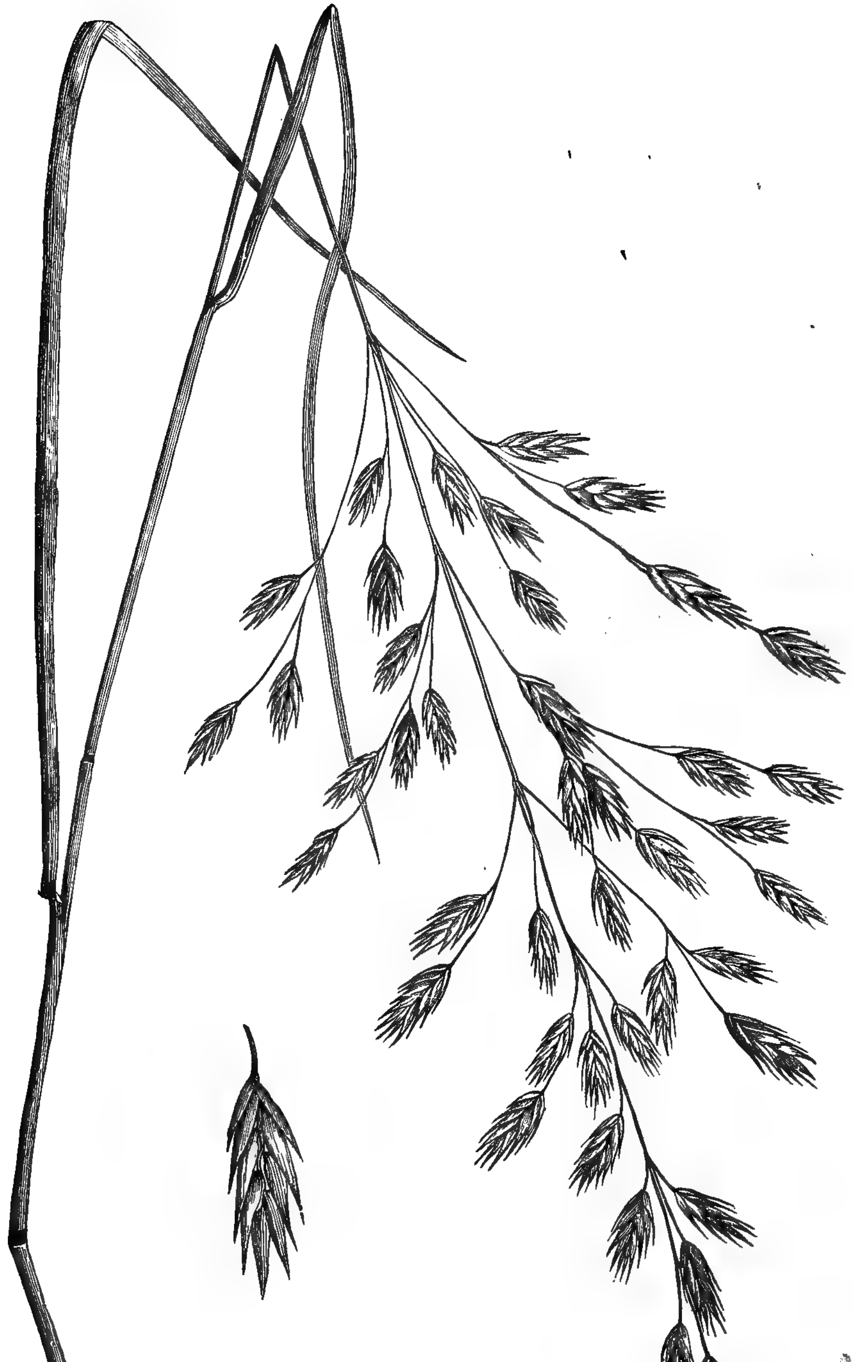
MOUNTAIN RED TOP—NORTHERN RED TOP.



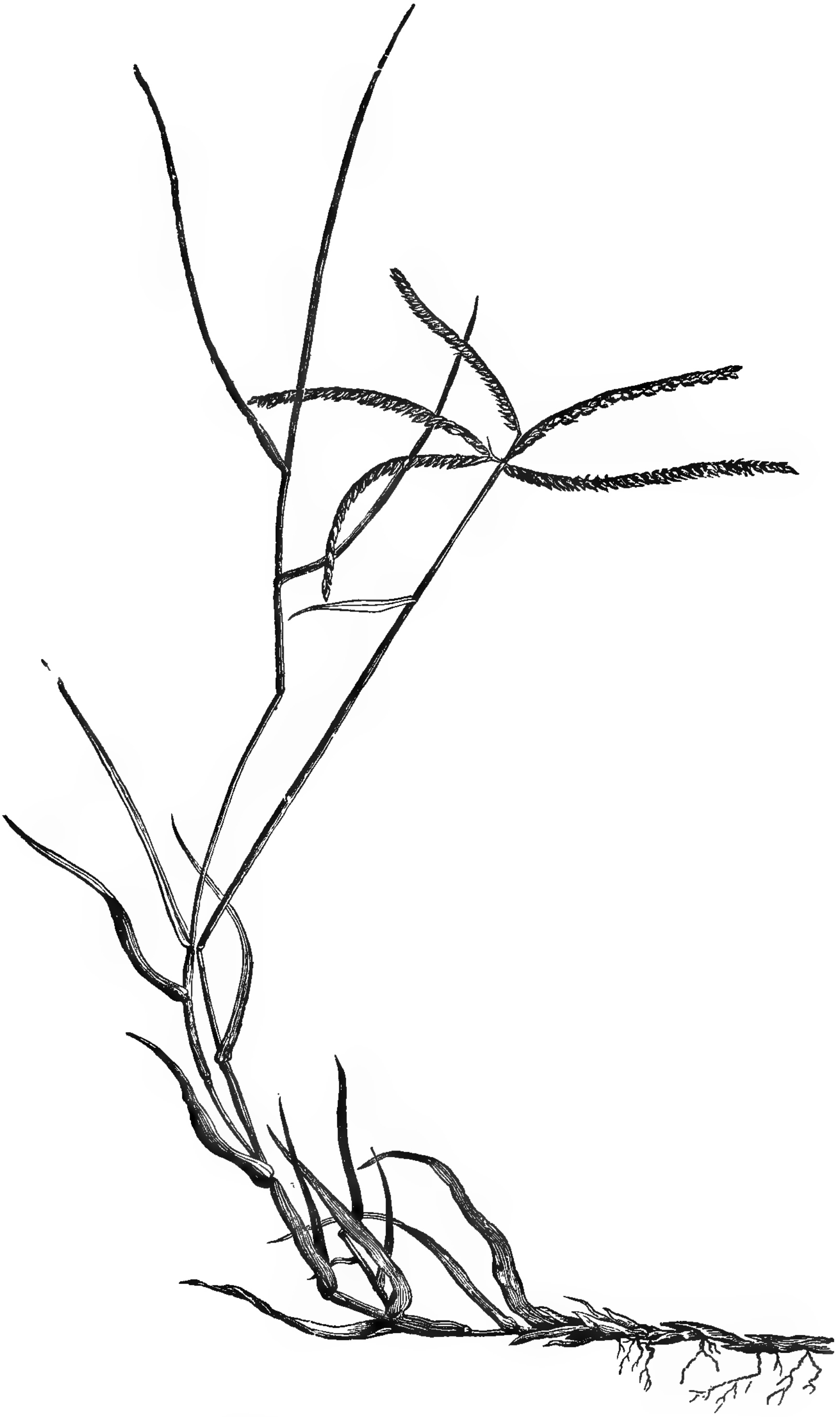
BROOM GRASS—BROOM SEDGE.



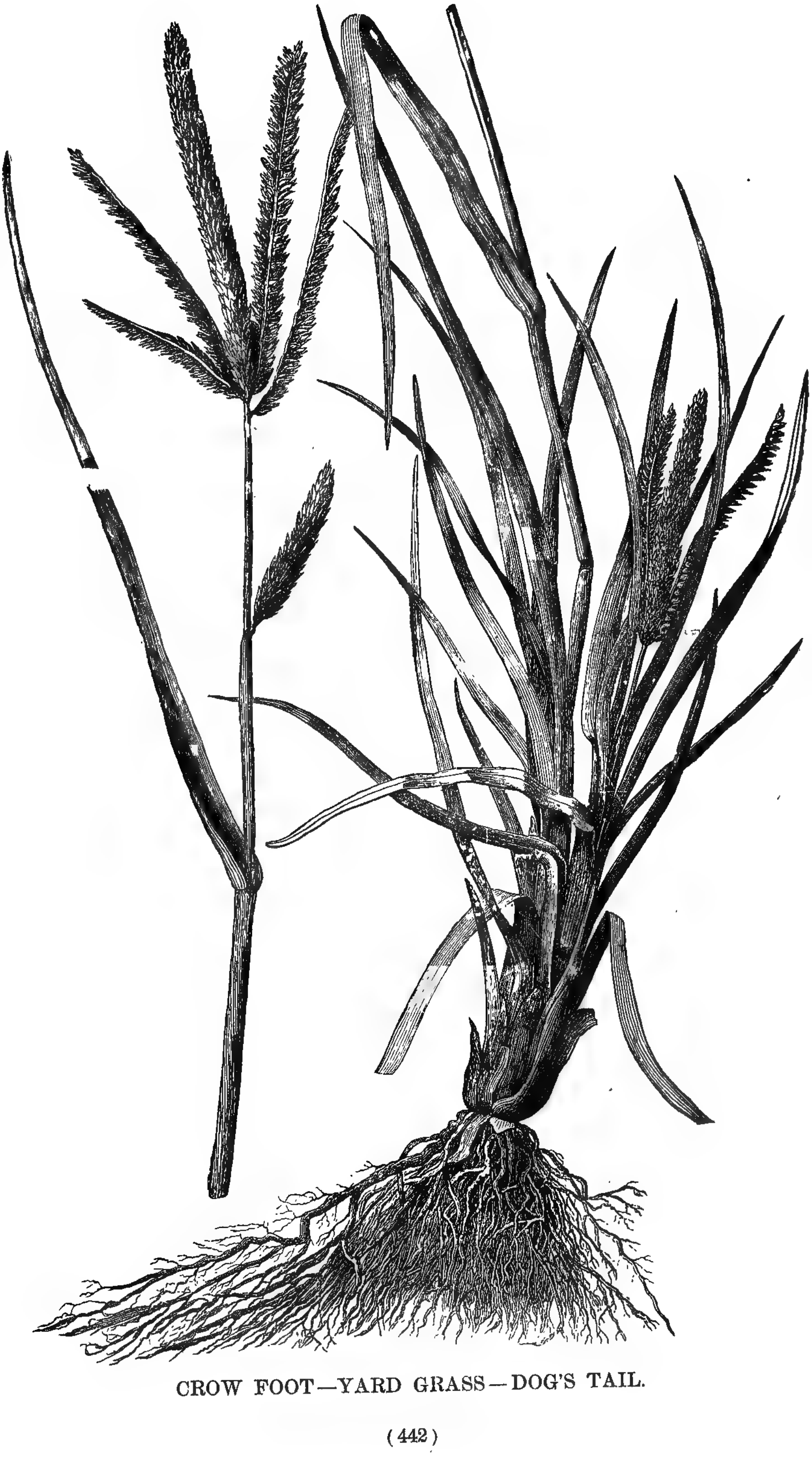
BROOM GRASS — ANDROPOGON FURCATUS.



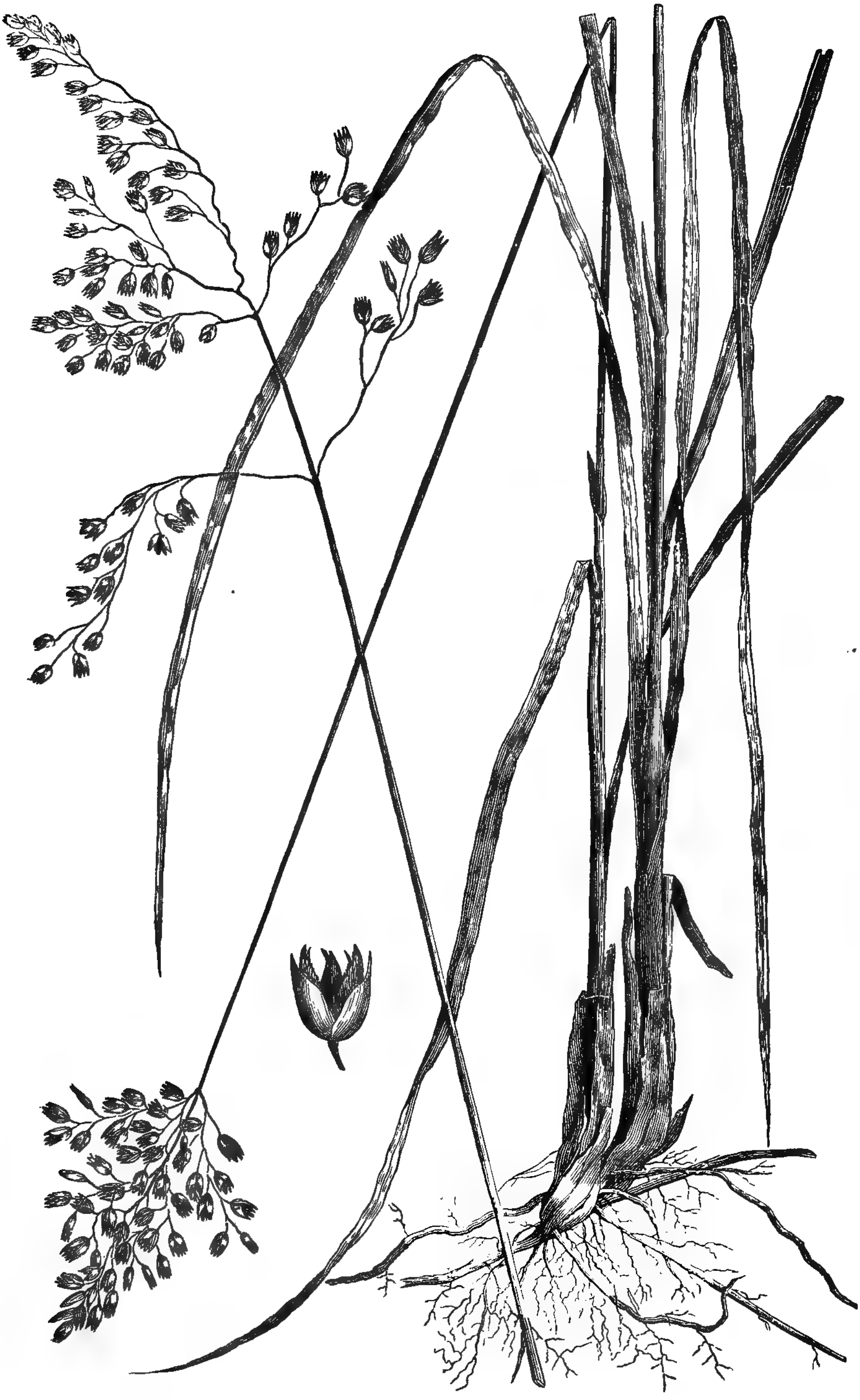
SCHRADER'S GRASS—RESCUE GRASS.



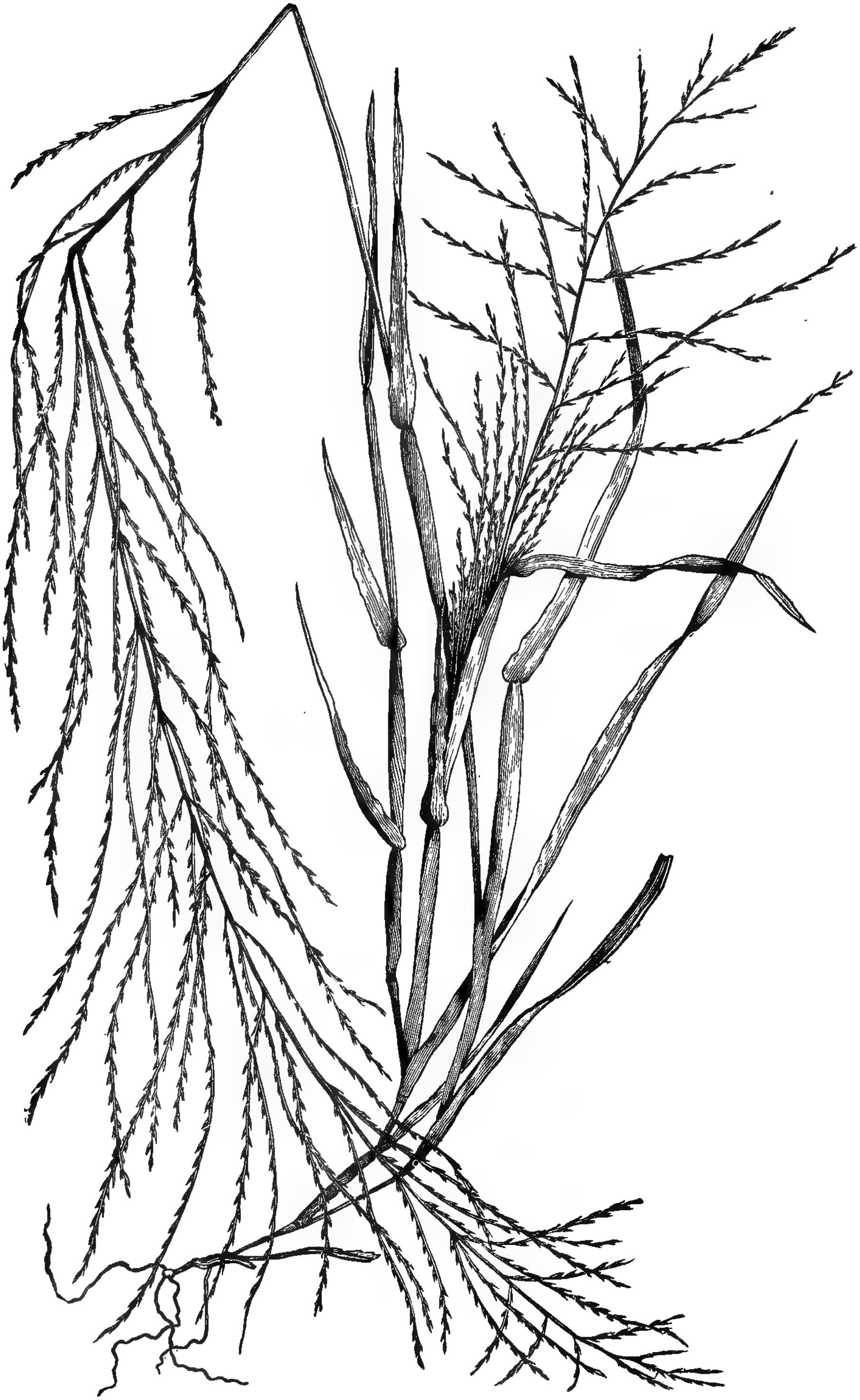
BERMUDA GRASS—WIRE GRASS.



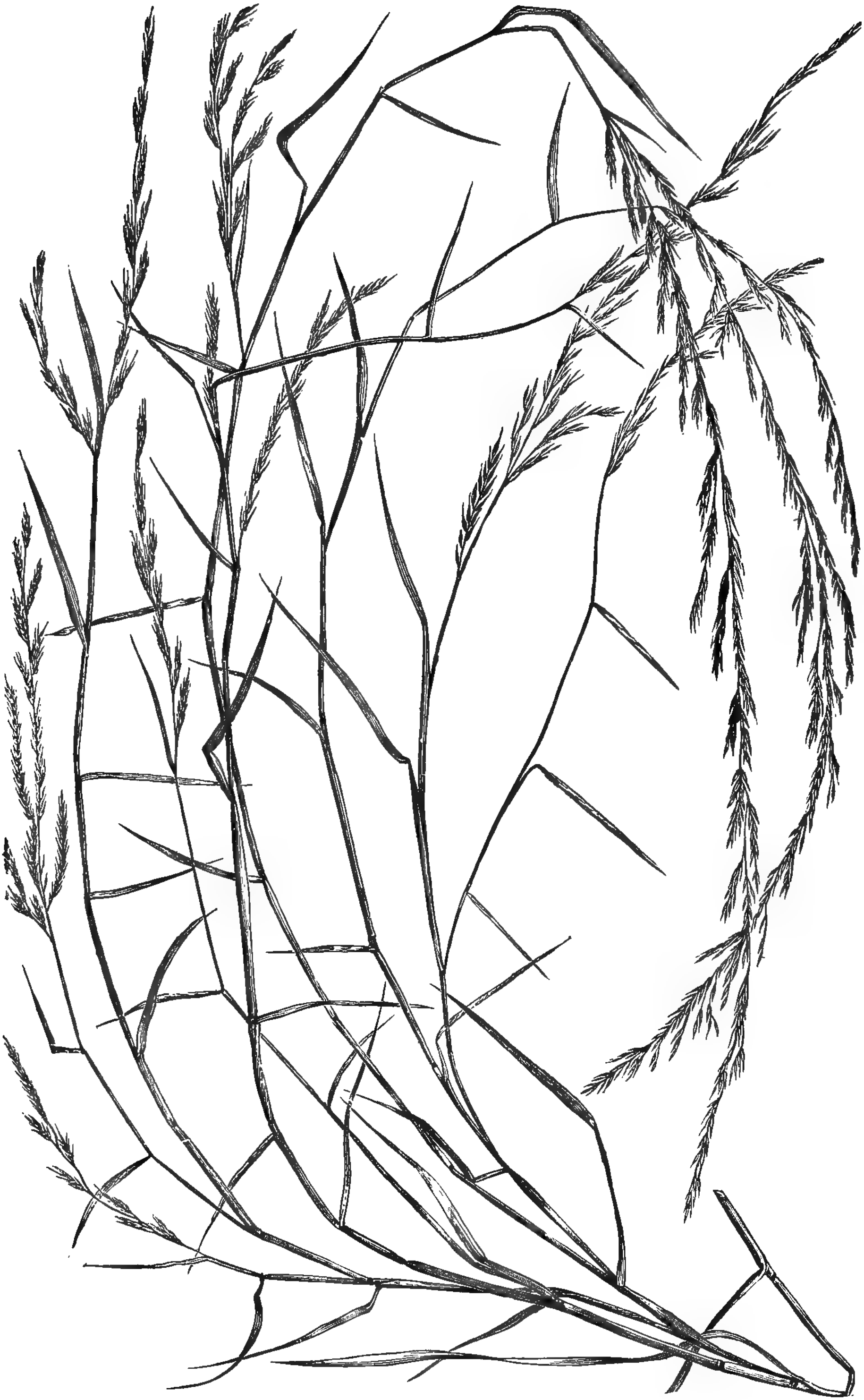
CROW FOOT—YARD GRASS—DOG'S TAIL.



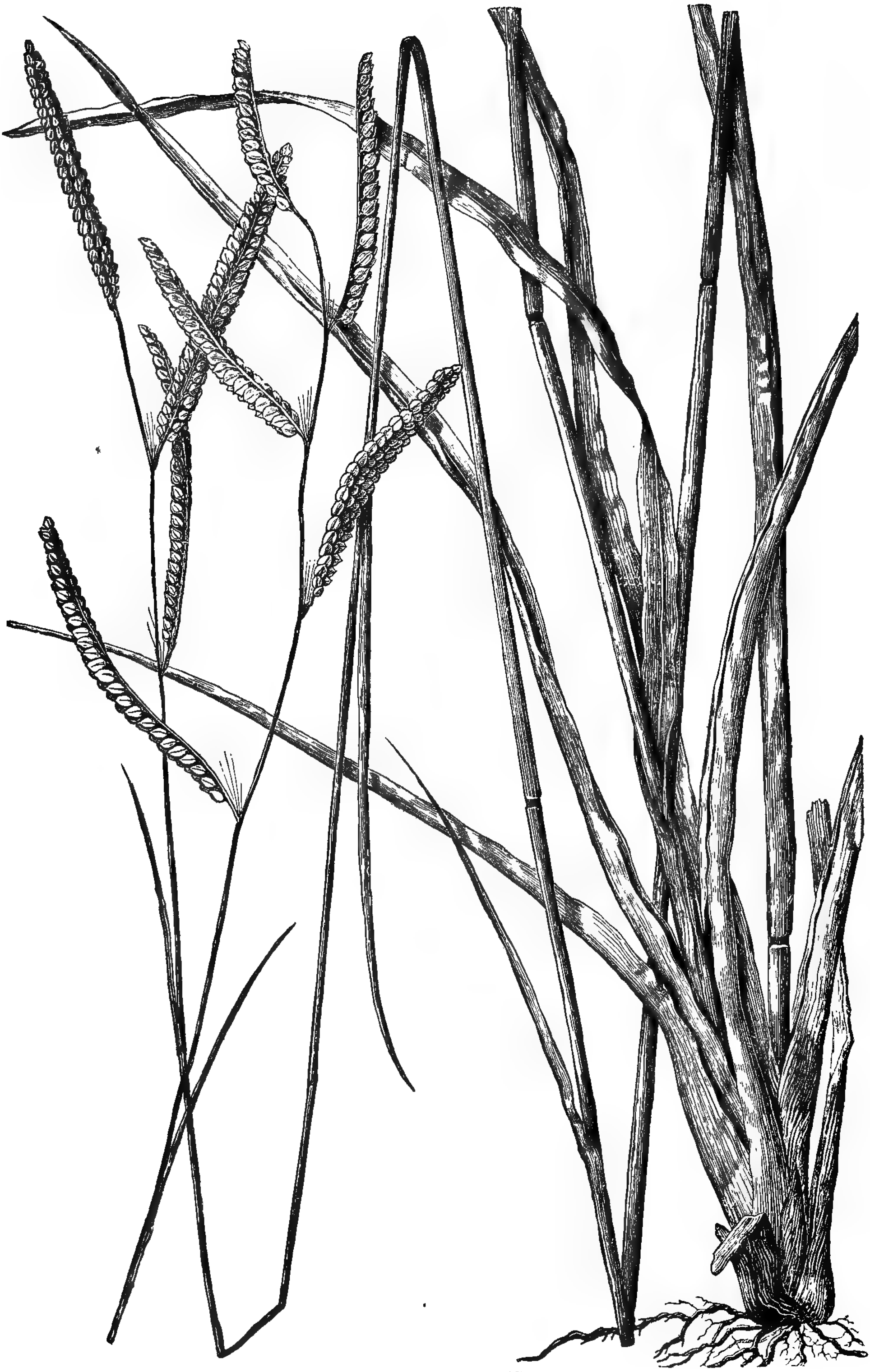
VANILLA GRASS—SENECA GRASS.



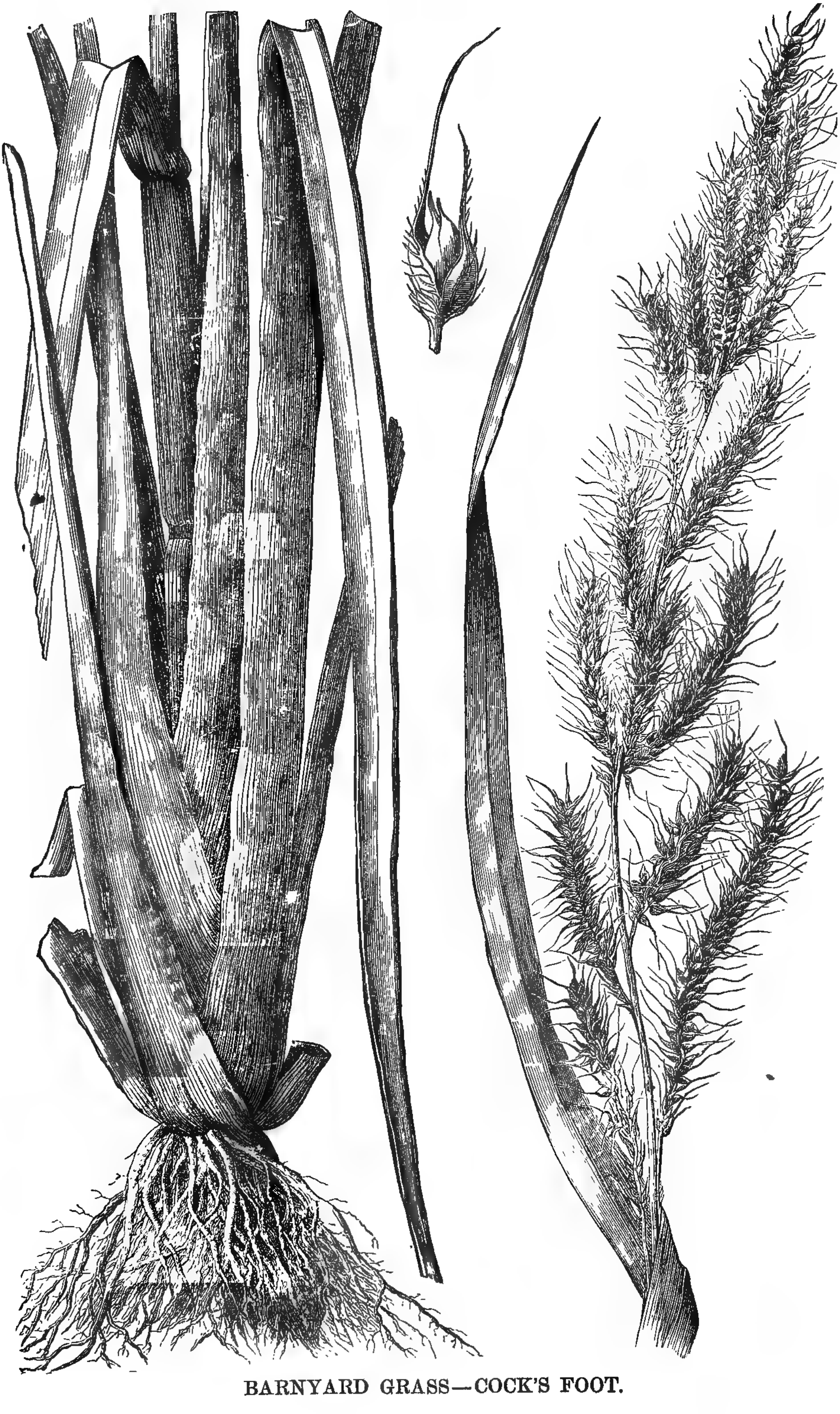
FEATHER GRASS.



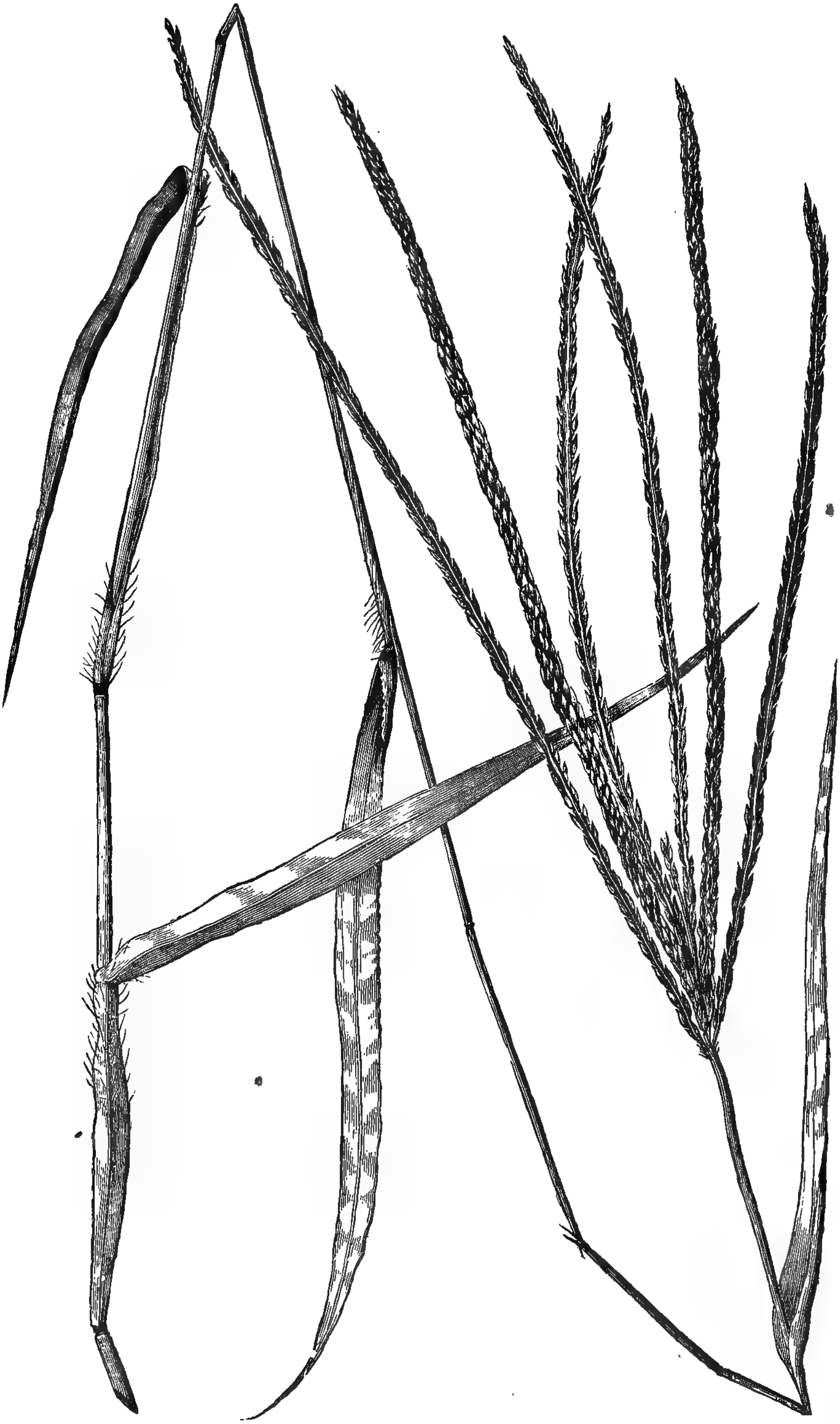
DROP SEED—NIMBLE WILL.



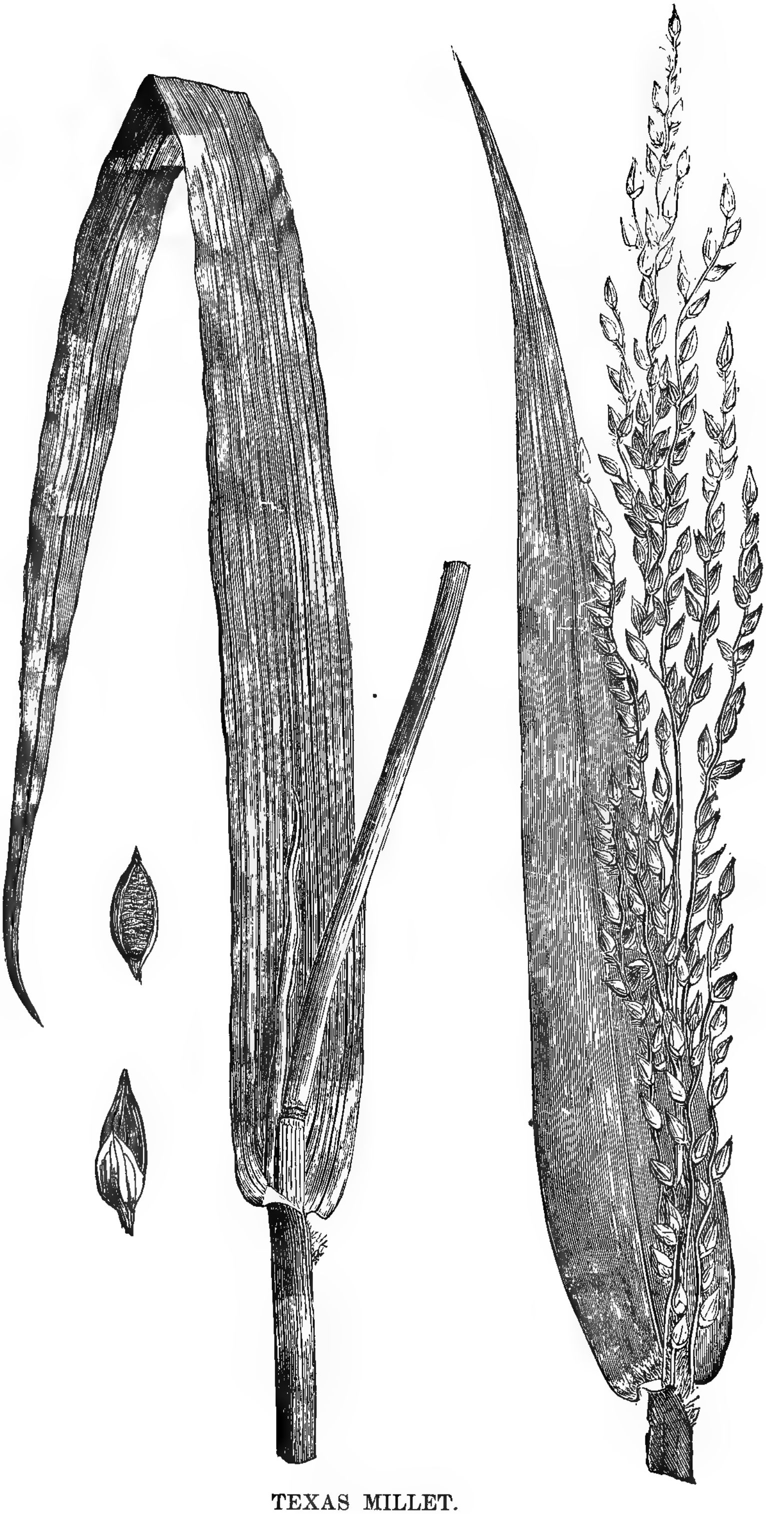
WATER GRASS.



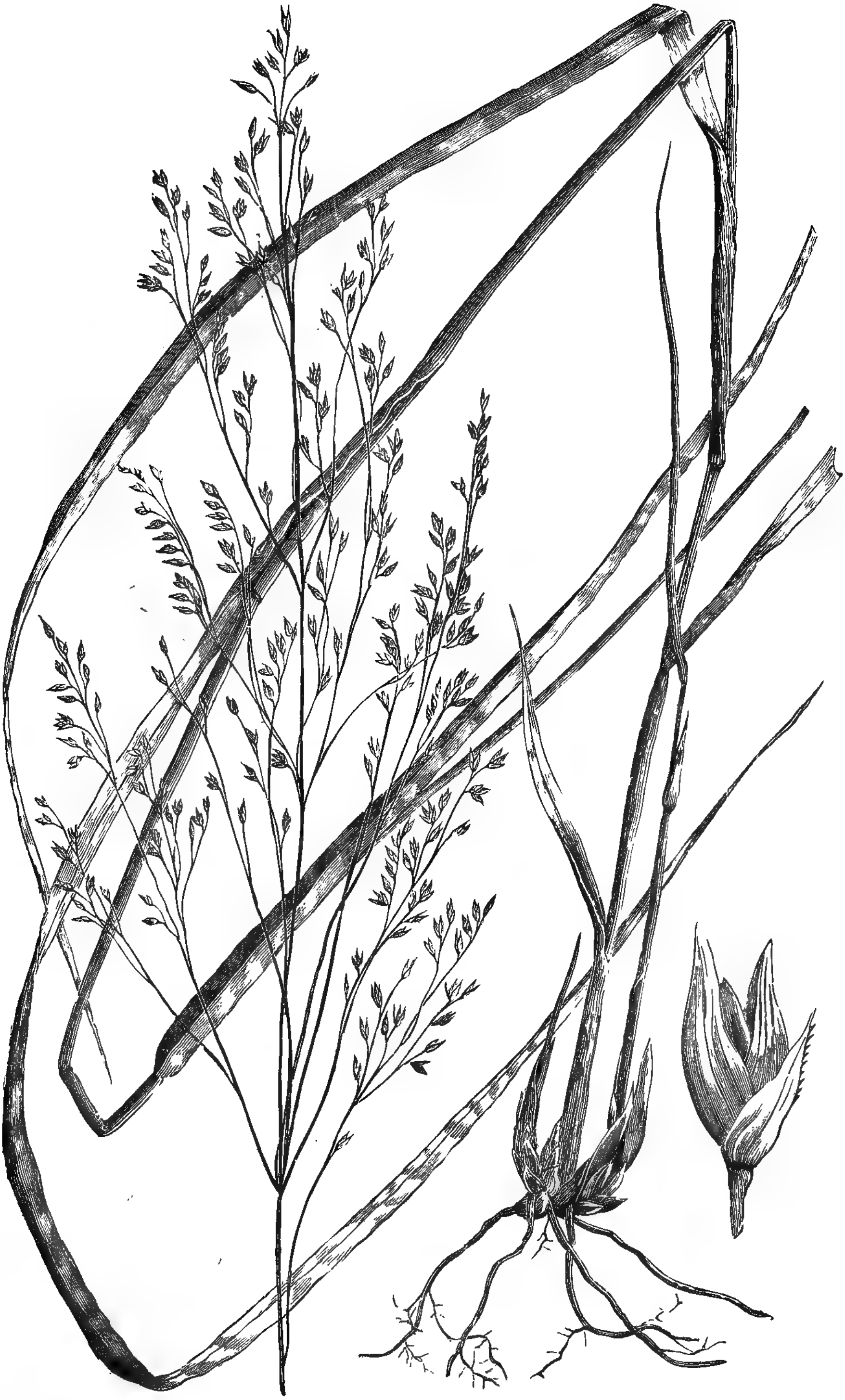
BARNYARD GRASS—COCK'S FOOT.



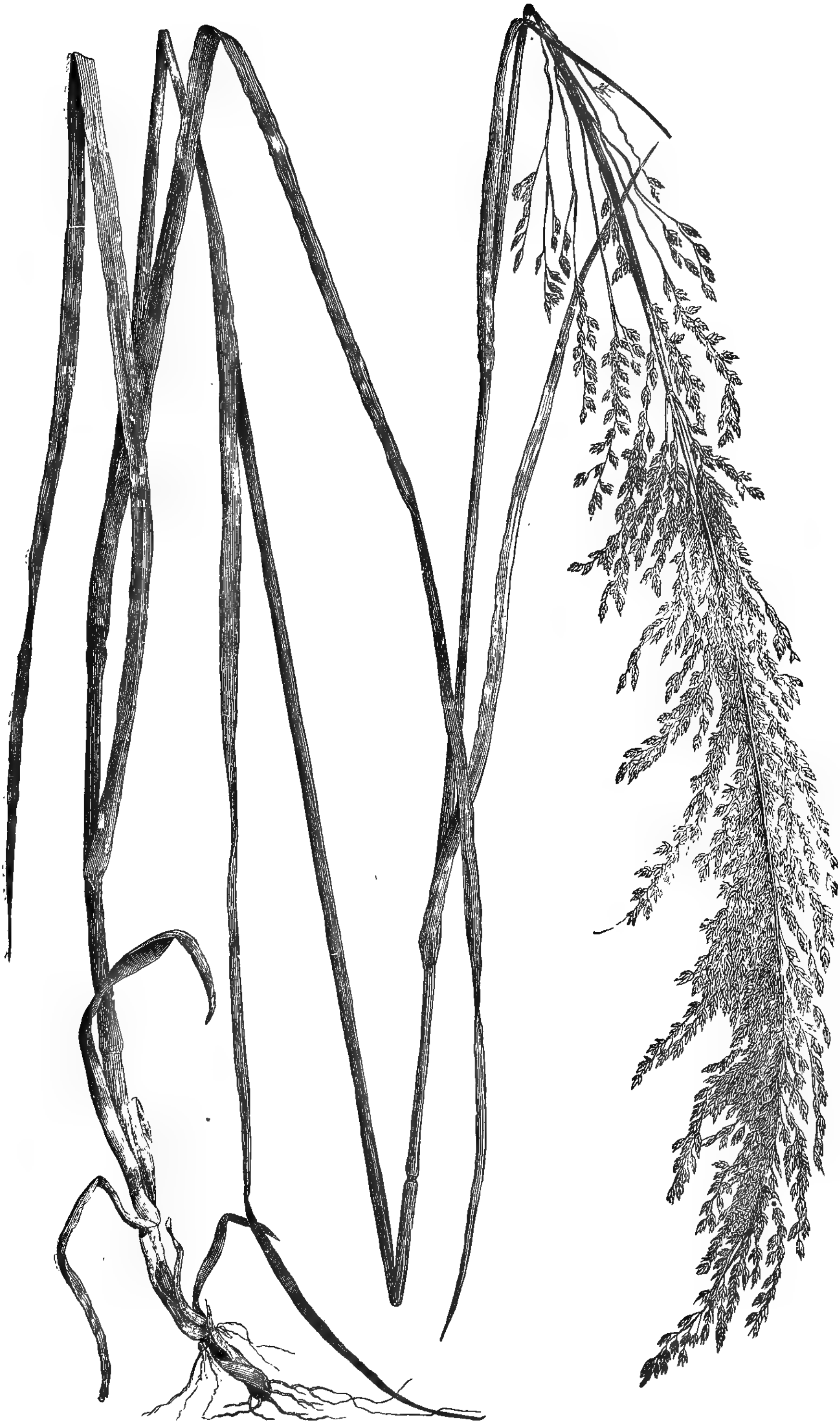
CRAB GRASS.



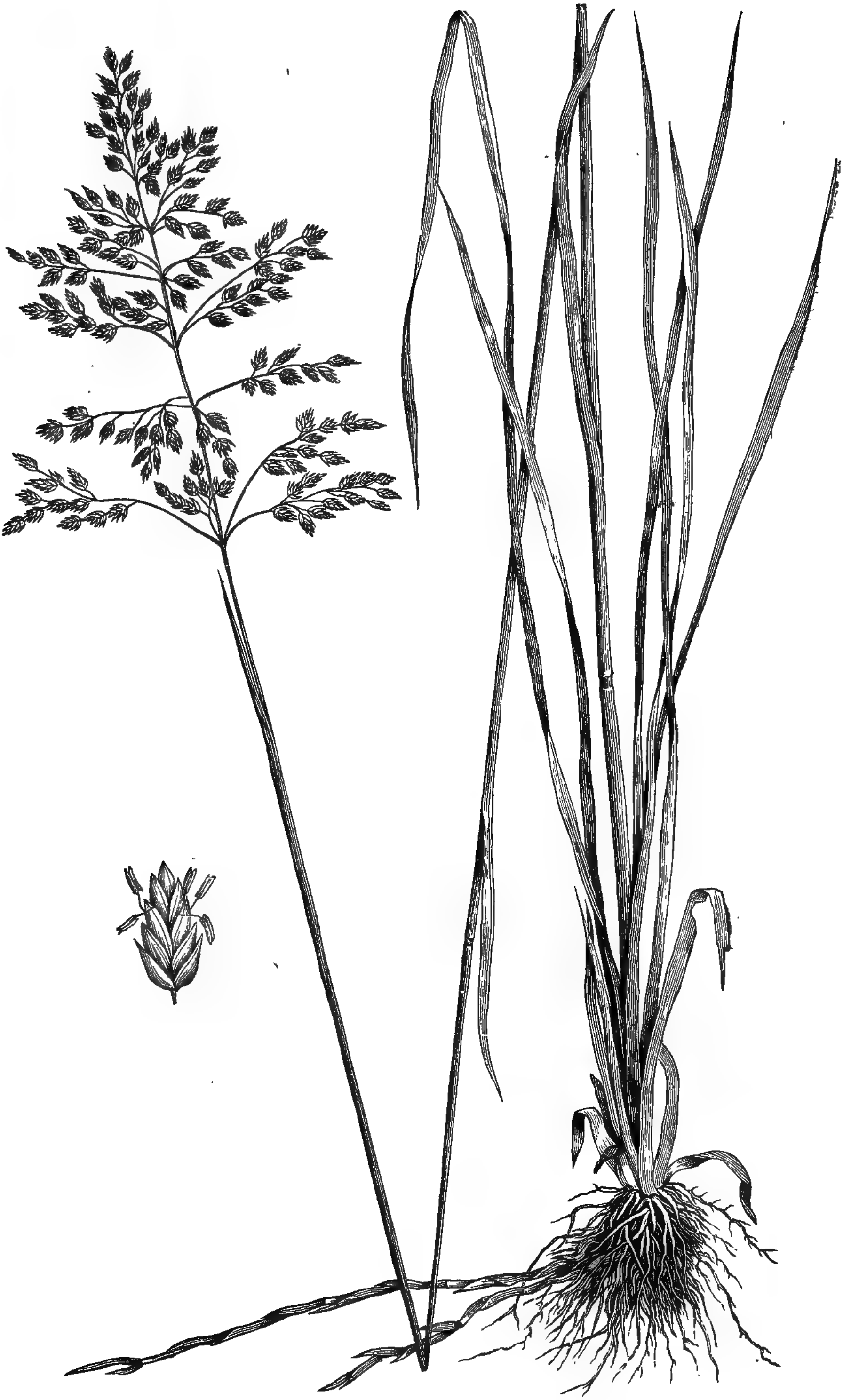
TEXAS MILLET.



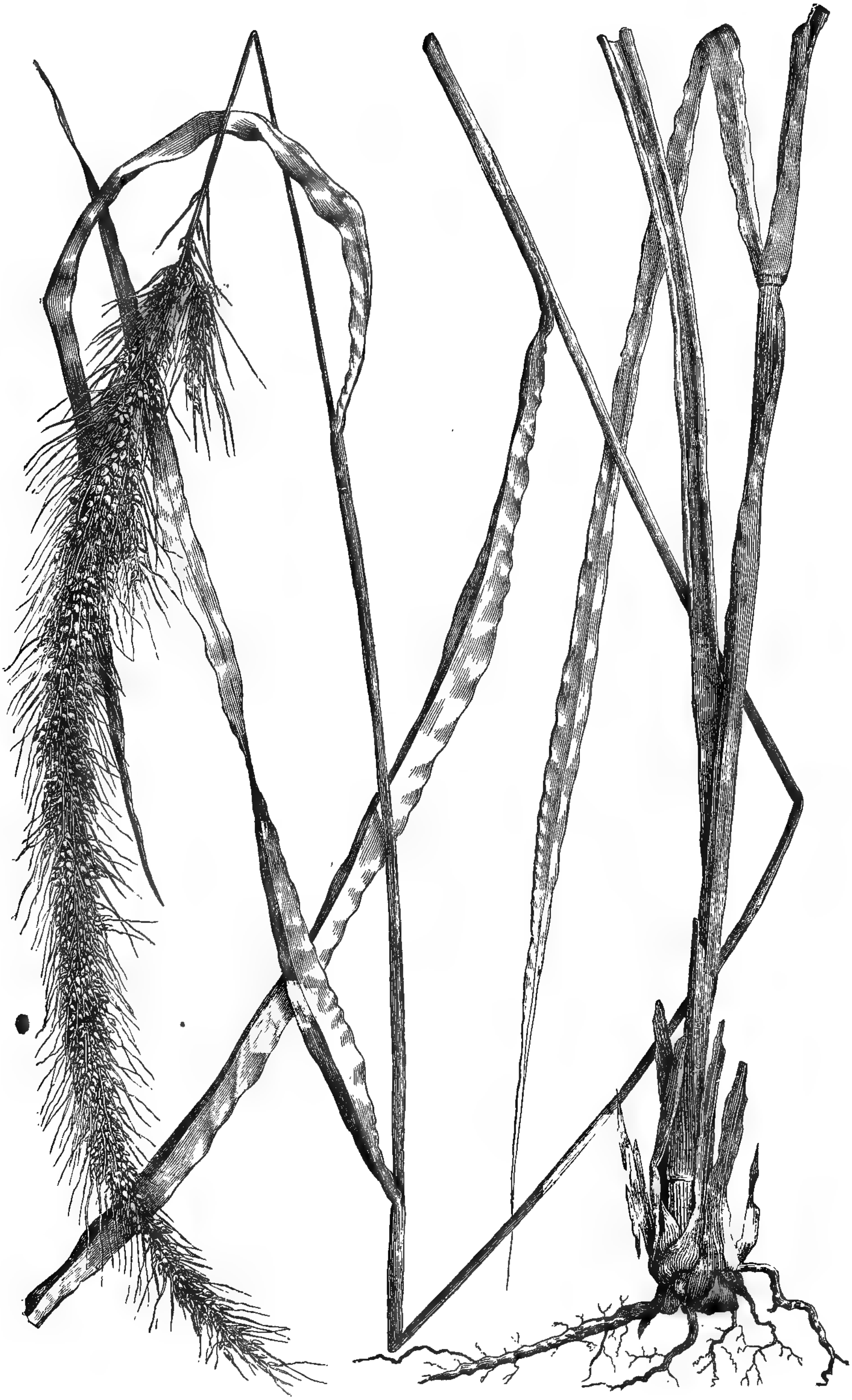
TALL PANIC GRASS—SWITCH GRASS.



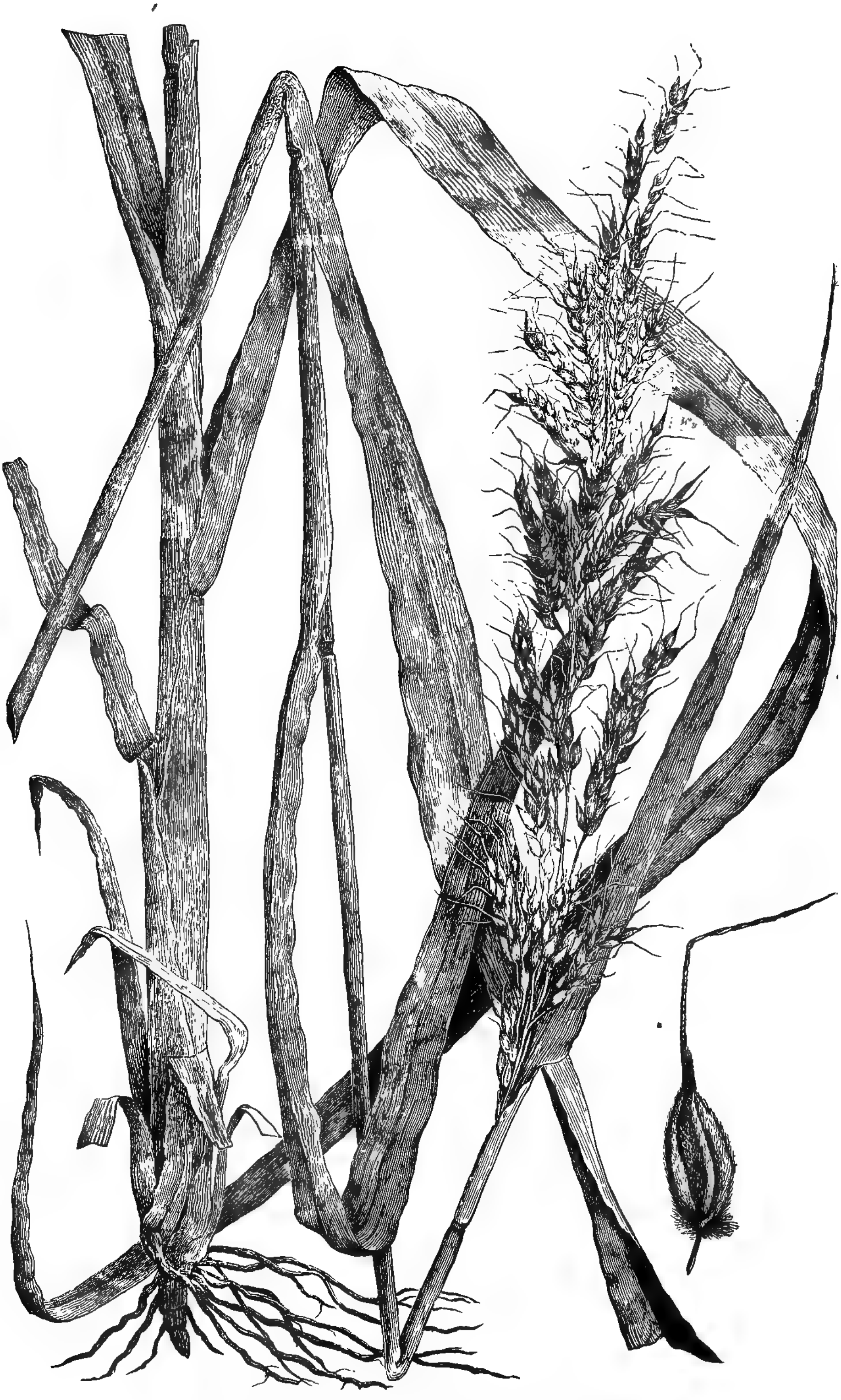
FOWL MEADOW GRASS.



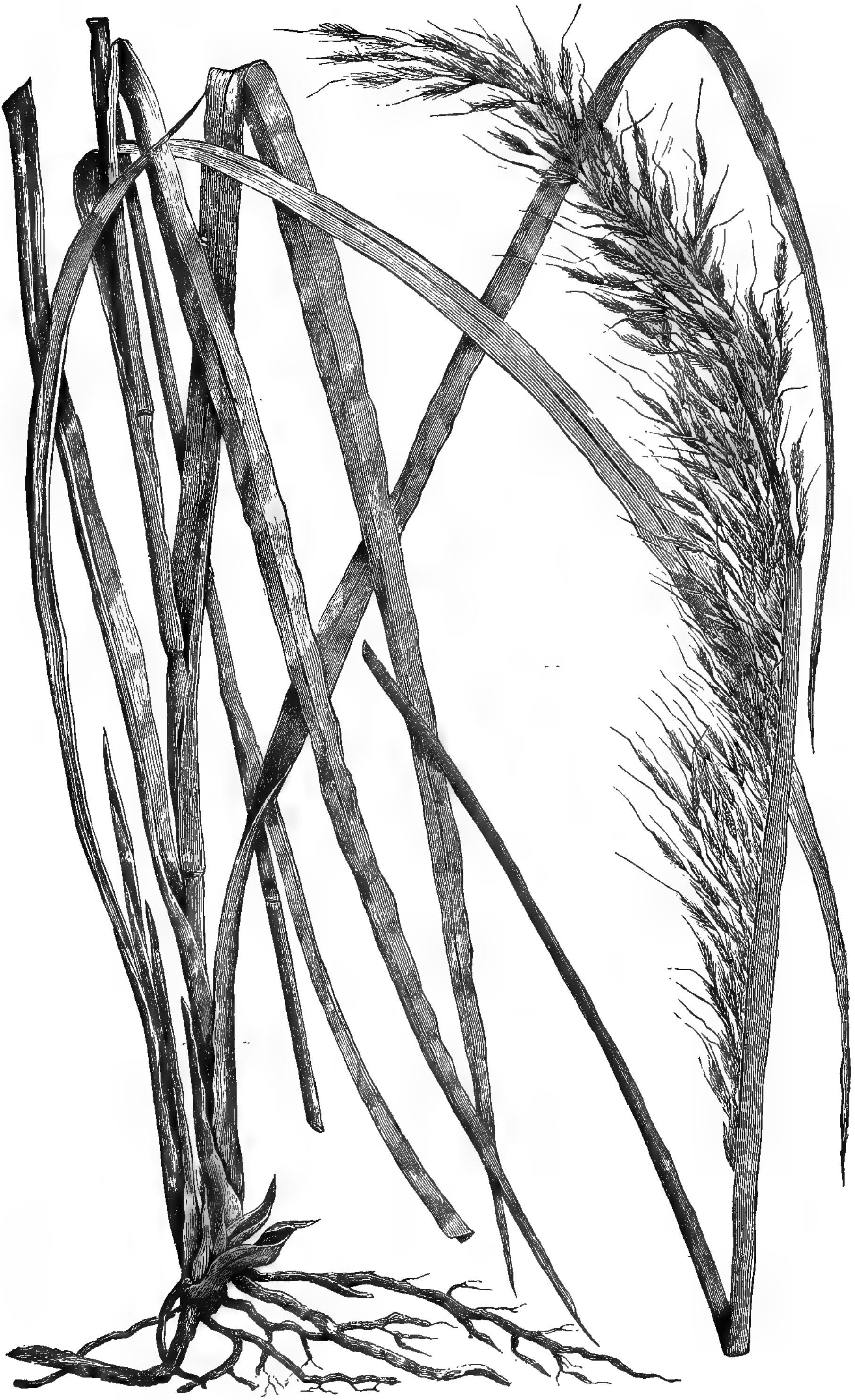
KENTUCKY BLUE GRASS.



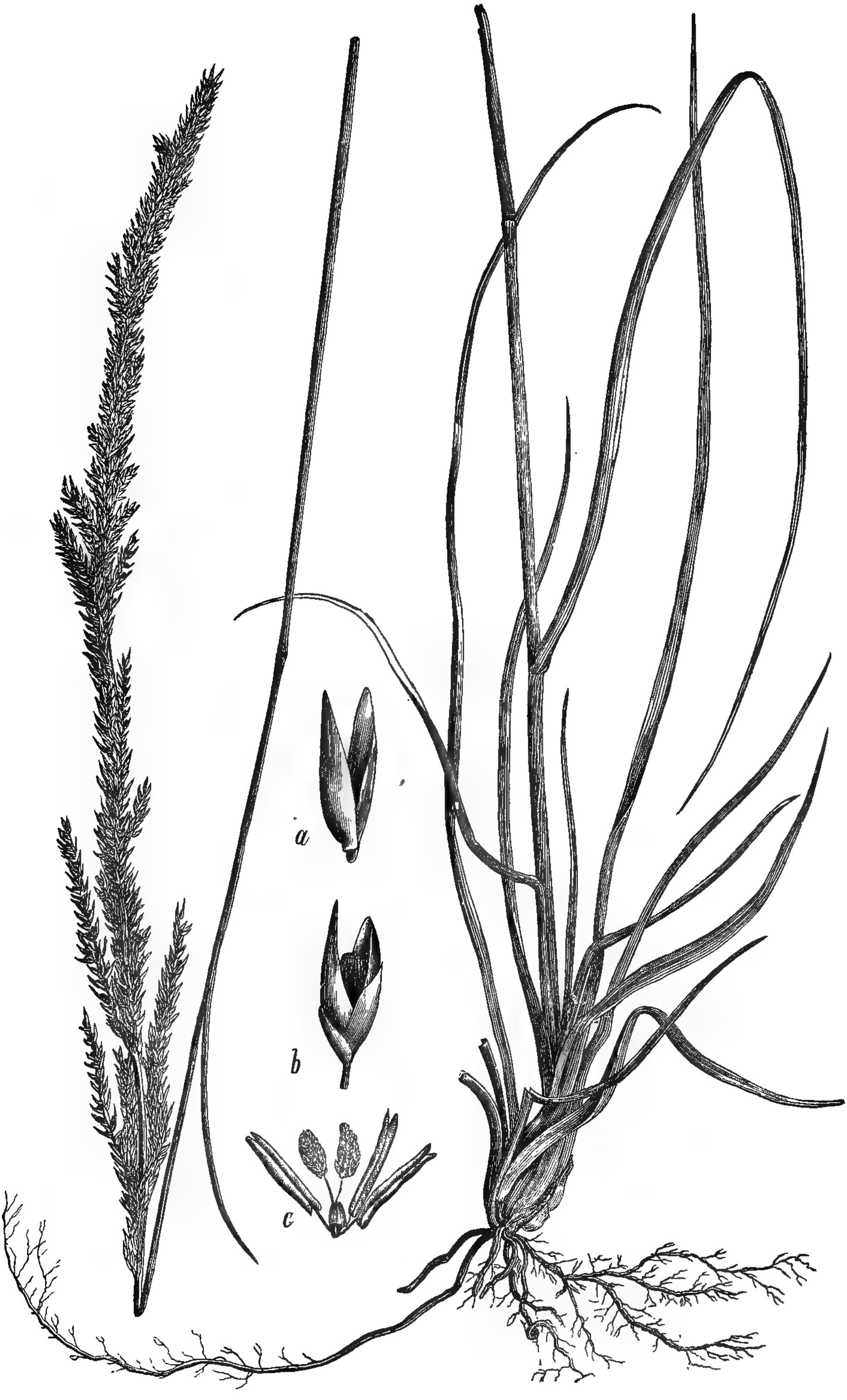
PIGEON GRASS—BRISTLE GRASS.



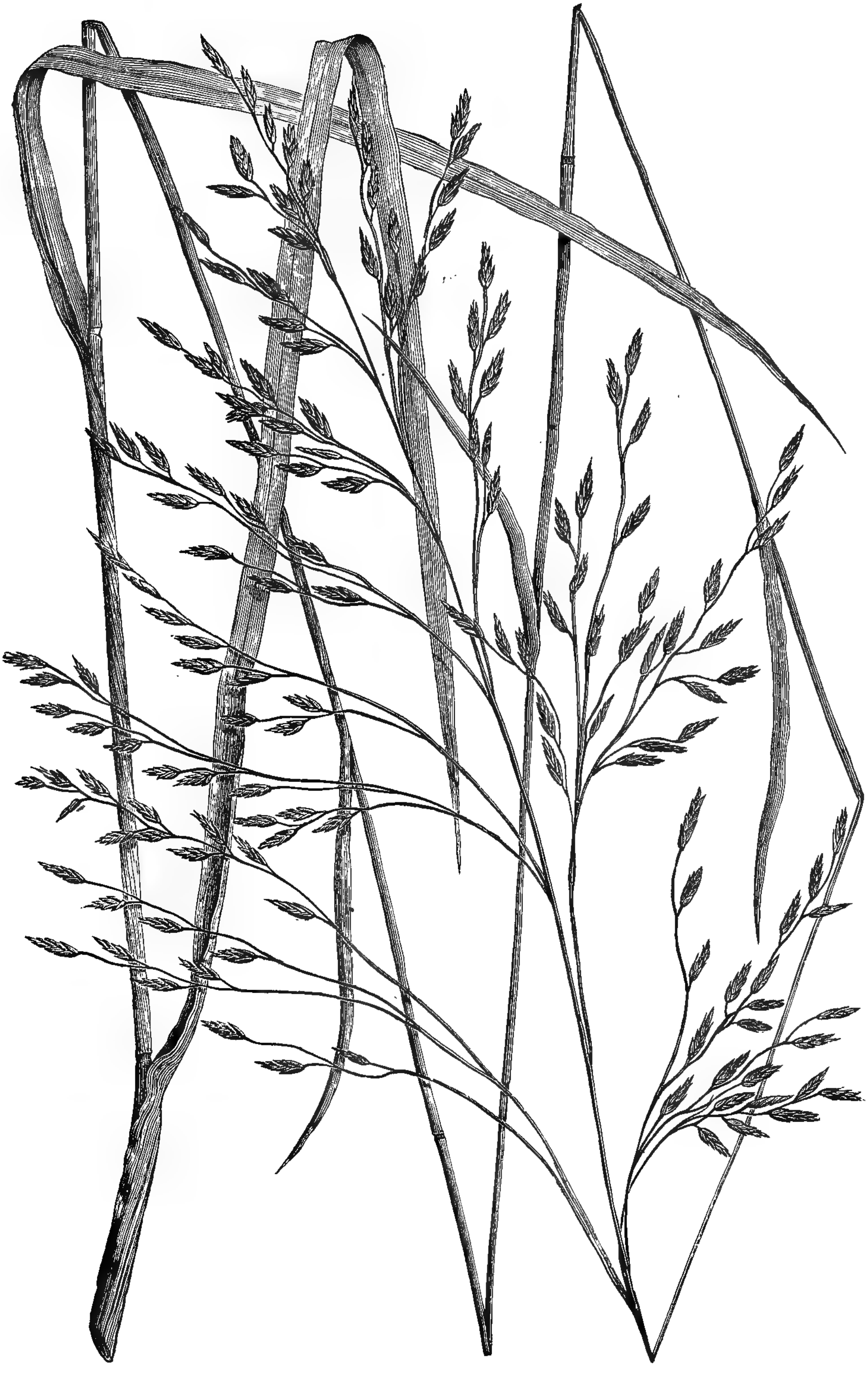
JOHNSON GRASS—FALSE GUINEA GRASS.



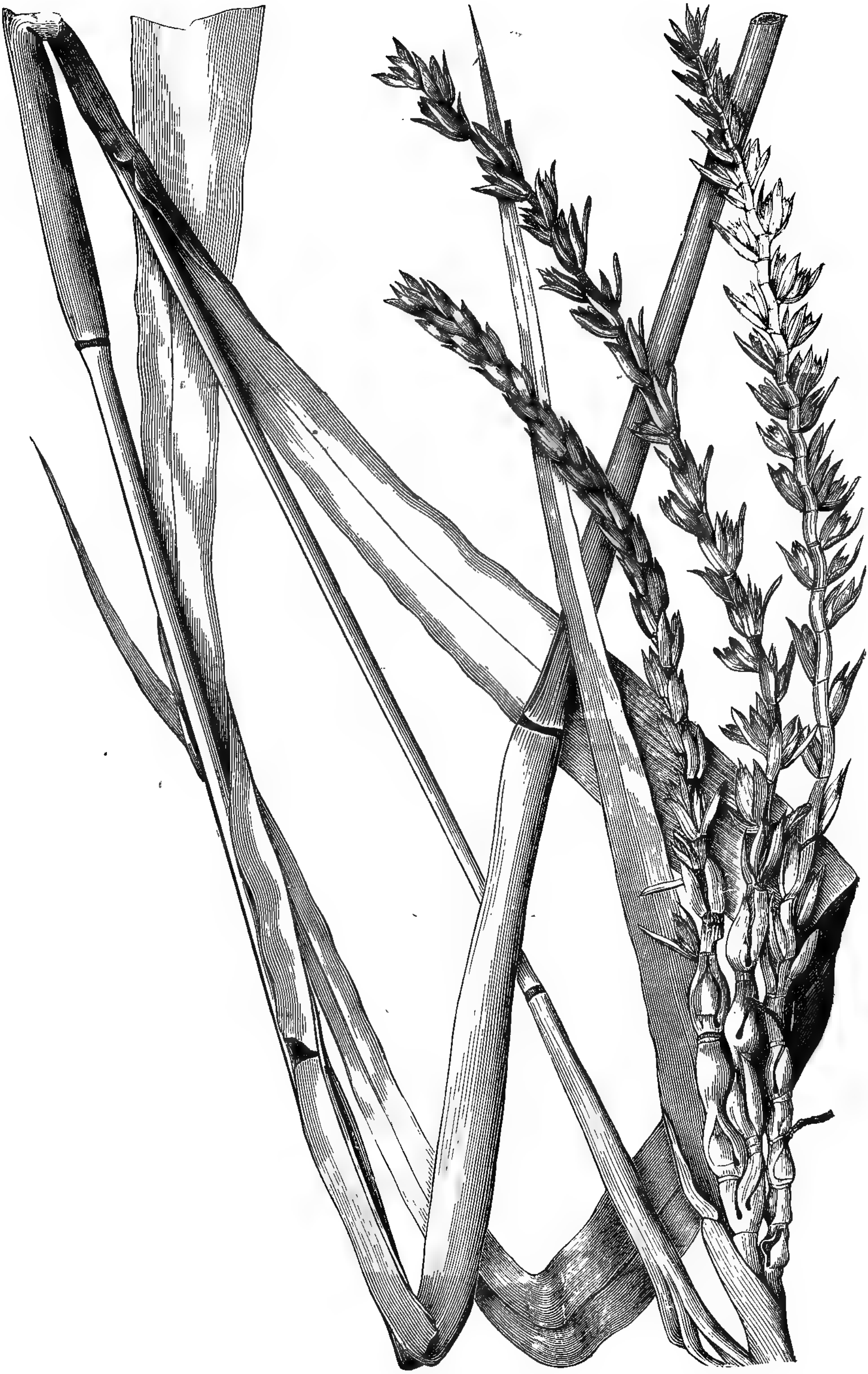
INDIAN GRASS—WOOD GRASS.



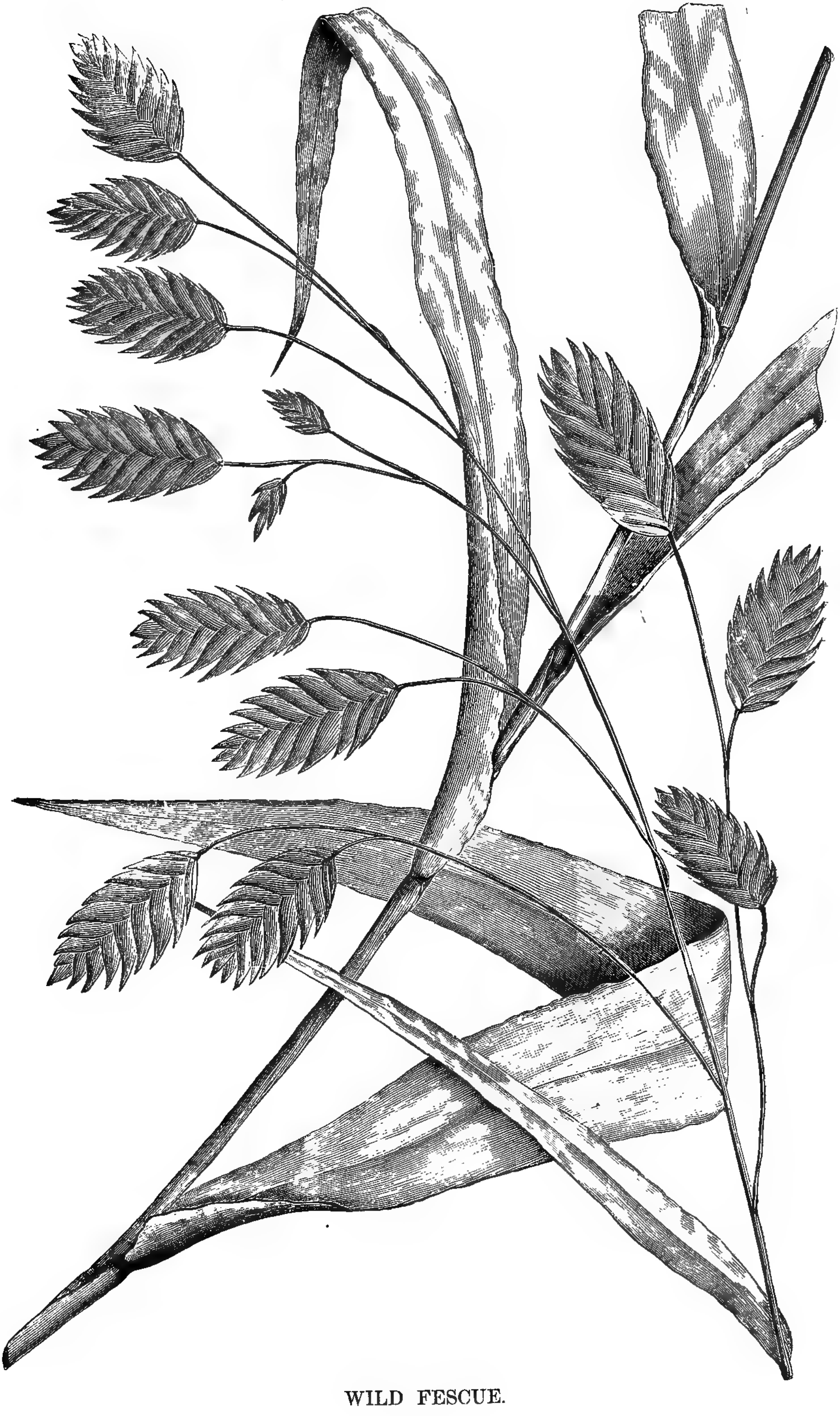
SMUT GRASS.



TALL RED TOP, (TRICUSPIS).



GAMA GRASS.



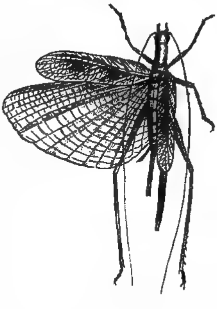
WILD FESCUE.

it can be cut every five or six weeks, yielding by its throwing out numerous stolons, increased crops until killed down by frost. The roots are easily protected during the winter by a good covering with ground, like the rattoons of sugar-cane, and allowing of a manifold division, afford the best means of propagation. These root-cuttings are set out in March or the beginning of April. This grass must not be confounded with the *Sorghum halapense* or Johnson grass, which is often improperly called Guinea grass, from its similar habit and appearance. *Panicum obtusum*, Obtuse-flowered Panic grass. This grass is similar in appearance to the *Panicum Texanum*, or Texas Millet, but is lower and less vigorous in growth, with narrower panicles and narrower and smoother leaves. It grows in South America, Mexico, New Mexico, and Texas. We do not know that it extends east of the Mississippi river, or that it has been tried with reference to its agricultural value. *Panicum sanguinale*, Crab grass. Prof. Killebrew, Tennessee, says: It is a fine pasture grass, although it has but few base leaves and forms no swards, yet it sends out numerous stems, branching freely at the base. It serves a most useful purpose in stock husbandry, and the northern farmers would congratulate themselves very much if they had it to turn their cattle on while the clover fields and meadows are parched up with summer heat. It fills all our cornfields, and many persons pull it out, which is a tedious process. It makes a sweet hay, horses are fond of it, leaving the best hay to eat it. *Panicum Texanum*, Texas Millet. An annual grass two to four feet high, sparingly branched, at first erect, becoming decumbent and widely spreading, very leafy, sheaths and leaves finely soft—hairy, margin of the leaves, rough; leaf blades six to eight inches long and one-half to one inch wide, upper leaves reaching to the base of the panicle, or nearly so; panicle six to eight inches long, strict; the branches alternate, erect, simple, three to four inches long, with somewhat scattered sessile spikelets. A grass of vigorous, rapid growth. It is very leafy, the leaves broad, rather thin, sprinkled with short, soft hairs. It grows two to three feet high, but the spreading stalks are often four feet or more in length, growing very close and thick at the base, and yielding a large amount of food. *Panicum virgatum*, tall Panic grass, Switch grass. A tall, perennial, southern grass three to five feet high, growing mostly in clumps in wet or moist soil, particularly near the coast; a good and prolific grass, if cut when young; when ripe it becomes harsh and unpalatable. It forms a considerable constituent of the native grasses of the prairies, particularly of moist localities. *Poa Serotina*, Fowl Meadow grass. This grass is closely related to the Kentucky Blue grass (*Poa pratensis*). It grows taller than that species, and is better adapted for a meadow grass than for pasture. This species is most common in the Northern States, particularly north of Pennsylvania. It is a good grass for moist meadows. In Wisconsin, where many natural meadows of this grass occur, it is highly esteemed. *Poa Pratensis*, Kentucky Blue grass. This grass is too well known to need an extended description. Prof. Killebrew, of Tennessee, truly says of this grass, it would seem a work of supererogation to argue as to the advantages of cultivating this grass. All know its benefits, and all see around them the great increase in the value of the land covered by it. It grows readily in all parts of the United States, north of latitude 40°, and lower down on suitable soils. It flowers in the earliest summer, and gives rich pasturage, except in the driest months, all the year. It varies in size in different localities, according to soil and climate. From the unexampled success its cultivation has met with in Kentucky, it has acquired the name of Kentucky Blue grass, though in the New England States it is known by the name of June grass. In all the middle portions of the United States it forms the principal constituent of the turf, though its excellence is rather depreciated in the Eastern States. In some sections it has been used as a hay, but it is not a success as a meadow grass, its chief excellence being exhibited as a pasture grass. It endures the frosts of winter better than any other grass we have, and if allowed to grow rank during the fall months, it will turn over and hide beneath its covering, the most luxuriant of winter croppings. Many persons, South and West, pass their stock through the entire winter on it alone, feeding only when the ground is covered with snow. (See article Blue Grass for further description.) *Setaria setosa;* Pigeon grass, Bristle grass. There are two species of *Setaria* or Pigeon grass which are very common in cultivated fields in the Northern States, springing up after the cutting of grain, and often yielding a fair crop for the scythe. In some of the Southern States, and particularly Texas, there is another species, the one above named, which is of larger and stronger growth. Its habit is much like the Italian millet, which is *Setaria Italica*, and its use and value are probably much the same as that species. *Sorghum halapense*, Johnson grass, False Guinea grass. A perennial grass with strong, vigorous roots, and abundance of long and tolerably broad leaves. Its stems attain a height of from five to six feet, with a large and spreading panicle. The flowers and seeds are much like those of broom corn, but the panicle is finer and more spreading. It has been much discussed in the Southern journals. It has been dreaded by planters because it seems almost impossible to exterminate it when it has once been established. *Sorghum nutans*, Indian grass, Wood grass. This is a perennial, tall grass, having a wide range over all the country east of the Rocky mountains. It grows rather sparsely and forms a thin bed of grass. The stalks are three to four feet high, smooth, hollow, straight, and having at the top a narrow panicle of handsome straw colored or brownish flowers, which are rather drooping in fruit. This grass has not usually been considered of much agricultural value, but it forms an important part of the native grass of the western prairies, and, if cut early, forms good and nutritious hay. In the Southern States and in Texas, there are two additional species or varieties which are not materially different. *Sporobolus Indicus*, Smut grass. A native of India, but now spread over many countries. It occurs more or less abundantly in all the Southern States, and is called smut grass, there from the fact that after flowering, the heads become affected with a blackish smut. Mr. D. L. Phares, of Mississippi, says that it grows luxuriantly in uncultivated lands, and is eaten by cattle and horses, and seems valuable. Dr. Gattinger, of Nashville, Tenn., says: All parts of the plant are equally pliant and succulent. It sprouts again after being pastured down, with numerous new culms, and its growing season lasts from May till frost. The culms stand about two feet high, and, as I have observed it, always growing in patches. It grows in low and small tufts, and holds to the soil. *Tricuspis seslerioides*, Tall Red-top. This grass grows from three to five feet high. It is very smooth; the leaves are long and flat, the lower sheaths hairy or smoothish. The panicle is large and loose, at first erect, but finally spreading widely; the branches in pairs or single, naked below, flowering towards the extremities and becoming drooping. The spikelets are five to six flowered; three to four lines long, purple, on short pedicels. The glumes are shorter than the flowers, unequaled and pointed; the lower palet is hairy toward the base, having three strong nerves which are extended into short cusps or teeth at the summit. It is a large and showy grass when fully matured, the panicles being large, spreading, and of a handsome purplish color. Instead of being called Tall Red-top it would be much more properly called Purple-top. It grows in sandy fields and on dry, sterile banks, from New York to South Carolina, westward to the prairies, and southwestward to Texas, where several other species also occur. *Tripsacum dactyloides*, Gama grass. A tall perennial grass, with solid culms, broad and flat leaves, and with flower-spikes from four to eight inches long, produced from the side joints or from the top, either singly or two to three together. The upper portion of these spikes is staminate or male, and the lower portion pistillate and producing the seeds. It grows from three to six feet high, with large broad leaves resembling those of Indian corn. The upper or male portion of the flower-spikes drops off after flowering, and the fertile portion easily breaks up into short joints. These joints are thick and polished, and the flowers and seeds are deeply imbedded in them. Mr. Howard in his Manual of Grasses, says: This is a native of the South, from the mountains to the coast. The seed stem runs up to the height of five to seven feet. The seeds break off from the stem as if in a joint, a single seed at a time. The leaves resemble those of corn. When cut before the seed stems shoot up they make a coarse but nutritious hay. It may be cut three or four times during the season. The quantity of forage which can be made from it is enormous. Both cattle and horses are fond of the hay. The roots are almost as large and strong as cane roots. It would require a team of four to six oxen to plow it up. It can, however, be easily tilled by close grazing, and the mass of dead roots would certainly greatly enrich the land. As the seeds of this grass vegetate with uncertainty, it is usually propagated by setting out slips of the roots about two feet apart each way. On rich land the tussocks will soon meet. In the absence of the finer hay grasses this grass will be found an abundant and excellent substitute. The hay made from it is very like corn fodder, is quite equal to it in value, and may be saved at a tithe of the expense. *Uniola latifolia*, Wild Fescue. This is a handsome grass, with larger spikelets than any other we have mentioned; in form they are somewhat like those of Bromus unioloides, and like them are very flat and compressed. Mr. Chas. Mohr, Mobile, Ala., says: A fine vernal grass, with a rich foliage, blooming early in May; two to three feet high; frequently in damp, sandy loam, forming large tufts. This perennial grass is certainly valuable, affording an abundant range early in the season; if cultivated it would yield large crops ready for cutting from the first of May. It is called by some Wild Fescue or Oat grass. It is not found near the coast, consequently I had no chance to observe its growth during the latter part of the summer, and in the winter season, and therefore am not able to judge of its value as a pasture grass. It grows as far north as Pennsylvania, but it is less vigorous in growth as it advances northward. The following glossary of terms, used in describing grasses, will be of advantage to the general reader, for identifying species named here, as well as with others found in botanical works on grasses:

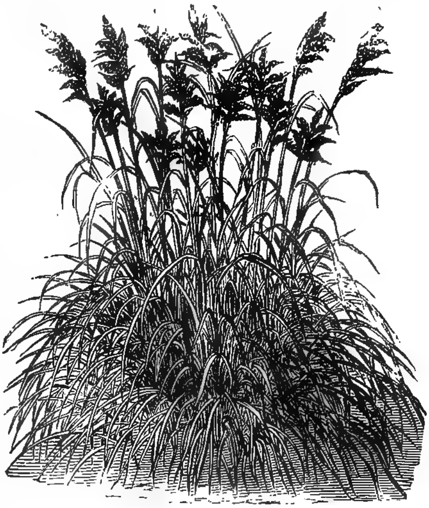
Acuminate—Extending into a long, tapering point.
Acute—Sharp-pointed.
Annual—Living through one season only.
Anther—The upper part of the stamen containing the pollen or fertilizing powder.
Awn—A bristle-like process proceeding from or attached to the glumes or palets of some grasses.
Biennial—Living through two seasons.
Boat-shaped—Concave within and convex without, as the glumes and palets of some flowers.
Bristles—Short, stiff hairs.
Bulbous—The base of the stem thickened so as to make a hard, roundish mass, as in Timothy grass (*Phleum pratense*).
Cæspitose—Growing in bunches or tufts.
Cauline—Relating to or growing from the stem or culm.
Ciliate—Having the margin fringed with hairs.
Culm—The stem or straw of a grass; when the stem creeps upon or under the ground it is called a *rhizoma*.
Decumbent—Leaning on the ground at the lower part but rising at the top.
Digitate- Branching finger-like from a common center, as the spikes of Crab-grass (*Panicum sanguinale*).
Diœcious—The two sexes separated and growing on different plants, as in Buffalo grass (*Buchloë dactyloides*).
Entire—Without notches on the margin.
Exserted- Protruded beyond the flower, as the stamens of grasses usually are when in bloom.
Fertile—Producing fruit.
Fibrous—Composed of thread-like fibers, as the roots of most grasses.
Floret—A little flower; a pair of palets with the inclosed stamens and pistil. There may be many of these in a spikelet.
Glabrous—Smooth; destitute of hairs or roughness.
Glumes—The outer or lower pair of bracts or scales in a spikelet, and inclosing one or more, sometimes many, flowers or florets.
Hirsute- Rough-haired, bearded.
Indigenous—Growing naturally in a country.
Internode—The space between the nodes or joints.
Keel—A sharp ridge along the middle of a glume or palet resembling the keel of a boat.
Lamina or Blade—The extended part of a leaf, generally open and flat, but sometimes rolled inward longitudinally, when it is said to be involute.
Ligule—A small leaf-like appendage, usually thin and semi-transparent (membranaceous), found at the lower part of the leaf or at the top of the sheath. It is said to be entire when there are no divisions in its outliner; bifid, when it is divided at the apex into two parts; lacerated, when it is cut or divided on the margin; truncated, when the upper part terminates abruptly in a transverse line, as if cut off.
Membranaceous—Thin and translucent, like a membrane.
Nerves- Rib-like elevations on the leaves, glumes, and palets.
Neutral flower—One having neither stamens nor pistil.
Nodes—Knots in the culm where the leaves are given off.
Oblong—Longer than wide, with the sides nearly parallel.
Obtuse—Blunt pointed.
Ovary—The portion of a flower containing the ovules or seeds.
Palet or Palea—The inner scales or bracts inclosing the stamens and pistil.
Panicle—The flowering part of the stem or culm of grasses, usually composed of a number of series or whorls of branches or rays, which are again divided into secondary branches. These may be short and close to the stem, or they may be long and spreading.

Perennial—Living for more than two years; indefinitely.
Pistil—The central organ of a fertile flower, usually consisting of an ovary, style, and stigma.
Pollen—The fertilizing powder contained in the anthers.
Pubescent—Covered with soft hairs.
Rachis—The name given to that kind of flowering branch where the flowers are arranged closely together on its sides without stalks or pedicels, as in Paspalum, and in the ultimate branches of the panicle.
Radical leaves—Those growing from the root.
Spikelet—The ultimate divisions of the panicles or flower-heads; they may be one-flowered, that is, a pair of glumes enveloping a single flower of a pair of palets (or sometimes one palet) with the enclosed stamens and pistil; or they may be two or more flowered, there being but one pair of glumes to each spikelet, whether it be one or many flowered.
Sheath—That part of the leaf which clasps the stem; it answers to the petiole or leaf-stalk.
Spike—When the flowers are sessile or without branches, as in Timothy grass (*Phleum pratense*).
Stamens—The organs of the flower which contain the pollen, consisting of the filament and the anthers.
Stigma—The extremity of the pistil which receives the pollen.
Whorl—A number of leaves or branches starting from one line on the stem.

GRASSHOPPER. The insects we commonly call grasshopper are really locusts. They will be treated of under that head. In fact, all jumping insects of the Grillidæ, including crickets, and katydids, are often called grasshoppers, as well as the locusts, the latter being, as a rule, more common than the long-winged grasshoppers. It would be better if the name grasshopper was only applied, as it might properly be, to that class of jumping insects with green bodies, and the wings and wing coverts of which are considerably larger than the body. To this class would belong the katydid. (See Katydid.) As illustrating one of the species of terrestrial grasshoppers, we give a cut of the Slender Meadow grasshopper, (*Orchilemum vulgari,*) a common meadow grasshopper, the name signifying to dance in the meadow. From the middle of summer until the fall our meadows are often filled with these grasshoppers, as they often are with true locusts, of which the red-legged species (*Acrydium femur-rubrum*) is most common. In seasons when grasshoppers are very thick they may be kept down by passing over the field with a large bag-net of millinet, attached to a hogshead hoop, and a proper handle. By using a horse for riding, a man will thus catch immense numbers, and being dried, they may be sold in large cities as food for mocking-birds, and other soft-billed species kept in confinement. (See Katydid and Locust.)


SLENDER MEADOW GRASSHOPPER.

GRASS, ORNAMENTAL. The varieties of ornamental grasses are numerous, and some of those recently introduced are especially beautiful. The annual ornamental varieties are too well known to need description, as are some of the finer of the perennial varieties. *Erianthus ravennæ,* (see cut above) resembles the celebrated Pampas Grass, but is hardy, at least to the latitude of 42° north, with slight covering in winter. It grows to a height of nine to twelve feet, and is handsome as a specimen plant on the lawn. It may be grown from seed, but is better propagated by division of the roots. Pampas grass, (*Generium argenteum,*) is a native of South America, and is a magnificent object, but unfortunately not hardy north of 38°. It is undoubtedly the finest of the strong growing ornamental grasses in cultivation, and if entirely hardy would be found in every collection, as a single specimen or as a center to a large bed. In favorable situations it is well worthy a place in large collections, even as far north as latitude 42°, where means of protection, by brush, litter, and frame work can be used. *Statice Latifolia,* although not a grass is introduced here on account of its great beauty, and as being used as are the ornamental grasses for winter bouquets when dried. The cut below shows this elegant object.


ERIANTHUS RAVENNÆ.

STATICE LATIFOLIA.

The foliage is broad and luxuriant, and the flowers lilac, and borne in large trusses. The family Statice comprises many species of hardy, half hardy, and greenhouse, annuals, biennials, and perennials. *S. maritima* is the well-known

Sea-pink or thrift, excellent for edging. *S. arborea*, is a green-house evergreen shrub.

GRAVEL. Water worn pebbles, loosely interspersed, more or less abundantly, in a sandy or clayey medium. It is of every degree of fineness, chemical composition, and value in farming. Those gravels containing silicious pebbles chiefly, and of a large size, are nearly unfit for tillage, and the value increases with the presence of slates, granites, hornblende, mica, marl, and clay. They are usually very porous, draining water off rapidly, and can not be of much value, unless incumbent on a subsoil that holds water at some little depth. If the gravel be fertile, it is usually warm and best adapted to roots. Stiff marls, burned clay, and an abundance of vegetable matter are to be used as manures. Gravel is well adapted for forming walks in gardens and the surface of roads.

GRAVEL. In farriery, the formation of hard calculi or stones in the bladder, or of a sandy sediment.

GRAVEOLENT. Fetid, having a strong odor.

GRAVES, GREAVES. Membranous matter left as refuse by the tallow-melter; it is used for feeding dogs, and given to poultry. Graves contains a large amount of fat, and is admirably adapted for fattening hogs, etc.; it has been used, also, as a manure; 200 pounds interspersed in stable manure may be added to the acre; but the most economical plan will be to compost in the nitre bed. It is a nitrogen manure, 100 pounds yielding about thirteen pounds of ammonia, and being equal, in this respect, to about one and a half tons of farm-yard manure. The presence of sulphur and phosphorus, besides bone earth, also constitute it a manure applicable to all rich crops; as corn, wheat, tobacco, etc., the only consideration being the economy of using so high priced an article. (See Manures.)

GRAVID. Pregnant.

GRAVITATION, GRAVITY. The tendency that masses have to approach each other; also called attraction of gravitation. The gravity of a body is therefore the attraction it extends toward other bodies; it increases with the bulk, density, and nearness of bodies, being directly as their density and mass, and inversely as the squares of their distances. Weight, and the descent of all bodies toward the earth's surface, is an effect of the earth's gravity, or terrestrial gravitation.

GRAZING. The turning of stock upon pasture, that they may seek their own food, is termed grazing. When they are turned upon an unfenced range and watched, it is termed herding. The question of grasses adapted to grazing is an important one to every farmer. The subject in its various branches will be found fully treated of under grass, clover, forage plants, and feeding.

GREASE IN HORSES. This is eczema of the heels, or inflammation of the heels and fetlocks, with formation of vesicles, and pustules, throwing out a fetid, watery discharge. This disease is owing to bad keeping and grooming, and a low condition of the system. It differs from the scratches in that the skin is moist. Sometimes granulations appear called grapes. The first thing to do is to move the bowels with from four to six drachms of aloes in a pint of water. Groom and blanket the horse, and keep in a warm stable. If there are granulations, sprinkle them with powdered sulphate of zinc. If the case is more simple, dusting with dry oxide of zinc, after washing clean with soft warm water and castile soap, will effect a cure. If there is a bad odor, use weak carbolic acid water, or make a wash of one ounce of sulphate of copper dissolved in a pint of water, to which afterward add one pint of whisky or rum. Apply two or three times a day, keeping the parts bandaged.

GREEN CROPS. Such crops, roots, etc., as are fed off the land or used in soiling, before becoming ripe and fit for storage. When plowed into the ground, any growing crop may form green fallows.

GREEN DYE. This is produced, in all its shades, by using a bath of blue, and then yellow.

GREEN FALLOW. Green crops plowed into the soil.

GREEN GRASS. Probably *Poa angustifolia*, applied also to Blue grass, *Poa pratensis* and *P. compressa*. An early and late pasture grass, much esteemed in the Eastern States. It bears water well, but is occasionally subject to rust. (See Grasses.)

GREEN-HOUSE. A conservatory. This should be distinguished from a hot-house, in which artificial heat is used. It is covered with glass either on one or both sides, if on one only, that should have a southern aspect. Plants are stored here in pots or frames, fruit-trees trained against the wall, and the roof partially covered with grape-vines. They are used to protect tender plants from winter, and advance the ripening of fruits. An Orangery is a place of deposit for orange and other trees set in pots, which produce their shoots in summer, and are then transferred to the open air. It does not always have a glass roof, but is frequently a pit dug in the soil on the hill-side, and covered, the south side of which only is glazed. In very severe weather the glass of the green-house may be covered with mats, and the temperature should not sink to the freezing point.

GREEN MANURES. Manures plowed into the land in a fresh or green state, especially green fallow crops. The principal plants used for this purpose are clover of various kinds, buckwheat, grasses, oats, rye, tares, various beans, lupins, spurry, borage and turnips running to flower; young Indian corn, mustard, and, indeed, nearly all herbage the seeds of which are not too expensive, have been proposed. But there are two points worthy of consideration in the use of these plants: 1st. That some improve the soil much more rapidly than others, viz., clovers, grasses and buckwheat. 2d. That an excess of green matter turned into the soil is disadvantageous, bringing on a tendency to mildew; it is best, therefore, to scatter lime over a green fallow, harrow it in, and sow the seed within a few weeks, unless the soil is very stiff; for the gaseous matter given out by the decomposition of the manures will be serviceable to plants, and should not be lost. In stiff soils make the fallow in the fall. By this means lands are very rapidly brought up if they are merely deficient in vegetable matter; the expense is also much less than by the accumulation and spreading of other manures. Sea-weeds, weeds cropped from the soil, etc., are also called green manures when plowed into the soil in the fresh state. Some writers use the term green manure for long or unfermented dung.

GREEN SAND. New Jersey marl. One of the upper secondary deposits of geologists, consisting, for the most part, of a sandy formation, the grains of which are, however, much softer than those of common sand, and consist of silicate of iron chiefly; they are of several colors, from greenish gray to deep green and olive. It is extensively developed in the United States, being found in the valley of the Connecticut, southeastern portion of New Jersey, Delaware, and Virginia. Some portions of this deposit contain from seven to twelve per cent. of potash combined with silicate of iron. This is particularly the case with that in Monmouth and Burlington counties, N. J., and Newcastle county, Del. Numerous pits are therefore, opened for the purpose of reaching this deposit, called Marl, which has been found, in many instances, to produce remarkable fertility when applied at the rate of 200 to 400 bushels on stiff clayey lands. In selecting specimens, we are to examine the amount of green sands in it, the fertility depending upon them; for the clay, common sand, and other impurities are of little importance. The richest kinds are of a deep green internally, sometimes with an olive tint, but the exterior becomes grayish and covered with a slight efflorescence; it is also readily crushed. The following analysis of a specimen from Monmouth county will give the particulars of its composition per cent.:

Silica	50.00
Alumina	7.00
Protoxide of iron	22.00
Potash	11.00
Lime	1.00
Magnesia	a trace
Water	9.00
	100.00

The potash here is combined with silica, but their union is readily destroyed by the carbonic acid of the soil, which rapidly forms carbonate of potash. This manure is peculiarly applicable to grass, oats, wheat, corn, and the *Cerealia* generally; it will also be serviceable to roots growing on a stiffish soil. It may not, however, pay the expenses of long transportation, a small quantity of ashes replacing it in the compost heap, and is little used except when near at hand.

GREENSTONE. A species of trap consisting of feldspar and hornblende. It is a fused and intruded rock.

GREEN VITRIOL. Sulphate of protoxide of iron. It is styptic, emetic, and much used in dyeing and inkmaking.

GREYHOUND. A coursing dog, remarkable for his swiftness and symmetry.

GREYWACKE. *Grauwacke.* A conglomerate of rounded pebbles and sand, naturally cemented together.

GRIP. A small drain.

GRIPES. Colic, which see.

GRIT. A hard sandstone usually coarse.

GROATS or **GRITS.** Oats prepared by hulling.

GROGGINESS. Any disease of the feet, as founder, or navicular disease, will produce that tenderness of movement called grogginess. (See Founder, Navicular disease, and also Horse's Foot.)

GROIN. In architecture, the junction of two arches.

GROSSULARIA. The generic name of the currant and gooseberry.

GROUND-BAIT. Balls made of grain, graves, bran, lentils, mixed with clay, and thrown in those parts of a pond or river where angling is carried on.

GROUND-CHERRY. Several varieties of *Physalis.*

GROUNDSEL. *Senecio vulgaris.* A homely, worthless weed known as ragwort, and naturalized from Europe in various portions of the United States. De Candolle has remarked of this weed, that it migrates almost everywhere with European man.

GROUSE. Among the sub-families of that known as *Tetraonidæ,* the grouse sub-family is a most important one from the value of the flesh of the species. North America is conceded to contain more species of this valuable game bird than any other country in the world. It is more than probable that America is in this respect superior to all other countries, since the cock of the plains rivals in size, that of any country. The principal species of American grouse are as follows. Cock of the plains (*Centrocercus urophasianus*), found on the far Western plains, the males weighing sometimes from six to seven pounds. The Ruffed grouse (*Bonasa umbellus*), is abundant North, South and West, and is commonly known as the partridge and also pheasant. Sabines grouse (*B. Sabinei*), found west of the Rocky mountains, is deep red in hue, as to the ground work of the feathers, and the excellence of its flesh is fully equal to the last named. The Allied grouse (*B. umbelloides*), inhabits the Rocky mountains, and north to the Arctic circle, is light gray in color, differently marked from the Eastern partridge, and is much smaller. The Prairie hen—pinnated grouse—(*Cupidonia cupido*), was formerly abundant from the Atlantic coast to Kansas. It is now nearly or quite extinct East, and not nearly as abundant West as formerly, except in Iowa, Minnesota and Kansas. Great numbers are killed yearly and sent to Eastern and European markets. The Sharp-tail grouse (*Pediocætes columbrianus*), takes the place of the pinnated grouse in the far West, and in its habits and the nature of its flesh resembles the prairie hen. The Arctic Sharp-tailed grouse (*P. phasianellus*), is a native of the far north, never being found within the limits of the United States. The three last named species are however said to be fertile together, the hybrids partaking sometimes more of one and sometimes more of the other parent. The Dusky grouse (*Dendragapus obscura*), is equal in size to the cock of the plains. It is a magnificent, white-fleshed bird, found in Northern California, and north into Oregon and Washington Territory, and south along the main chain of the Rocky mountains, as far as Texas. Richardson's grouse (*Dendragapus Richardsonii*), differs from the foregoing, though sometimes confounded with it. This species is found from the South pass of the Rocky mountains, northward, and along the slopes as far as the forests extend. It is never found upon the plains. The Spruce grouse (*Canace Canadensis*), inhabits the northern portion of the United States, and thence far north, even to the Arctic seas. Its home is in the thick forests, and swamps, and thus it is seldom met, unless specially hunted for. Franklin's grouse (*Canace Franklinii*), is a native of the Rocky mountains, from latitude 50° to 54° on the high elevations forming the base of the snowy peaks. It was formerly considered the same as the Spruce grouse, but it differs in several points, and is a species by itself.

GROUT. In building, mortar made fluid with water. Plaster used for finishing walls. Mortar used in fixing foundations.

GRUB. The larva of May beetles, and similar species, found infesting meadows, fat compost heaps, rotten stumps, etc., generally short, thick larva, which, when handled, assumes nearly the form of a ring.

GRUBBER. A strong hoe for tearing up the roots of shrubs and trees.

GRUIDÆ. Birds which wade like the crane (*grus*).

GRYLLIDÆ. A family of locusts, resembling the *Gryllus*.

GUAIACUM. A resin obtained from the *Guaiacum officinale*, a West India tree. It is little used in medicine for rheumatism.

GUANO. One of the commercial manures, the excrement of sea birds, accumulated for ages upon rainless rocky islands of the South Pacific coast. When pure it is one of the most valuable of the special fertilizers. (See article Fertilizers.)

GUINEA CORN. Egyptian corn. Indian corn of a very small grain, used for popping, is so-called.

GUINEA FOWL. (See Poultry.)

GUINEA GRASS. (See Grasses.)

GUINEA PIG, or **CAVY**. *Cavia cobaya.* A small rodent animal, of six or seven inches in length, light color and herbivorous; a native of South America. It is considered a delicacy in Italy; the skin is also valuable. The female brings forth from ten to fourteen young at a litter, carries young three weeks, and bears every two months in warm weather. They are very cleanly, and can not endure cold.

GULA. The region of the throat nearest the lower jaw.

GUM. A concrete juice, the product of most vegetables. There are many varieties, all reducible to two kinds—soluble, or true gums, which dissolve in water, forming mucilage, and are insoluble in alcohol; and insoluble, or tragacanth gums, which soften and swell in water, but are not soluble. Fruit trees often exude gum; this is considered a disease, and may arise from the punctures of insects, but, according to some, is also an indication of a poor soil, requiring putrescent manures. Various names, as *Bassorin. Arabin, Cerasin,* etc., are given to specimens of gum from different trees.

GUM RESIN. A concrete juice, obtained in various ways from plants, partly soluble in water, and partly in alcohol, as gamboge, aloes.

GUTTA SERENA. Blindness, without loss of transparency in the eye.

GYMNOCARPI. The second division of Persoon's *Fungi,* including those that have their sporules in an exposed dilated membrane or hymenium, as *Agaricus, Boletus, Helvella.*

GYMNOSPERMÆ, GYMNOSPERMS. A class of plants having naked seeds; at present this feature is said to be peculiar to the *Coniferæ* and *Cycadeæ.* Linnæus erroneously made it an order of *Didynamia.* The seeds of gymnosperms are situated in carpels imperfectly closed, the aggregate of which forms the cone.

GYNANDRIA. A Linnæan class, in which the stamens and pistil are consolidated into a column. It consists, principally, of the *Orchidaceæ.*

GYNOPHORE. The stalk on which some ovaria are elevated, as in the passion flower.

GYPSUM. Sulphate of lime. A mineral found extensively in various parts of the globe. It is a constituent of soils, especially peat soils, and is found in sensible quantities in the clovers, some of the grasses, in turnips, and in the dung of animals subsisting on grass and clover. Its chemical composition is water, twenty-one per cent. lime, thirty-three per cent., and sulphuric acid, forty-six per cent. When calcined at a low heat it is deprived of its water, and is then known as Plaster of Paris. Gypsum is soluble in 450 parts of boiling water, and in 500 parts of cold water; and a ton of pure gypsum when ground will yield twenty-five bushels of land plaster. Its effect is most marked on soils that are light, dry, and open. On strong clays its effect is not so marked; in fact, the value of gypsum upon any soil can only be arrived at by experiment. On grain the usual application is from 200 to 300 pounds per acre; on grass, clover, peas, beans, Indian corn, and potatoes, from 400 to 500 pounds are often applied, and to the two latter crops, often in combination with ashes. Applied to clover and grass, after mowing, it increases the aftermath, and also the crops the succeeding spring. To grain it is applied at the time of sowing, and to hoed crops it is applied in the hill or drill at the time of planting. A better way, however, would be to scatter it well around the hill at the time of planting. Thus, at the first cultivating, that outside the hill would be covered, the greater quantity of moisture would be absorbed, and the whole more equally distributed where the roots could find it. Gypsum is said to attract ammonia from the atmosphere. This, however, is not true except in a sense. Gypsum is soluble in rain-water; rain-water contains carbonate of ammonia. Thus it enters into combination with the sulphuric acid of the gypsum, and sulphate of ammonia, and also carbonate of lime is formed; that is, the ammonia gives up its carbonic acid and takes sulphuric acid, and the gypsum vice versa, according to well-known laws of chemical affinity. In the same way it fixes the ammonia of stables and manure piles, while the action of lime would be to render the ammonia still more volatile. Gypsum is not a manure itself. It is only beneficial in connection with manures, or when the soil contains humus, or is otherwise fertile in organic matter, though the fertility may be locked up from insolubility. The term fix is explained as follows: Supposing the gypsum to meet with a sufficient supply of ammonia in the soil, and that it exercises its full influence, 100 pounds of common unburned gypsum will fix or form sulphate with nearly twenty pounds of ammonia, containing sixteen and one-half pounds of nitrogen. One hundred weight, therefore, (112 pounds,) will form as much sulphate as will contain twenty-two and one-half pounds of ammonia; and, if introduced without loss into the plants, it will furnish them with eighteen and one-half pounds of nitrogen. The sulphuric acid contained in gypsum, from well-known principles, acts beneficially in decomposing and bringing into activity the humus and insoluble matter accumulated in loams or peaty soils. Gypsum is decomposed by carbonate and muriate of barytes, the carbonates of strontia, potash, soda, and of ammonia, as well as by oxalic and humic acids, and where any of the four last named occur naturally in the soil, or are applied by artificial means, new combinations take place, which are attended in some cases with beneficial results. For instance, in order that gypsum may be useful as a fertilizer, the soil must always contain more or less humus, even if it be only two or three per cent. If, however, it contains too much free humic acid, it will decompose the gypsum, so that humate of lime will be formed, and the sulphuric acid will be set free, which may then act as a corrosive on the rootlets of the crops. On this account, a soil very rich in humus must never be manured with too much gypsum, because, though the sulphuric acid were to combine with another base contained in the soil, it would still form therewith a salt easily soluble in water, by which the plants would receive too much sulphuric acid at once. If strewn over fresh dung, and plowed in with it in the field, it will undergo a partial decomposition by the carbonate of ammonia developed from the excrements, so much so that sulphate of ammonia and carbonate of lime are formed. Gypsum, therefore, is known to act chiefly through its sulphuric acid, which, on the one hand, obtains soluble ammonia from the humus constituents of the soil, and furnishes this to the plants at a period when they are especially inclined to the production of leaves and stems; and on the other hand, strengthens and increases the power of plants to absorb ammonia from the atmosphere, and this in greater proportion as these are more abundantly endowed with young and vigorous leaves.

GYRATE. Twisted round in circles.

GYRI. The annular series of scales on the tails of some quadrupeds.

H

HABITAT. The natural abode of animals, plants, etc.

HACK, or HACKNEY. In England, a general term for a road horse, which does not always convey any sense of inferiority, or refer to horses let out for hire. It is, however, often used in that sense.

HACKMATACK. The American Larch. (See Larch.)

HAIL. Atmospheric water congealed into ice, either globular or irregular, often measuring an inch across. It is altogether different from snow, in occurring during the spring and summer. Hail is produced only during violent winds, which carry a great deal of moisture into the upper regions of the air, where it becomes solidified by extreme cold. Hence the reason why hail is often found in comparatively narrow areas.

HAIR. Slender tubes of animal matter analogous to horn. It is a non-conductor of heat. Refuse hair ranks as a manure with skin or glue, producing the same results by decay; woolen rags are the most familiar example used in this way. Hairs in botany, are transparent tubes of cellulose inserted into the epidermis; they are totally dissimilar from animal hairs, in containing no nitrogen. Cotton is an instance of hairs attached to seeds, called pappus.

HAIRBIRD. (See Sparrow.)

HAIR GRASS. The genus *Aria.*

HALCYONIDÆ. A family of fissirostral birds, of which the king-fisher is the type.

HALESIA. The snowdrop tree (*H. tatraptera*); ornamental trees introduced and hardy south of forty degrees.

HALHYDRATES. Salts in which the combined water of the acid becomes a component of the salt.

HALOGEN. Bodies which unite directly with metals, without any previous oxidation, and form salts, as chlorine, sulphur, fluorine; their compounds are termed Haloid salts.

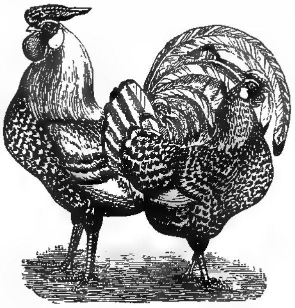
HALTICA. A genus of small coleopterous insects. (See Flea Beetle.)

HAM. The thick part of the leg of animals.

HAMES. The wooden or iron collar pieces to which the traces are attached.

HAMMER BEAM. A horizontal timber from or near, but above the foot of a rafter, acting as a tie.

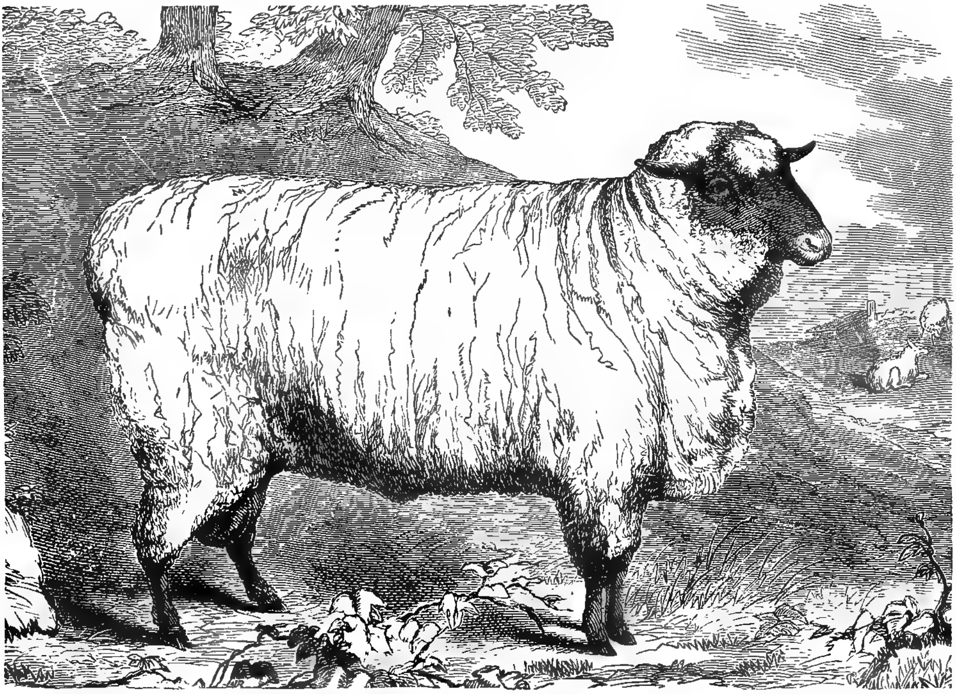
HAMBURG FOWLS. Hamburg fowls are of a number of varieties, the principal ones being the Black Hamburg, and the Penciled Hamburgs, the latter being divided into Golden and Silver Penciled. Whatever the variety they all have these characteristics. They are of small to medium size, compact, and handsome in their carriage, with bright, firm, double combs, ending at the rear in a long point, turned up. The tail is large, upright, and with long plume feathers. Their constitutions are good. They are good layers, and seldom inclined to sit; the eggs are small, but of delicate flavor. The cut shows a pair of Penciled Hamburgs. That they are an old breed, is evidenced from the fact that Aldrovandus describes it as the Turkish fowl. The white body and black markings, the greenish-black tail, and the blue-tinted legs, show that this old writer had in his mind what now is the Silver-penciled Hamburg fowl. They have long been known in England, as Bolton Grays, Creoles, Creels, Corals, etc., from their markings, and on the continent, also, under a variety of names, showing their wide dispersion and general good qualities. The general character of the Penciled Hamburgs, either silver or golden, besides these already noted, are: In the plumage on the body of the hens, each feather except the neck-hackle, is penciled with several transverse



PENCILED HAMBURGS.

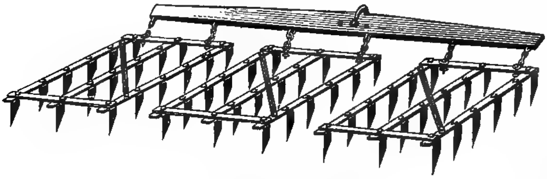
bars of black on a clear ground, white in the silver variety, and a golden red or rather a rich bay in the golden; the hackles, however, being free from dark marks. The cocks have not these marks, they are either white or bay. The legs in both sexes are blue; the ear-lobe white, well-defined, and the face scarlet. The tail of the cocks should be black, the sickle and side sickle feathers glossed green, with a narrow white edging. The tails of the hens are distinctly barred, or penciled with black.

HAMPSHIRE DOWN SHEEP. This English breed is said to have been produced by crossing the South-Down upon the old breed of Hampshire, and subsequently by an infusion of Cotswold blood. This gave them an increase of wool, a larger size, their constitutional and hardiness being retained. It is claimed for them that they are more hardy than the South-Downs. When introduced into the United States, especially in the South, they have given satisfaction, and crosses on Leicester and on Cotswold, are reported to have taken kindly and with profit to both. As a rule, however, the breeder should avoid too great a size, when mutton is an object, since it induces excessive fat, which is not liked, and indeed, is an objection to many of the large breeds. In relation to this British breed of sheep, the well known statistician, J. R. Dodge, in Sheep and Wool of the World, says: This family of Downs, unlike the Sussex, is founded through skillful breeding. It was effected in harmony with the idea of more meat in a shorter period of time—the same which originated the Leicester and the Short-horn—by admirers of the South-Down style, who saw in the size and the early maturity of the Wiltshire horned sheep and the Berkshire Nott, qualities forming an admirable foundation for a breed upon which the fine form and superior quality of flesh of the Down could be ingrafted. It is worthy of notice that a breed which has long displaced the original Sussex Down and other breeds in Berkshire, Hants, Wilts, and Dorset, has been made what it is, in the hands of skillful breeders, by the blood of the finest specimens of the race which they now dominate in all this section. This change is a natural result of the inclosure of the commons, the introduction of artificial manures, and the production of such crops as turnips, rape, vetches, trifolium, rye, and Italian rye-grass. This is one of the facts with which the history of British sheep-husbandry teems, illustrating the necessity of change in breeds, with changed conditions of production or consumption. It is estimated that the weight, both of mutton and wool, has been increased in this region fifty per cent. The statistics of 10,000 Hampshires for three successive years showed the average yield of lambs to be ninety-one per cent., the mortality of ewes five and one half per cent., and of tegs three per cent. per annum. The wool is of fine quality, but short staple, averaging four and one half pounds per fleece. The best specimens of these sheep may be found at the Overton and Weyhill fairs, in Hampshire, and the Britford and Wilton fairs, in Wiltshire. The wether-lambs are now usually sold in the latter part of summer or early autumn, and the ewes are kept three years for breeding. The period of service of rams is from August 1 to the middle of September. In England, the ewes are usually kept on turnips and hay during the



HAMPSHIRE DOWN RAM.

winter, the hay being cut into chaff with a portion of straw, and sometimes seasoned with a little malt-dust, bran or cake. The lambs go out on turnips, if the weather is fine, in a few days after they are dropped, though many farmers keep them penned for two or three weeks. After April 1 they leave their diet of turnips and hay, and go to the water-meadows by day, and are folded at night on Italian rye-grass, winter-barley, or trifolium, the wether-lambs getting a little cake or corn. On farms that have no water-meadows a large supply of late swedes is secured, and the lambs are kept upon winter-growing grasses and forage-plants until the vetches are in bloom. Early in May they are weaned, when it is common to pasture in clover by day and fold on vetches by night. When the vetches are consumed, the sale lambs are supplied rape and cabbages and the ewe-lambs follow to consume what the wethers leave. Thus managed, the lambs attain great size and command high prices. Formerly they were largely sold, from July to September, to go to Kent and Surrey, and other points near London, to be fattened for the markets of that city. They are now so good that they are sold for immediate consumption. It was deemed proper to give somewhat in detail the mode of management in fat-lamb growing, not only to show the practice employed with this particular breed, but to call renewed attention to the necessity of high feeding in this business, and illustrate again the constant variation in feeding and management to meet the requirements of changed or differing circumstances.


ADJUSTABLE HARROW.

HAMS, CURING. (See Pork.)

HAMSTER. *Mus cricetus.* A kind of rat found in the north of Europe, which lays up extensive stores of food.

HAND. A measure of four inches, used in estimating the height of horses. The fore leg of a horse or other animal.

HANGBIRD. (See Oriole.)

HARD WATER. Water containing salts of lime, especially gypsum. It is softened by adding soda-ash or ammonia.

HARE. The family *leporidæ* includes the hares and rabbits. Their well known characteristics are long and erect ears; large prominent eyes; four incisors in the upper jaw, and two in the lower, the two middle ones in the upper jaw much the largest; hind legs long, and adapted for leaping; fore feet five toed, hind feet four toed; tail short or wanting. The gray rabbit is a hare and one of our most common species, doing great damage to gardens, and especially to nurseries and young orchards in winter, by barking the trees. They are easily trapped under a dead fall, or common, dark, box trap, by means of the ordinary figure four set of sticks.

HARICOTS. (See Bean.)

HARL. The refuse skin of flax and hemp.

HARLAN'S BUZZARD. (See Buzzard.)

HARPALUS. A genus of predaceous beetles. (See Beetles.)

HARRIERS. A breed of dogs used for hunting hares.

HARROW. A frame generally square or A-shaped, filled with teeth, used for the purpose of breaking down lumps, mellowing the ground, covering seed sown broadcast, and in destroying young weeds in cultivated crops. Among the later improvements in harrows for special purposes are the revolving and the smoothing harrow. The revolving harrow is so hung that upon being drawn forward, the frame in which the teeth are placed revolves, thus stirring the earth to a considerable depth. It frees itself of trash perfectly, and is a most useful implement. The smoothing harrow has the teeth slanting backward at a greater or less angle. Its work is superficial, but it is an excellent implement among young weeds and in cultivating crops. The cut shows one of the modern forms of the square harrow, the teeth of which may be made to slant back at will. The harrow will always be valuable however, for breaking up, and at the same time consolidating the lower surface of plowed soil. The drill and also superior modern pulverizing implements have, in a measure, superseded its use. It is, however, still indispensable on all farms.

HARTSHORN SPIRIT. Solution of ammonia. (See Nitrogen.)

HARVEST FLY. (See Cicada.)

HARVESTING. Harvesting is one of the most important labors of the farm, and must be attended to at the proper time whatever else may be in the way of the farmer. For this reason a diversity of crops, excessive hurry in this labor by extending it over a greater length of time than must otherwise ensue. Thus winter wheat, rye, spring wheat, barley, oats, and flax may succeed each other, and with the aid of improved harvesting machines, all may be secured in good condition, unless the season be extremely wet. The proper time of harvesting wheat has long been a mooted question, millers still contend that it should be cut when in the dough state, and there is no doubt but it makes more fine flour to the bushel of sixty pounds than does a bushel of perfectly ripe wheat. Nevertheless the yield per acre is less, the straw is harder to cure, and the price given no more per bushel, in our great markets. In harvesting the farmer is guided by the profit to accrue to himself, not to the miller. When the crop is large, the harvest must often necessarily begin early. and continue until the crop is dead ripe to secure all the crop. Hence the farmer must manage the harvest according to circumstances. The best time to cut wheat, all things considered is when the stalk is yellow half way up the stem, and the grain just out of the dough state and fairly hard. The straw is then valuable if well cured, and the grain in condition to dry out without shriveling. All the other grains, rye, barley, oats and flax should not be harvested before this time. Buckwheat is harvested just at the time of frost, or else when there is a maximum quantity of seed ripe, since this plant continues to grow, blossom, ripen, and drop its seed until killed by frost. Corn may be cut up at any time after the kernels are glazed, or out of the milk, the best time is after the grain is out of the milk and while yet the leaves are green, since the only reason for cutting up corn is to save it from frost or for the value of the fodder.

HARVESTING ICE. (See Ice Harvesting.)

HARVESTING MACHINERY. It is little more than thirty years since the first harvesting machinery was put into successful operation For years the work was not successful, until repeated failures, amended by improvements, resulted in the self-raking harvesters, and these again gave way to the self-binding reapers. It may now be safely asserted that harvesting machinery has nearly reached that perfection which human ingenuity may give it. In the harvesting of grain, the best machines cut the grain clean, and of uniform height, even when lodged, deliver it to the automatic binder, which binds and flings the sheaf on a platform to be dropped on the ground when the full number required for the shock is completed Thus, there is no gleaning, and the bundles are so evenly and tightly bound that there is little possibility of their losing straw or coming unbound. In the making of hay, in addition to machines that will cut at any desired height from the ground, the hay tedder aids in catching weather. The horse hay-rake first places it in windrows, and then into rough cocks. The hay sweep carries it, half a ton at a time, to where it is deposited on the stack by horse power. If the hay is to be carried long distances, the hay gatherer takes it from the windrow and carries it to the top of the load, and at the barn, the hay carrier conveys it from the wagon to any part of the mow. Thus, we have almost the perfection of economy in the making and harvesting of hay. Not only in the cheapness with which it is made but also, in the excellence of quality of the cured hay. It may be safely estimated that harvesting machinery has more than quadrupled the area of hay and grain, that may now be taken care of per man, over what could be done forty years ago. In newly settled districts, where help is difficult to be had, it has enabled vast areas to be yearly sown, without which machinery, these tracts would for many years have remained only partially cultivated.

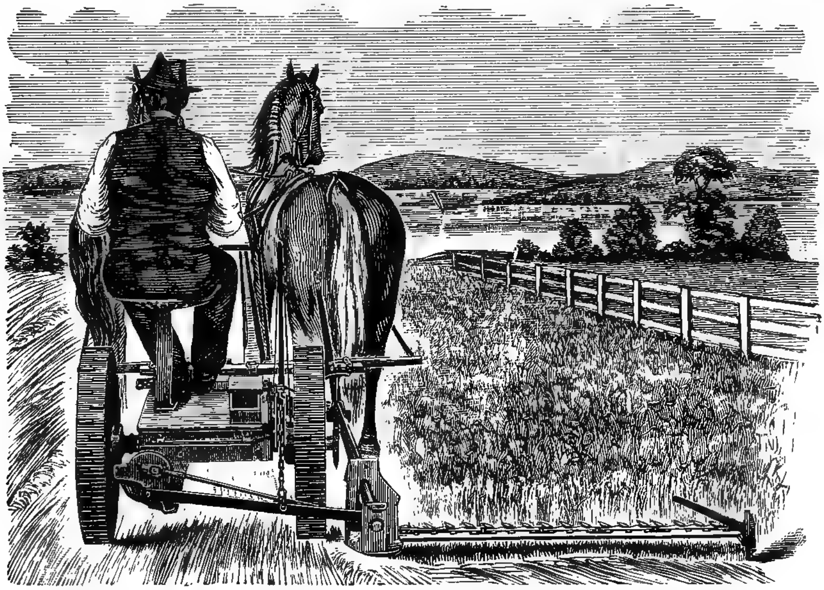
HASTATE. A descriptive term in botany; halbert-shaped.

HATCHEL. A carding comb or hackle.

HAUSTELLATES. Insects furnished with a proboscis for suction.

HAWK. The genus *Falco.* (See Buzzard.)

HAWTHORN. *Cratægus oxyacantha.* Probably every person who has thought about plants for hedging, has had a longing desire for the English Hawthorn, from the associations in his mind in reading about the beautiful hedges of England. Whatever it may do there, it is not adapted to hedging in the United States, especially in the West and South. Our common Buckthorn (*Rhamnus catharticus*) has also been tried extensively. Neither of these are of value agriculturally, except as specimen plants in large collections.



MOWING.

HAY. The hay crop of the United States is one of the most valuable in the list of agricultural products. Hence the necessity of making and saving it in the best possible manner. So difficult is this in moist climates, as in England, that various expedients, as constant stirring, after it is cut, and even artificial drying is resorted to. Tedding by machines or by hand, is indeed quite common in the Atlantic States, and is not unknown even in the West. Throughout the whole prairie region, however, the dry, hot weather usually enables the farmers to get up their hay in good condition, and in a state of greenness, as to color, unknown further east, and impossible in the climate of Great Britain. The hay is usually cut in the morning and laid into windrows, or cocked in the afternoon, from whence it is often drawn immediately to the stack or to the barn. It is not generally known, but is nevertheless the fact, that hay can be put into a barn much greener than into a stack. The reason is that in a stack there is easier access of air, and air and moisture favors the heating and fire-fanging of vegetable substances. In a mow the moisture ultimately finds its way to the top, which will sometimes be quite wet, while the body of the mow remains intact. The putting of hay, however, into the stack or mow in a damp state, is both in theory and practice to be reprehended. Under peculiar conditions of the atmosphere, hot, close weather, or continued moist weather, will cause the hay to heat unduly. sometimes to such a degree as to cause it to take fire. In England, this is not a very uncommon occurrence. The proper way is, if the hay shows signs of dampness in the cocks, and the weather is not such that it will become thoroughly dry in pitching on the wagon and into the stack, to spread the heaps, somewhat, an hour or two before hauling. If the weather is fine the hay will undergo a sweat in the heaps, and in two or three days come out perfectly cured. The same remarks will apply to grain. It should never be stacked until thoroughly dry. However dry either hay or grain is put into the stack or barn, it will always undergo a sweat. This usually lasts from one to two months, until the mass again becomes dry, when it will be found—if properly cured before putting away—to be perfectly sweet, with a pleasant odor, free from the dust of mold, and it will then keep intact indefinitely. During the progress of this sweat it should not be touched. Grain will thrash tough at this time, and hay is not fit for feeding until it has undergone this sweat. Thus, intelligent stablemen will not buy new hay, preferring to feed old hay until about the first of September or October. During this sweat hay will lose weight, ranging all the way from ten to twenty per cent., losing the former amount if put into the mow in proper condition. The yield of hay made from the cultivated grasses and clover, on good land, should be from one and a half to two tons per acre. The average product North will be far below this. Rhode Island produces the smallest average yield per acre, 80-100 of a ton; Oregon produces the largest average yield per acre, 1.45 tons; Iowa comes next with 1.42; then Illinois, Wisconsin, Nebraska and Minnesota with 1,40; Nevada, California and Missouri come next with 1.35 tons; and Michigan 1.30 tons per acre. All the other States fall below this. Even New York, with her superior cultivation, only reaches 1.15 tons per acre. Curiously enough, some of the Southern States present good averages. Thus, Virginia and North Carolina give 1.25; Georgia, Alabama, and West Virginia give 1.30; Mississippi, 1.35; Tennessee, 1.36; Texas, 1.38; and Arkansas, 1.40 tons per acre. It may be interesting to know that the hay crop of the United States, was about 31,000,000 tons in 1876, worth about $370,000,000. In 1877 it was 31,629,300 tons, worth $271,934,950. This was the product of 25,367,708 acres. The same year, the corn crop of the country aggregated 1,342,588,000 bushels, from 50,369,113 acres, worth $480,643,400. In 1879, there were 35,493,000 tons of hay made in the United States, from 27,484,991 acres, valued at $330,804,494, an average yield for the whole country of 1.24 tons per acre, worth an average of $8.60 nearly per ton, or an average value of $10.72 per acre. Thus, the reader will see that the hay crop of the country, acre for acre, exceeds considerably in value that of Indian corn. In 1878 the yield of hay exceeded that of 1877 not so much in acreage as in average yield, bringing the hay crop of the United States, in 1878, up to about 38,000,000 tons. The cutting, curing, and stacking of hay cost, in the New England States in 1869, an average of $4.51; in the Middle States, $3.76; in the Southern States, $3.22; and in the Western States, $2.93 per acre. With improved machinery and implements, the cost of making hay in the Western States need not exceed seventy-five cents per ton. We have seen it put into the cock for forty-five cents per ton, including cost of wear and tear of implements, and we once put forty-eight tons in the stack at a total cost of sixty-three cents per ton; the average yield being 2.25 tons per acre, the pitching on and off the wagon being done entirely by hand, and the haul averaging one quarter of a mile. It is considered that the produce of permanent meadows is more nutritious, ton for ton, than that of temporary meadows, mown only for a year or two in the regular rotation. This is particularly true of pastures. So also it is known that hay made from young grass is more nutritious than that made from grass nearly ripe. In practice, it has been found most economical to cut hay just after it has gone out of blossom, or, as it is termed, when in the second blossom, that is, just when the later heads are in blossom. This is from the fact that at this time the head and stalk contain its maximum of digestible matter, which decreases as the plant gets older, and accumulates more and more woody fiber. Below we give a table showing the composition of good pasture grass and meadow hay, and immediately following, a table showing the composition of clover and clover hay.

	Grass.	Meadow hay.
Water	68.23	14.61
Flesh-producing or nitrogenized substances	4.86	8.44
Fat-producing or non-nitrogenized substances	11.45	42.63
Woody fiber	12.60	27.16
Ash	2.86	6.16
	100.00	100 00

	Red clover.	White clover.	Clover hay.
Water	80.65	83.65	16.50
Flesh-forming substance	3.60	4.52	15.81
Fat-producing matter	13.78	10.26	37.63
Woody fiber			22 47
Ash	1.97	1.57	7.59
	100.00	100.00	100.00

On comparing these results with those of the analysis of the grasses before quoted, we notice that while the general composition is much the same in both cases, the clover contains, on the whole, more water, and at the same time more albuminous or flesh-forming principles, than the natural grasses.

HAY TEA. The infusion made by pouring boiling water over hay; it is one of the best known means of recovering weak animals. It will replenish the udder of cows, cause horses to urinate freely, and assists assimilation of food.

HEADLAND. A term applied to the lands or ridges in fields, on which the plow turns, or upon which the team turns in cultivating them. Headlands should not be allowed to gain in height by frequent plowings one way.

HEART. The central hollow muscle which receives the blood and drives it over the system. The heart is divided into two ventricles.

HEART WOOD. Duramen. The central, old, and colored wood of trees; it is the most durable.

HEAT. Agriculturally considered, heat is the force through which plants are enabled to grow and perfect their seed. In connection with this, however, there must be moisture and with moisture substances soluble in water proper to the sustenance of the plants. Thus under a given heat, or an average heat, extending through a certain period, we have the ripening point of the various crops cultivated for the use of man. Nevertheless heat and cold are merely relative terms. Thus, if we immerse one hand in cold and the other hand in warm water, and then successively in water of a medium temperature between the two, this water of medium temperature will feel cool to the hand taken out of hot water, and warm to the hand taken from cold water Again, the temperature of the body in health is constant, being about ninety-six degrees. When the temperature is much below this point, or when the body is suddenly cooled from artificial causes, we feel the sensation of cold. If, on the other hand, insensible perspiration is obstructed we are uneasy from the accumulation of heat, the act of perspiring being the natural refrigerating process among animals. In expansion by heat wood is found to do so chiefly in a direction transverse to its fibers, and but little in length. On the other hand iron expands in the direction of its length to such a degree as to force apart walls, when rigidly placed, and railway bars, unless spaces are left between, will expand to so great a degree as to be sometimes forced up in the shape of a semicircle. Again, the contraction of bodies upon cooling is often not so great as their expansion. Thus we find old fire grates, and iron when it is often strongly heated, much distorted. Heat is communicated in various ways, through particles in bodies, generally in two ways; in solids, by passing the heat received from particle to particle. This is called conduction. In fluids heat is communicated by being carried connectively, that is, the heated particles rise by their increasing levity through heat, conveying the heat and giving it out to other parts. Thus water heated from above, remains comparatively cold at the bottom, but heated from below the whole body comes to be of nearly a uniform temperature. In wood the heat conducting power bears no definite relation to its density. Thus birch one of the lightest of woods, conducts heat better than any other; oak, a very dense wood, conducts nearly as well, but iron-wood, a wood of great density, is a bad conductor of heat. Thus we see why some vegetable substances seem colder than others. Again, the conducting power of a medium has much to do with the sensible heat experienced. Thus, a metal heated to 120° may burn the hand, while immersed in water without motion at 150° it may not scald. So, also, air heated to 300° has been borne by the human body without injury. Feathers, down, wool and cotton, are bad conductors of heat. Hence their superior warmth as clothing because they prevent the escape of heat from the body. The order of their value in capacity being, furs, wool, cotton, silk and linen. The rays of the sun striking the earth produce sensible heat; part of this is absorbed by the soil, and part reflected back into space. The relative powers of absorption may be represented by lampblack at 100°, common glass will absorb about ninety degrees, and a highly polished metallic surface will absorb but six degrees. Therefore, practically a dark soil will absorb much more heat than a light one The relative power of soils to absorb heat giving the maximum temperatures of various earths exposed to the sun, both moist and dry, the thermometer 77° in the air, was found by Becquerel, to be as follows: the difference in temperatures between moist and dry being due to the heat spent in the evaporation of a portion of the water of the moist earth, an important point for the farmer to note in periods of intense heat.

Kinds of earth.	Maximum temp. top layer.	
	Moist earth.	Dry earth.
	Degrees.	Degrees.
Silicious sand, yellowish gray.....	99.05	112.55
Calcareous sand, whitish gray.....	99.10	112.10
Argillaceous earth, yellowish gray.	99.28	112.32
Calcareous earth, white............	96.13	109.40
Mold, blackish gray................	103.55	117.27
Garden earth, blackish gray.......	99.50	113.45

The following table, also from Becquerel, gives the relative retention of heat by different soils, that of calcareous sand being one hundred, and also the time of cooling from 144°.5 to 70°.2, the temperature of the surrounding air being 61°.2, of eighteen feet cubes of the same size of the different earths:

Kind of earth.	Capacity for heat.	Time required.
		h.
Calcareous sand..................	100.0	3.30
Silicious sand....................	95.6	3.27
Argillaceous earth	68.4	2.24
Calcareous earth............. ...	61.8	2.10
Mold..	49.0	1.43

Another noteworthy agricultural fact in relation to heat is, the amount of heat which falls upon a given surface depends upon the inclination to the different points of the horizon. A field, for instance, in latitude 40°, sloping toward the south, receives a greater, and one toward the north a less amount of heat; moreover, the former obtains more than an equal extent of ground parallel to the horizon, and the latter, as in the other case, much less. A field, also, which slopes in an easterly direction receives less heat than another inclined toward the west, inasmuch as more reaches the latter, since the maximum heat of the day takes place after the sun has passed the meridian; as it is, each of these enclosures gets a less amount than one of equal extent parallel to the horizon. A certain degree of heat is required to bring the sap of plants into active play, just as a certain amount of heat is required to produce germination in seeds, and each species of plants has its own determinate degree of mobility of sap or germination, as respects the seed. (See Germination.) Thus vegetation is accelerated and becomes luxuriant in presence of its maxima of heat, acting upon rich earth in connection with moisture. Hence, we see gardeners forcing plants out of season by means of heating material, in connection with glass structures, or by means of hotbeds and cold frames, and even by the protection of hedges, fences, and belts of timber. In relation to the heat of the earth, Pouillet, from many observations, gives the following deductions: The diurnal variations are not perceptible at depths greater than about forty inches. The mean annual temperature of the different strata differs little from the mean annual temperature of the air. The differences between the maxima and minima of the different strata decrease in a geometrical progression, while the depths increase in an arithmetical progression. From all the observations it appears that, at a depth of from twenty-six to twenty-nine feet, the annual variation is only 1°.8 Fahr.; at from forty-nine to fifty-two feet, it is but 0°.18 Fahr.; and at a depth of from sixty-five to eighty-one feet, it becomes only 0°.2 Fahr. At the depth of about twenty-six feet, or where the variation is 2° Fahr., the seasons are precisely reversed; that is, the maximum temperature occurs about the 1st of January, and the minimum about the end of June. In animal tissues heat is generated by the food we eat and the exercise we take. In vegetables chemical action produces but little heat, the heat of vegetables being principally due to the heat surrounding them and their varying powers of conducting heat. The following observations, collected from various sources, will show the researches that have been made from time to time in this direction: In the tissues of living bodies a multitude of chemical processes are constantly going on, engendering a certain heat, which in warm-blooded animals constitutes their temperature proper. But in cold-blooded animals and in vegetables, this chemical production of heat being very feeble, the temperature which they have comes principally from the ambient medium; not only from the air but also from the water, charged with different elements, which is sucked up by the roots in order to form the sap. Like that of the air, the temperature proper for vegetables is submitted to periodical variations, only its amplitude is much less extended. This heat is liberated in the leaves, organs of respiration, in the flowers, organs of generation, as well as in the green parts of vegetables. In the phenomena of nutrition, the ascent of sap can not be effected without a slight production of dynamic heat, nor afterward can its elaboration in the leaves, under the influence of light, take place without chemical reactions, and consequently without another liberation of heat. In fine, the whole of these chemical reactions are always accompanied by the production of heat, whose influence upon the vital functions of the plant we have not yet been able to appreciate. This estimation becomes the more difficult, as the production of vegetable heat is accompanied by many effects of cooling, such as evaporation from the leaves, liberation of oxygen, arising from chemical reactions which take place under the influence of light, and from which results a disengagement of carbonic acid. The first experiments undertaken to determine the temperature of the internal parts of vegetables do not go back much beyond eighty years. At that time thermometric observations did not possess that degree of exactitude which they have since acquired. None of the precautions necessary to protect the thermometers from atmospheric influences were then in use. Hence resulted a multitude of errors concerning the true nature of the internal heat of vegetables. In the first place Hunter's experiments, made in 1775, upon a walnut tree, by means of a hole which he had bored in it, in an obliquely downward direction toward the center. The sap of the walnut, which flowed abundantly, was frozen at 0° when it was drawn from the tree, although the temperature of the latter was lower. Why does the sap, he asked, preserve its fluidity in its natural channels much below zero? He cites the property possessed by water of freezing more easily when in a considerable mass, than when it is found in capillary spaces, where the attraction exerted by the sides upon the liquid molecules opposes their solidification. Indeed, Senebier has seen water remain liquid at 7° below zero in capillary tubes, with a diameter greater than that of the ducts of plants. Neuffer and Schübler have found that trees freeze with more difficulty, as their layers are closer. This circumstance contributes to give vegetables the power of resisting a high degree of cold. Rumford and Leslie have also made the observation that air being a bad conductor of heat when its molecules can not be displaced, must be the best envelope we can take to oppose refrigeration. It seems to result from this that the more layers possessed by vegetables the better ought they to resist cold. Such is the case with plants having a large number of epiderms, as the birch, which attains the highest elevation in the Alps, and advances farthest into the polar regions, and as the horse-chestnut tree, which flourishes in the tropical regions. Numerous observations have been made by Pictet and Maurice at Geneva, from 1796 to 1800, upon a horse-chestnut tree, in the trunk of which a hole had been bored on the north face to receive a thermometer. The results were as follows: During the five years from 1796 to 1800 the annual mean temperature of the air on the north side was sensibly equal to that of the tree. The annual difference between the two means being only 0.04 of a degree, we may infer that the mean temperature of the tree was strictly equal to that of the air. The difference between the monthly temperatures of the air and those of the tree was more or less sensible according to the season. During the winter months the temperature of the earth at a little over four feet below the surface of the ground is higher than that of the tree; in spring, it is the reverse. In summer, according to the year, the temperature of the earth is higher or lower than that of the tree; and in autumn it is always higher In general, it is toward autumn the temperatures are nearly equalized, but varying with seasons. Although the mean temperature may be the same in the air and in the tree, nevertheless, the variations that are met in the tree are much less than those in the air; the tree, therefore, preserves longer its acquired heat within limits depending upon its diameter. Another important fact shown by the Geneva observations is that the maximum of temperature in the air, according to the season, takes place from two to three o'clock p.m., while in the tree the temperature continues to rise, however feebly, from two o'clock until sunset, when the observations were ended. Thus the maximum in the tree appears later than in the air. Moreover we need only take the mean of the tree's temperature at sunrise and sunset in order to obtain almost exactly the mean temperature at two o'clock. During the three years, 1796, 1797, 1798, the variation of temperature through the night, in the air, was at a mean of 3.42, and in the tree of 0.73; that is to say, 4.69 times greater in the first case than in the second. In 1826, Halder advanced the assertion that trees are sometimes found in winter at a temperature below the freezing point, and pass even to a congealed state without injury to their vitality. The thermometer had descended almost to—15°, and —17°.07 in some young trees, without hindering their vegetation. Halder attributes to evaporation the lower degree of temperature observed in the tree. Rameaux has reached the following conclusions:—The temperature at any altitude at the center of the trunk of a poplar tree increases during the day and diminishes during the night; always differing in one section from another, according to the thickness. Before sunrise, and even for some time afterward, the central temperature decreases from the foot of a tree to its top. The contrary takes place during the rest of the day.—In the daytime, the temperature of a section is carried as far beyond the temperature of inferior sections as the ambient heat is stronger. These differences reach their maximum about sunset, after which they diminish gradually, are effaced little by little, and end by taking contrary signs.—During the night the temperature of any section was so much higher than that of the sections situated over it as this was lower than the ambient temperature. The differences reached their maximum toward sunrise, after which they diminished very rapidly, ending by taking contrary signs. In the morning, before sunrise, the central temperature of the tree in its four sections was inferior to that of the ground at the mean depth of its roots; during the day it was the contrary. Rameaux finally reached the following conclusion: Atmospheric heat, if not the sole source, is so predominant a cause of vegetable temperature that its effects weigh down all the other causes put together. Whence it follows that the temperature of a tree must, in each section, increase from surface to center during the daytime, when the ambient heat is highest; it must diminish, on the contrary, from centre to surface during the night. The author, nevertheless, believes that the temperature of the ascending sap must exert some influence equally with that of the air. In the polar régions we observe the same facts. The experiments made by Bravais, at Bossekop, and by Thomas, at Kaafiord, in the winter of 1839-40, have proved that heat follows in the interior of pine trunks the curve of the temperatures of the air, with a retardation of eight to twelve hours When the diameter of the tree was increased the retardation was greater. We can conclude from all these experiments, adds Becquerel, that cold penetrates to the heart of living trees, as to that of dead ones; that in the living pine the temperature throughout the greatest cold is a little more elevated, either because the sap sometimes rises even through mean temperatures of the air inferior to zero, and heats the interior of the tree by becoming congealed, or because the heat of the ground being superior to that of the air, gives the sap a portion of its proper heat. According to Becquerel, the observations hitherto collected upon the temperatures of vegetables, lead to the following consequences: The annual mean temperature of vegetables is the same as that of the air; the two curves of temperature have the same appearance, although not coincident throughout, considering that trees only participate in the diurnal variations of the temperature of the air in proportion to their diameters. The air is, therefore, the principal source of vegetable heat. The maximum of temperature in the air is reached in winter about two o'clock in the afternoon, and in summer about three o'clock; in vegetables these hours are delayed according to their bulk. In trees with a diameter of three or four décimètres (twelve to fifteen inches) the maximum occurs in winter about nine o'clock p.m., and in summer about midnight. When the temperature of the air sinks below zero, vegetables resist for a longer or shorter time this cooling, as well as the heating which follows a thaw, without being due to the bad conducting properties of the wood. When the cold continues during many months, as in the north of Europe, the temperature in the tree is successively lowered, but never as far as in the air. There is a difference of from one-half to a degree. The temperature of vegetables, which is almost wholly derived from without, appears, nevertheless, to be influenced by the heat liberated in chemical reactions in the tissues, and by the temperature of the soil from which their roots extract liquids to form the sap. We are still ignorant how, in winter, when the upward motion of the sap is almost suspended, the underground temperature may diminish refrigeration, although the external temperature is below zero. Trees exposed to solar and to nocturnal radiation, during the day and a great part of the night, heat the strata of air with which they are in contact, and cool them when the leaves have taken the temperature of the air before the sun has yet appeared. But its cooling effect is small under the latitude of Paris, at least during the spring, at which time the observations were made. Woods and forests probably exert the same influence, varied by divers causes; but they really act as repositories of heat when the trees receive the direct rays of the sun, which is principally from May to October. The air, as a transparent body, only stops a small part of the solar rays in their passage through it. These rays then proceed to opaque bodies, the earth, and to plants, which absorb a much more considerable part of them. Solar heat is, therefore, one of the principal elements which distinguish agricultural climates as they receive it more or less abundantly, either by reason of latitude or altitude of the localities, protection from winds, the exposure, or the topographical character of the soil, and of a multitude of atmospheric agents which reflect or intercept the solar rays. As an effect purely local, science at first neglected it; but the savants were not slow in perceiving the enormous influence of this solar heat upon the progress of vegetation, maturity of fruits, etc. Humboldt did not cease to remind us that solar effects must be studied in order to account for vegetable phenomena, and the Academy of Sciences of Paris has made it a subject of its recommendations to travelers. In 1840 Gasparin made some experiments upon three mulberry trees of the same variety, the first receiving full solar rays, the second receiving them only till noon, and the third kept entirely in the shade. The solid matter of the leaves of the first had a weight equal to 0.45 of the whole leaf, that of the second 0.36, and that of the third 0.27. In 1852 he cultivated beans on a plat of ground divided by a partition which shaded one-half of it from the solar rays. After drying, the plants from the south weighed 0.581; the same number of plants grown at the north, although much more developed in height, 0.337; but it was especially in their fructification that the difference was remarkable; the southern plants had one hundred and thirty-one pods, the northern only forty-seven. It is impossible, adds Gasparin, to attribute these results to a simple augmentation of heat; light enters into it for the most part, combining its influence with that of caloric. Indeed, in this experiment the plants had received in eighty-four days a sum of 1,286°.50 of atmospheric heat and only 255°.71 of solar radiation. Certainly an addition of 3°.07 of obscure heat received each day in a greenhouse could not have produced such results. The incontestable effects of radiation upon vegetation struck De Saussure, the great observer of the Alps, and he sought to estimate it by means of experiments upon heat condensed at the bottom of a glass box. Pouillet has estimated the quantity of solar heat which reaches the limit of the atmosphere at 1°.7633 per minute. By supposing the sun at the zenith, he has found for Paris the mean 0.7390 as the number of rays which reach the earth. Forbes has found in Switzerland 0.680, and Quetelet, at Brussels, 0.615. But what is especially important to know, for agricultural practice, is the quantity of solar heat which strikes opaque bodies and accumulates there, by the great principle of conservation of forces, together with the variable state of the temperature of these bodies exposed to the sun, on different days of the year and different hours of the day. When we see solar radiation produce effects so diverse in opaque bodies according to their nature, volume, figure, color, etc., we see how difficult it is to know what happens in each structure of the vegetable kingdom. Thus wheat struck by the sun acquires a temperature different from that of grapes or melons; the leaves, a temperature other than the stem, flowers and fruits, the parts dry or deprived of life become warm very differently from living bodies, whose surface constantly transpires, and whose heat never much surpasses that of the surrounding air. Another mathematical and astronomical question which must be taken into consideration, is, that the sun strikes the earth's surface more or less obliquely, and acts upon it according to the sines of the angle of incidence, and, while ovoid bodies are fully affected by these changes of inclinations, spherical bodies are not at all. We, therefore, perceive what importance this capital question has in regard to the amount of solar radiation received by the soil, by leaves or fruits, according to their extent and form, relatively to the law of the sines of the angle of incidence. A late report of the chemist of the Department of Agriculture, Washington, gives some facts in relation to loss of heat by radiation and the influence of water by evaporation, from which we gain the following: If we examine the tables showing the difference of the temperature of the air and the dew-point, we find that it varies widely with the relative proportion of moisture in the atmosphere. Thus, when the relative humidity is seventy and the temperature of the air is 70°, the difference between the latter and the temperature necessary to the formation of dew has been found to be 10°. When the relative humidity is fifty and the temperature of the air 73°, the variation becomes 20°; while if at the same air temperature the relative humidity be forty-three, the variation will be 25°. With the relative proportions of moisture here given, and with higher temperatures, these variations become still wider We see, therefore, that during the dry weather that often occurs during the summer months, vegetation suffers not only from deficient moisture to supply its demand, but also from very much wider variations of temperature due to radiation. Indeed, it is during the prolonged summer droughts that we generally notice the heaviest dews. Now, let us see what will be the temperature to which the plant must be subjected in consequence of this reduction due to radiation. Wells found that a thermometer laid upon a grass-plot on a clear night sank sometimes 14° lower than a similar thermometer suspended in free air at a height of four feet above the grass; and the observations of Pouillet seem to show that the diminution of temperature attending the production of dew is at all times sensibly constant at about the figure determined by Wells. Our summer-night temperature usually varies between 70° and 85° Fahr. With the reduction which must take place when the relative humidity is seventy, we will have temperatures ranging from 60° to 75°; with the relative humidity of fifty we will have temperatures of 50° to 65°, while with the relative humidity of forty-three, which could, of course, occur only during very dry weather, the temperature would fall from 45° to 60° Fahr. But these are considerably below the lower limits of temperature at which it has been found by careful observation the movements of protoplasm and the transformation of plastic material can take place, and which, for even half hardy plants as the *Phaseolus* (bean) and *Zea mais* (corn), is stated at about 61° Fahr. The lower limit for the more tender plants is doubtless much higher than this, so that it is easy to see how they may suffer and become debilitated by the cold of summer nights. But the germination of fungus spores and the growth of mycelium, may take place at a much lower temperature and during the temporary interruption of the transformation of plastic material, which must occur at the reduced temperatures mentioned. The mycelium of the germinating spore may effect penetration through the epidermis of the plant into the cellular tissue beneath, where it may feed upon the dormant protoplasm, which is already fitted for assimilation. This result having been arrived at, the recovery of the plant from the abnormal condition produced by the reduced temperature, which would otherwise take place, will be prevented, leaving the plant in condition favorable to the rapid growth and spread of the fungus even to the death of the plant. But while the discoveries of Wells and his colleagues showed under what condition radiation of heat from the plant into space and the production of dew could take place, they also showed how it could be prevented, and in this they give us a remedy for one of the possible causes of mildew and rot. They found, what is familar to all, that dew is not formed on cloudy nights nor in sheltered positions. Indeed, one of Wells' experiments to show that the radiation of heat took place, and that the formation of dew went hand-in-hand with it, was to arrange a board or piece of pasteboard on props and note the temperature and the production of dew in the grass below it and on some cotton wool on the top of it. He found that beneath the cover no dew was produced, and there was at the same time no reduction of temperature. In relation to the second cause of reduction of temperature, evaporation, we have seen how debilitation of the plant, due to an interruption of the vital processes by cold, may be produced. Quoting again from Sachs, we find that in the aërial parts of plants transpiration is an energetic additional cause of loss of temperature, inasmuch as water in the act of evaporation withdraws from the plant the amount of heat necessary to its vaporization, and hence makes it colder. If water upon a leaf be allowed to evaporate slowly, no injury results; but, if a current of dry air of average temperature, or even warm air, be caused to pass over it, a reduction of temperature will take place often greater than will occur in the production of dew.

HEAVES. This is a disease of the organs of breathing, caused by the rupture of the air cells, so the animal can not expel the air without a double effort. It is an unsoundness, caused by hard work especially on a distended stomach, and is aggravated by bad food, especially musty hay and grain. The disease is incurable, but may be palliated by feeding on sound, clean winnowed grain, with but little hay, and that entirely free from dust. The animal should be given but little water at a time, and should be allowed to stand an hour after feeding before being driven. Mild cases may be cured by a summer's run on the prairie, where resin weed (*Silphium laciniatum*) abounds. If to this be added each day for ten days, and then omitted for ten days, and so continued, the following prescription will much assist: One ounce of Fowler's solution of arsenic, one drachm extract of belladonna, and one-half drachm tincture of ginger, mixed with a pint of water and given at a dose.

HECKEL. An instrument for separating the fibers of flax and other fibers.

HECTIC FEVER. A fever occurring in debilitated persons, and also in animals, particularly the horse.

HEDGEHOG. The name of a genus of useful insectivorous mammals, (*Erinaceus*), of service to the farmer by destroying worms, slugs, and insects. They hybernate during cold weather in holes in the earth.

HEDGING. (See Fencing.)

HEELS, ECZEMA OF. (See Grease.)

HELIOTROPE. *Heliotropium Peruvianum.* This genus of plants, of which there are now many varieties, including of late some applicable to bedding, have no merit as to their foliage, but are cultivated for their peculiar and delicious perfume. From a supposed resemblance, in the bloom, to the odor of cherry pie, they have even been called, by some, by this name. The scent, however, comes nearer to vanilla, which again is the extract of an orchid. They are all green-house plants, but do well in the border, in the North, after the middle of June, if protected from wind, giving an abundance of bloom in the summer and early fall. In winter the plants should be kept in the house, rather dry, and when re-potted the tops should be brought into shape, and the roots somewhat reduced. When trained against the wall of a conservatory or green-house, the plant may be kept almost continually in bloom summer and winter, and increasing in growth yearly. Also a silicious mineral of a green color, with red spots; bloodstone.

HELIX. A genus of shell animals, including the garden snails; they are injurious to herbage, and may be kept off by sprinkling with lime, or destroyed by hand picking.

HELLEBORE. A genus of plants remarkable for their purgative properties. *Helleborus fœtidus* is a native of the United States; they are very dangerous and uncertain drugs, but useful as insecticides.

HELMINTHOLOGY. History of worms.

HELOPIDÆ. A family of heteromeran, coleopterous insects. Some of the species infest the bark and roots of trees.

HELVE. A handle.

HEMATITE. Iron ore.

HEMATOSIN. The red coloring matter of blood.

HEMATOXYLON. The red dye extracted from logwood.

HEMELYTRA. The wings of hemipterous insects; the upper wing-cases, half of which only is coriaceous, the rest being delicate.

HEMEROBIANS. Short-lived insects of the neuropterous class, resembling the May fly; they lay their eggs on plants, and the larvæ devour plant lice, and thus subserve the purposes of the pomologist.

HEMIGAMOUS. A descriptive term, meaning that one of two florets in a spikelet is neuter.

HEMIPTERA. Insects having four wings, the upper pair of which is only half coriaceous, or which are half horny and half membranous; they are haustellate. The larvæ have six feet, and resemble the imago; after a few moltings they increase in size and acquire wings.

HEMLOCK. 1. *Conium maculatum.* An umbelliferous plant, with perennial roots, flowering in July; branches much spread and dotted, leaves very compound. It is narcotic, and often injures cattle. 2. *Abies Canadensis.* As an ornamental tree it is not much used, in the West, not being adapted to prairie soils. An evergreen found in the northern portions of the United States and the British Provinces. It is a good timber-tree, and often attains very great dimensions.

HEMORRHAGE. A flow of blood caused either from an accident, or from a full state of body. In the case of wounds, if severe, it may proceed from a torn artery that should be tied with a ligature. Strong compression should be used, by means of deeply stuffing the wounds, aided when possible with a tourniquet, or handkerchief twisted tightly by means of a stick, as in the case of a limb. The tourniquet to be applied above and below the wound.

HEMP. The cultivation of hemp for its fiber was formerly an important industry in the middle-Western States; Kentucky, Missouri, Illinois, and Indiana raising large quantities of it. In 1850, the production was 34,871 tons and in 1860, 104,480 tons. Since then the cultivation of hemp has declined, wire cordage, manilla, jute, coir and other fibers having in a great measure supplanted its use. Land which will yield fifty bushels of corn per acre will produce about a thousand pounds of undressed lint per acre. The crop, however, is a difficult one to manage and heavy to handle. Hence, notwithstanding the fact that per acre it represents a greater value than most crops, the expense attending its preparation has caused its diminished cultivation.

HEN. (See Poultry.)

HENBANE. *Hyoscyamus niger.* An annual herb, black henbane, found in waste places. Neither horses, cattle, swine, nor sheep, will eat this plant. The whole plant is deadly to poultry, whence its common name; it intoxicates hogs, but cows, horses, dogs and goats are able to bear a considerable amount before they are affected. The leaves are active only in the second year of the plant; if scattered about buildings, they are said to drive away mice and rats. Henbane owes its medicinal properties to an alkali, *hyoscyamia*, which can be obtained in a separate state. It is crystallizable. Besides this alkali, the plant yields, by destructive distillation, an empyreumatic oil, which is a powerful narcotic poison. Of late years the extract is much used in medicines.

HEN-HAWK. (See Buzzard)

HEPATIC. Relating to the liver.

HEPATICÆ. A family of flowerless plants, resembling mosses, and growing in damp places.

HEPTANDRIA, HEPTANDROUS. Flowers with seven stamins.

HERBACEOUS. Of the succulent texture of an annual plant.

HERBAL. An account of plants; a collection of plants.

HERBARIUM. Literally a collection of dried plants. These may be arranged in books, properly named, or in cases, each according to its genera and family. Thus, in grasses, the cereal grains may be followed by meadow, and these by pasture grasses; or the several species of each genus, as triticum, in which wheat and couch grass both belong, may be arranged, following with the other genera of cereal grains and their representatives, and so through the whole category of plants to be saved, noting on cards attached peculiarities, etc.

HERBIVOROUS. Eating herbs; the ox, horse, etc,, are herbivorous.

HERD. 1. Applied to a number of cattle. 2. Applied to herding stock together in grazing.

HERD'S GRASS. (See Grasses.)

HEREFORD CATTLE. Hereford cattle, named from the county of Hereford, England, where they have long been the favorite cattle, have, within the last twenty years, gained an immense popularity in the United States, and now successfully contest the palm of victory with the best Short-horns at the leading fairs in the North. Massive, docile, fattening easily, and at an early age, with plenty of meat on the prime parts, possessed of hardy constitutions, they are, as with the Short-horns, possessed of all the good qualities that constitute a first-rate beef animal. They are especially regarded with favor in the great grazing grounds of the far West, for crossing upon the native stock there, and large numbers of the young bulls are yearly sent West from Illinois, Ohio, and Canada, for breeding purposes. One hundred years ago the Hereford, although an admirable animal for that day, were not bred to white faces; they were brownish or yellowish-red, some even being brindled. The illustration, page 181, will show the Hereford of eighty years ago, the cut being made from a picture of a Hereford of that day, in the possession of the editor. Gradually the white was made to extend along the top of the neck, also on the throat, dewlap, brisket and fore legs, belly and flanks. Then the feet were included, until we see the finished animal of to-day. The Herefords are undoubtedly allied to the Devons, and are among the most ancient of the distinct breeds of English cattle. The cows are not deep milkers, in fact they give but little milk, and are very much smaller than the bulls or oxen. In this latter characteristic they also resemble the Devons. The oxen are large, strong, honest, gentle, sagacious and long-lived. They work kindly in the yoke, and from their uniformity in color, are as easily matched as the Devons. The flesh is superior in quality, finely marbled with fat, heavy in the prime parts. The bulls are potent; when crossed upon the native red cows of the country, throwing the blood, both as to color, and general characteristics of the breed. Herefords are said to have been first brought to the United States by Henry Clay, in 1816 or 1817. They were, however, allowed to intermix with other cattle of the country, and were soon degenerated. An importation to Massachusetts, a few years later, left a favorable impress upon the stock of that State. In 1840, an importation of Herefords was made to New York and Vermont. In 1852, a very considerable importation was made into Ohio, where, with later importations, they have been most successfully bred, largely leaving their impress. In 1860 and 1861, importations were made into Canada, since that time successive importations and careful breeding have given the United States, and especially Maryland, Ohio, and Illinois, as fine herds of Herefords as are to be found in England. In England, the Herefords hold high rank, as they deservedly should, and in the great fairs there, as here, compete successfully with the best Short-horns. In the West, they are steadily gaining ground, and there are many who claim for them superiority over the Short-horns, as early maturing beef-makers. It is certain that they prove better on the butcher's block, and when we take into consideration the value of the full-blood and half-blood steers, as working oxen, and their wonderful constitutions, there is no reason to doubt that the time is not far distant when Herefords will be as common as Short-horns among the breeders and feeders of the flush pastures of the West. They are, however, too scarce and high priced in the United States for a full conception of their good qualities among the masses of our farmers. Turning to English authority, we find in the Agricultural Gazette of June, 1878, the following, in relation to the Herefords: This breed enjoyed the remarkable distinction of producing both the champion animals at Oxford, Grateful being declared to be the best bull, and Beatrice (a two-year-old heifer) being declared to be the best cow or heifer in the yard. Both, as may be supposed, were very good, the heifer pre-eminently so. She is a daughter of the famous bull Winter de Cote, and another instance of hereditary merit. The yearling heifers and calves indicate that this breed is, as beef-makers at an early age, quite up to the highest Short-horn standard. The Teeswater may milk better, and be more ready of adapting itself to local circumstances; but where the pasture is good, it is hard to beat the whitefaces for grazing. The editor of the Chamber of Agriculture Journal, writing at the same date, says of the Herefords: The Short-horn old bull class was both larger and better than usual. Last year it numbered but nine entries; this year the muster was thirteen, and they were headed by the crack bull of the period, Sir Arthur Ingram, Attractive Lad second. The yearling heifer class was a remarkably good one, as was also the heifer calf class. The old bull Hereford class produced an extraordinary animal in Grateful, who secured the reserve at the Hereford Show in 1876, but did not make his appearance at Bath or Liverpool last year. He has made wonderful development since appearing as a two-year-old, as is proved by the fact that Thoughtful, who was then placed above him, and has since taken firsts at Birmingham, Liverpool, and Bath, has now been put second to him; and that not only was he selected by the judges as the best Hereford bull on the ground, but in the contest for the championship succeeded in carrying it off, against such a Short-horn competitor as Sir Arthur Ingram. This is no slight honor to the Hereford breed, and of course any animal counted worthy of such a distinction, must be a first-class one. Grateful at four years old has capital loins and chines, with great thickness and depth of frame, and is very level all over; but his grand feature is the astounding mass of flesh with which his frame is covered. His girth is eight feet ten and one-half inches. In the cow class Lady Blanche, which took second prize at Bath, now came to the front position. She is marvelous at her fore flank, and displays a great mass of flesh on a well-shaped, grand frame, which, however, fell off slightly at the rump. The second prize cow, Little Beauty, was highly commended at Bath, and wonderfully retains her showyard merit at eleven years old. The two-year-old heifers, Leonora and Beatrice, were sure to win. Beatrice has recently reared a calf, which is slightly against her for showing; but Leonora is in full bloom with her beautiful head, symmetrical form, and all that loveliness which is so taking to the eye. After being selected as the best Hereford female on the ground, she carried off the champion prize against a remarkably shapely Short-horn heifer, and one of the best Devons, so that both cups were awarded to Herefords. On pages 478 and 479 will be found illustrations of an improved Hereford bull and cow.

HERMAPHRODITE. An animal or plant in which there is a real or apparent concurrence of the generative organs of both sexes. It is most common in plants, and is also found among some of the lower invertebrate animals. In the higher orders it is unnatural.

HERMETICALLY SEALED. Perfectly closed on all sides. Entirely shut up. As properly prepared cans of fruits, etc., are hermetically sealed.

HERNIA. Under the names of Burst and Rupture, is designated a protrusion of the bowels or their coverings, through an opening of the abdomen, and also sometimes, especially in pigs, a protusion into the scrotum. In young animals it is easily cured by bandages. Return the protruding part, carefully bandage it, using a pad or truss to cover the tumor or swollen part, being careful in returning the gut that it is not strangulated or bursted. The bandage must be worn for months, or until the rent in the walls of the abdomen is entirely healed. If there is strangulation the animal must be chloroformed, and in this case a veterinary surgeon should be called.

HERPETOLOGY. The natural history of reptiles.

HESPERIDIUM. In botany, a many-celled, few-seeded, superior, indehiscent fruit, covered by a spongy, separable rind; the cells easily separable from each other, and containing a mass of pulp, in which the seeds are imbedded.

HESSIAN FLY. *Cecidomyia destructor.* The Hessian fly is so called because it was supposed to have been introduced into America with the forage brought by the Hessian soldiers, of the British army, during the Revolutionary war. It is a two-winged fly, very minute, about a tenth of an inch long, generally two-brooded in a season, and which in some seasons is very destructive to small grain and grass. The means of protection by brining the seed grain, is not reliable. The surest means for their extermination is burning over all places where they may hibernate, such as dead grass stubble, corn-stalks, etc. (See also Fly.)

HETEROCEPHALOUS. In composite flowers, when some heads contain male, and others female flowers.

HETEROGAMOUS. When the spikelets of the same grass contain dissimilar sexes, or when the flower heads of compositæ contain florets with different sexes.

HETEROGYNIA. A tribe of hymenopterous insects, as the bee and ant, in which one female is neuter and another fertile.

HETEROMERANS. A class of coleopterous insects, having the first and second pairs of legs with five joints in the tarsus, and the third pair with only four.

HETEROPTERANS. A tribe of hemipterous insects, in which the upper wing-cases terminate abruptly by a membrane.

HETEROTROPAL. When the embryo of a seed lies across it, but does not point toward its base or apex.

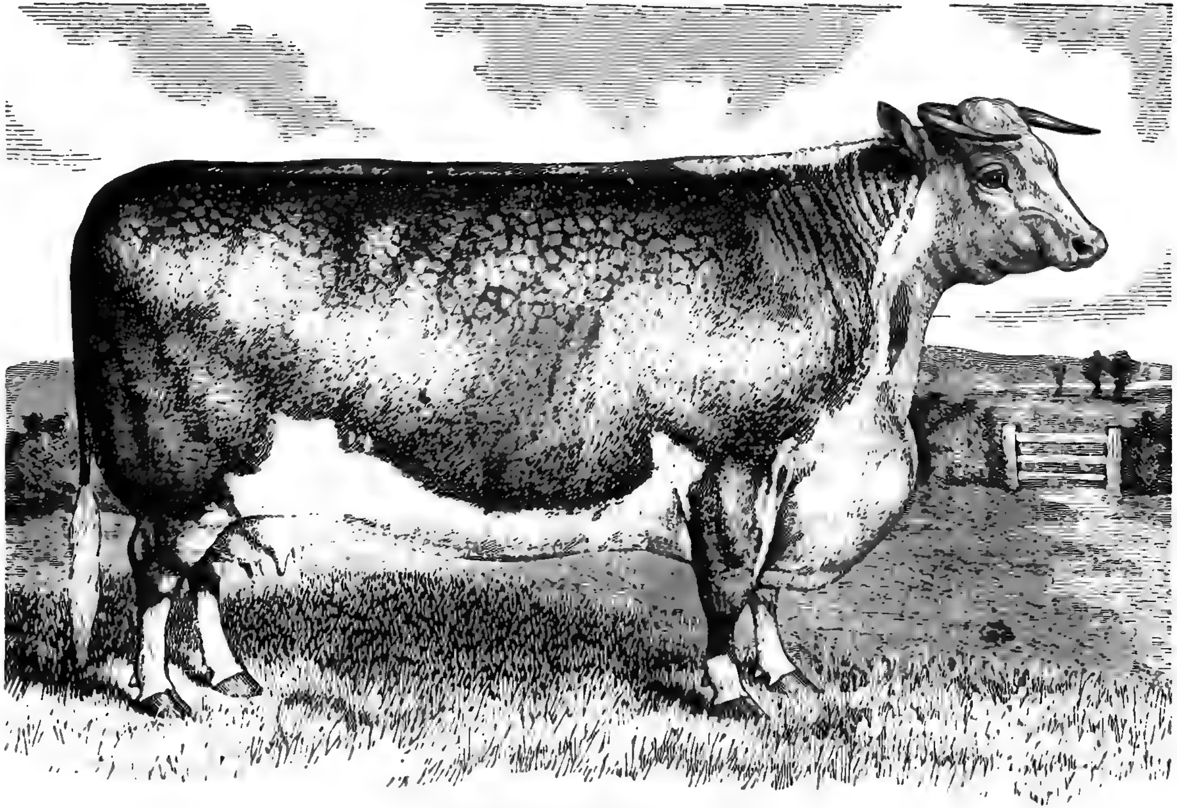
HEXAGYNIA. With six pistils.

HEXANDRIA. With six stamens.

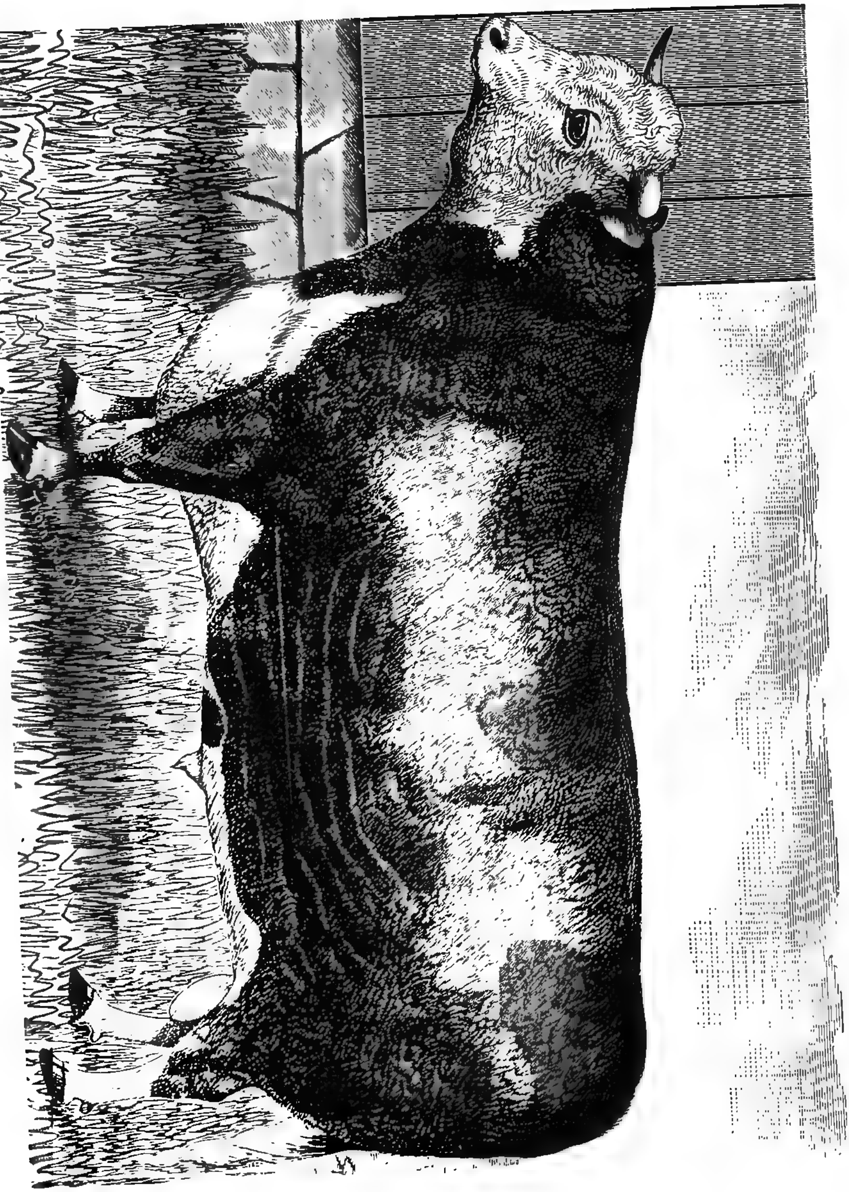
HEXAPODS. A tribe of wingless insects with six feet.

HIBISCUS. A genus of mucilaginous plants of the malvaceous family. (See Mallow.)

HICKORY. The hickory, *Carya*, of the order *Juglandaceæ*, is common in most parts of the United States, and is found exclusively on the American Continent. The species are the bitternut hickory, *Carya amara;* shell-bark hickory, *C. alba;* the thick shell bark hickory, *C. sulcata;* mockernut, *C. tomentosa;* pignut, *C. glabra;* and the pecan-nut, *C. olivæ-formis.* The different species grow in a variety of soils, never in wet ones, and resemble each other in the quality of the timber, and in the grain and quality of their wood. In the qualities of hardiness, weight, and strength, combined with elasticity, it is unsurpassed. The timber until thoroughly sea-

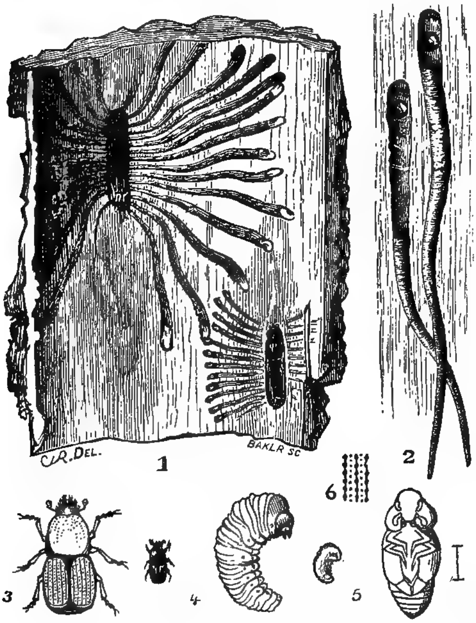


IMPROVED HEREFORD COW.



IMPROVED HEREFORD BULL.

soned, or if exposed to moisture is peculiarly liable to the attacks of insect borers, and is liable to decay in the presence of heat and moisture. For this reason, when wanted for timber, it is immediately peeled when cut, and seasoned in the shade as quickly as possible. The least valuable species for timber is the first mentioned, and the most valuable, all things considered, are the two next mentioned. The second growth of pignut hickory, however, is considered as being superior in strength and toughness, and is used for axletrees and handles for tools. The several species all ripen their nuts in the fall. The tree can not be transplanted except with great difficulty and loss. The nuts should be gathered and kept over winter by strewing in a slight trench, over them place thin inverted sods with a little earth over all, or keep them in boxes in moist sand in a cold cellar, until spring, when they may be planted two or three together where they are to stand, and all but one plant finally removed. Give clean culture until there is no longer danger of being smothered by weeds. If a hickory plantation is to be made, plant four by four feet, use the superfluous wood for poles, as they encroach on each other in growth, until finally the trees may stand thirty-two feet apart each way. At sixteen feet apart each way they may stand until nearly or quite one foot in diameter, since, the closer together, the taller and straighter will be the valuable part of the trunk of any tree. The hickory is subject to quite a number of insects, including leaf feeders, and especially borers. One of the worst of these is the Hickory Bark Borer, (*Scolytus four-spinosus*), a short oblong and nearly cylindrical beetle, called by Dr. Riley, *S. Caryæ*. It has short antennæ which terminate enlarged as in a club, the length is one-fifth of an inch; color black, with brown wing cases. The cut at 1, shows the burrows of the larvæ between the bark and the wood, growing wider as they diverge from the line where the eggs are deposited; 2, another view of the same, showing the hole made by the exit of the beetle; 3, beetle, both magnified and natural size; 4, larva, the same; 5, pupa magnified. The female beetle, says Dr. Cyrus Thomas, selecting the trunk or larger limb of a hickory tree, bores through the bark and forms a vertical chamber next to the wood from half an inch to an inch in length, on each side of which she deposits her eggs, varying in number from twenty to fifty. The larvæ when hatched feed on the inner bark, each one forming a track of its own, thus forming the radiating burrows so common on the under side of the bark of hickory trees. The larva is a soft, yellowish, footless grub, much like the larva of some of the curculios, and from which it can not easily be distinguished, except by its habits; it is very small, not exceeding the fifth of an inch in length when fully grown. The eggs are deposited during the months of August and September, and the beetle issues about the latter part of June or first of July. It attacks the bitternut, shell-bark and pignut, hickories, and probably the pecan. No practical remedy is known, nor is there much probability of any extensive experiments being made until forest timber becomes more valuable than it is now.



HICKORY BARK BORER. (See Hickory.)

HIDE-BOUND. Insufficient or improper food, especially if in connection with cold bad shelter, will occasion indigestion. There will be a rough staring coat, loss of condition, the skin will feel hard, and be stretched tight to the body, there will be shivering with or without shedding of the coat in patches; this is termed hide-bound. It might better be called a stingy man's monitor. The treatment is obvious. Easily digested food, a comfortable stable, blanketing, faithful grooming, and gentle alteratives occasionally to keep the bowels regular, should effect a cure.

HIDE, or HIDE OF LAND. An ancient measure of from 100 to 150 acres.

HILUM. The scar on a seed, where the funicle is attached, or where it is united with the carpel.

HIPPOBOSCA. A genus of viviparous, two-winged insects, which prey on horses and other animals; the forest flies are of this race.

HIPPURIC ACID. An acid existing in combination with soda, in the urine of horses, cows, and persons eating certain vegetables. It is separated by muriatic acid, and, when pure, is crystallized in silky needles.

HIRCIN. The fluid fat separable from suet, which gives it the peculiar odor resembling the smell of goats. By saponifying, hircic acid may be obtained.

HIRSUTE. Set with stiff hairs.

HIRUDINÆ. The tribe of leeches.

HIRUNDO. The genus of swallows.

HISPID. Set with minute spines, or stiff bristles.

HISTERIDÆ. A family of coleopterous insects with five joints on each tarsus, and belonging to the section of *Clavicornes*. They are peculiar from the quickness with which they feign death when in danger.

HOARFROST. Frost attended with the precipitation of much watery vapor. (See Dew.)

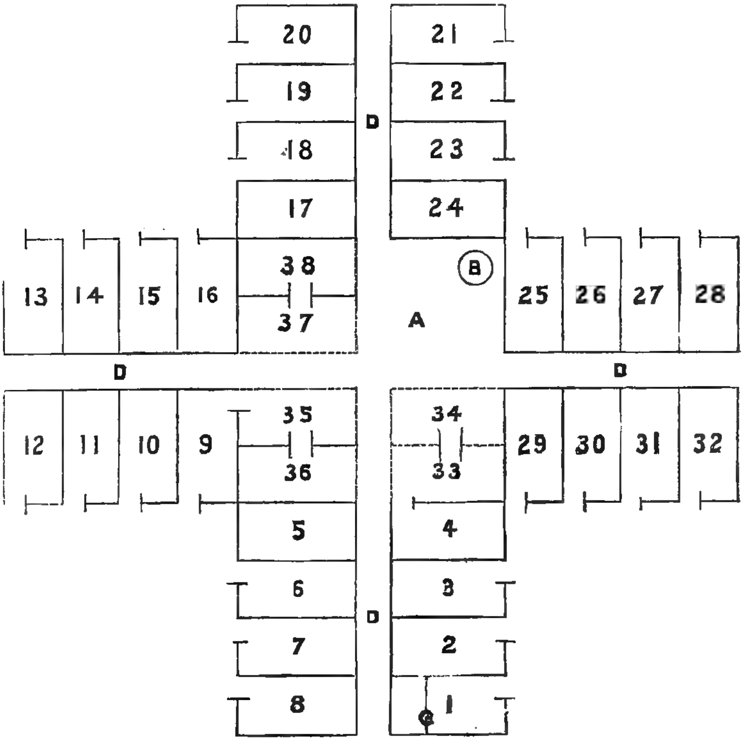
HOARHOUND. *Marrubium vulgare.* A plant formerly cultivated in every garden, the tea or decoction of the leaves being used for coughs, colds, etc. It is now a common weed in many places.

HOARY. In descriptive botany, covered with short hairs, so as to have a white or frosted appearance.

HOG. (See Swine.)

HOG CHOLERA. (See Cholera, Hog)

HOG HOUSE. In the breeding and rearing of swine, it is essential that they be kept from severe cold, and the attacks of insects. Nature has not provided them with a warm covering of hair. They are natives of warm climates where vegetable food may be found the year round. They are not fond either of great heat, since the sun affects their naked skin much in the same way it would that of man. Hence the care taken by the most intelligent breeders and feeders to provide them comfortable quarters, both summer and winter, one that may be partially darkened, in summer, and that will conserve heat in winter. Thus, by allowing them to take advantage of their natural instinct, in lying together in beds, they may be most economically managed. When but few are kept, simple pens, with enclosed places for sleeping may be provided. For fattening in autumn they may simply have a dry yard with a dark, close place in which to lie. When many are kept, the cheapest and best structure will be found a permanent one, containing an apartment for cooking food, pens for fattening and store hogs, pens for the boars and also the breeding sows. The best form is a central building, thirty feet or more square, and two stories high, the upper story to be used for grain and feed, the lower story as a cook room and for preparing the feed. From this central building wings are projected, on every side, twenty-four feet wide, and of sufficient length to accommodate the requisite number of hogs. These wings will allow pens to be made on each side of a passage way from which the hogs may be easily fed from a tank on low wheels. A yard should be attached to each pen, to which the hogs can have access at will. The outline ground-plan annexed, will give a good idea of a hog house or stable, where economy of space is connected with the best and most perfect system of feeding. The pens should be eight by ten feet, with door to yard outside and a suitable feeding trough next the passage way. These pens are kept bedded, and are to be regularly cleaned into a truck running in the passage way, and thence transferred to a wagon at the end doors, which also serve to take in feed, etc. This central building may contain eight pens, and each wing as many as may be desired, although ten pens in each wing is as much as can usually be considered economical. A, shows central room; B, cooking apparatus; D, D, D, D, passage way.



HOG HOUSE.

HOGSHEAD. An old measure containing sixty-three wine gallons A large barrel in which sugar, tobacco, and coarse produce are packed, containing from ten to fourteen cwt.

HOLCUS. The genus of soft grasses. (See Grasses.)

HOLERACEOUS. Culinary plants, potherbs.

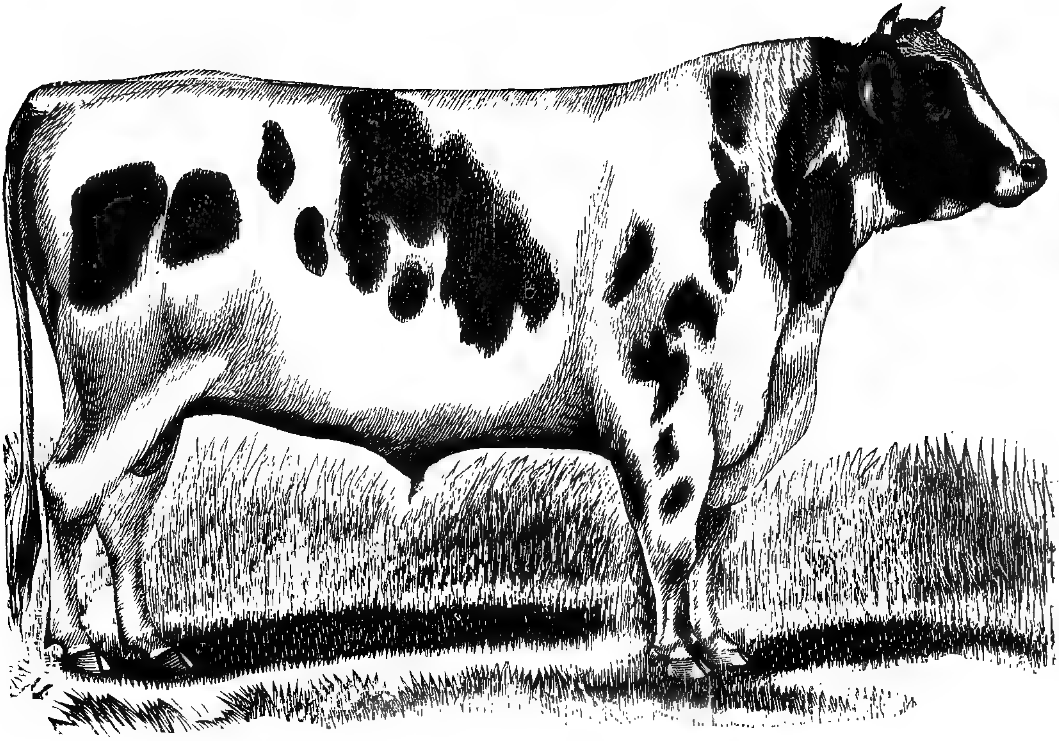
HOLLOW HORN. Anæmia in cattle, or horn ail, is more often produced by hollow belly, as it has not inaptly been termed, than by all other causes whatever. It is the twin with hidebound' in horses, and is produced by the same causes, want of care and an unthrifty condition of the animal. It should be unnecessary to say that boring the horn, and pouring turpentine or other nostrums into the hole, splitting the tail, etc., is not only useless, but brutal. Give the animal a quart of linseed oil to clean out the bowels. If diarrhœa ensues check it with astringents; keep the animal warm, and give plenty of nourishing, easily digested food. As an assistant, give as a tonic, daily, two drachms sulphate of iron, one drachm powdered nux vomica, and one ounce of powdered gentian. Give in dry food, or as a drench in a quart of water or gruel, allowing it to trickle slowly down into the stomach.

HOLLY. *Ilex.* There are several species. The European Holly is not hardy much north of Washington. Our native holly (*I. opaca*) is hardy and beautiful.

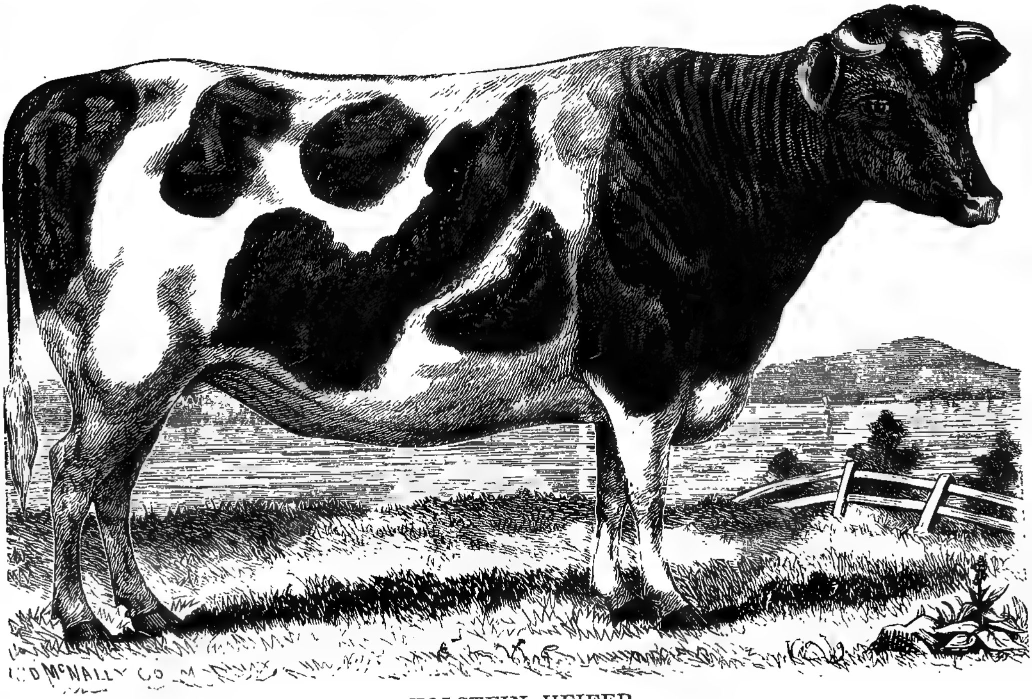
HOLLYHOCK. A biennial plant, *althea*, of which there are now many beautiful varieties, various in color, entirely double, and valuable for floral decoration in baskets, saucers, and other floral work, where very short stems may be utilized.

HOLLY OAK. *Quercus ilex.* A European species.

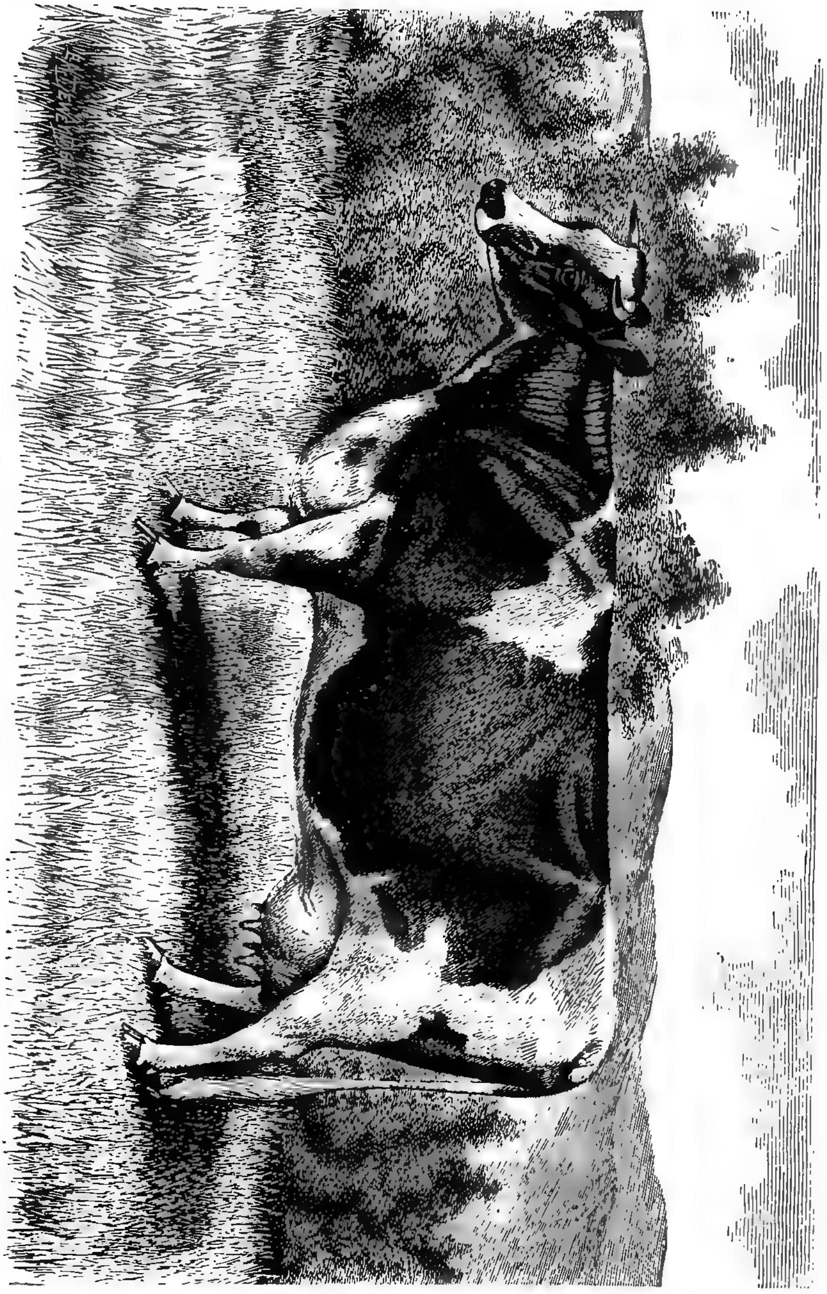
HOLSTEIN CATTLE. Within the last ten or fifteen years Dutch cattle, now generally called Holsteins (from the name of the country whence the principal importations have latterly been made,) have, in the West, grown into great importance. There, on the flush prairie pastures, their yield of milk, rich in curd, is most extraordinary. It is undoubtedly true that Dutch cattle were among the first cattle brought to America, for the reason that the Dutch were among the first settlers, and it is quite a supposable case that they would have been as likely to have brought their best breeds with them, to New York and New Jersey, as did the French their breeds to Canada, or the English to the New England and the Virginia Colonies. Hence, since the English first settled in Virginia in 1607, and the Dutch in New York in 1614, the presumption is evident that they brought the cattle of their native country with them. Indeed there is a record that cattle were imported by the Dutch in 1625, and that they were of the Dutch breed is more than probable, since these cattle were noted for milk and labor, the two prime necessities in any new settled country abounding with game. Where this wonderful race of Short-horned cattle first became broken up into the various sub-families, that are now generally recognized is not known, neither would it be interesting to follow. It, however, seems certain that within the last three centuries systematic attempts began to be made to breed them with a view to permanent improvement by fixing characteristics, that were specially desired to be perpetuated. It has resulted in fixing a breed of superior excellence as dairy cows, giving extraordinary messes of fairly rich milk. If, besides this, we take into consideration the fact that the Holsteins fatten kindly, when not giving milk, and to heavy weights it is not surprising that they should have become so largely sought after, especially in countries of flush pasturage, where dairying is one of the dominant agricultural industries. The hair of the Holsteins is short, soft, and fine. The skin is good in texture and of moderate thickness, fairly mellow to the touch, and their general form is that of great milking quality. The udder being extremely capacious, having great depth and breadth, with prominent milk veins running well forward, and with good sized teats standing well apart. The color should be pure white and black, either banded, pied, mottled, or else spotted over the body. The fashion, however, of to day, is against mottled and spotted, and in favor of distinctive markings, as shown on pages 484 and 485. The bull and heifer showing the spot peculiarities, and the cow the solid markings. Holsteins, or Dutch cattle, as a distinctive breed of milking cows, were introduced into the United States early in the present century, but the pure blood was soon lost. Sometime between 1820 and 1825, Mr. Herman Le Roy, a merchant of New York, imported some improved Dutch cattle and kept them on his farm near the city. Mr. L. F. Allen describes the descendents of these cattle in 1833, as being large, well spread, black and white, and remarkable for their uncommon yield of milk. This herd, however, was eventually scattered, and became mixed with the ordinary stock of the country. The first record of pure bred animals, the descendents of which have been kept so, seems to have been the importation of Mr. W. C. Chenery, of Boston. The first in 1852, being a single cow. In 1857, this gentleman made a further importation of a bull and two cows, followed, in 1859, by four other cows. Unfortunately some of the animals were infected with contagious pleuro-pneumonia, and with the exception of a single bull, the entire herd was destroyed. In 1861, Mr. Chenery made another importation of most superior animals, from celebrated milking herds, officially guaranteed by the authorities of North Holland, where they were bought, and the importation and their descendents were recognized as being high class milkers. There has been considerable controversy, of late years, as to the proper name to be applied to this breed of cattle, and it has been asserted that the Dutch cattle are descendents of cattle originally bred in Holstein. This is probably incorrect. In Holstein, (North Holland) however, more care seems to have been taken in breeding and selection. And from the fact that not only the original Chenery stock were brought from North Holland, but the principal importations of late years, the name Holstein has now generally come to be recognized, and undoubtedly for the reason that sagacious American buyers wisely acknowledged the greater uniformity of these cattle over those of the other strains of Dutch cattle. As giving facts in relation to these cattle, however, we append the conclusion of a letter, or rather elaborate statement, succeeding a previous letter, by Prof. Hengeveld, teacher at the Netherland Royal Veterinary Institute, Utrecht. This was written to Mr. Charles Mueller, United States Consul, at Amsterdam. Prof. Hengeveld takes exceptions to statements in the Holstein Herd Book, and after citing authorities to show that the Holsteins are descended from certain Dutch cattle, never, we believe, seriously questioned, concludes with much interesting testimony, valuable as giving very early history, showing among other matter much valuable information on various sub-families of cattle of the North of Europe. The extracts are as follows: According to the Allgemeine Deutsche Real Encyclopedia, the origin of Holstein-Schleswig lies buried in obscurity, and Holstein was probably visited by the Cimbri, while, a century after, the Roman Emperor Cæsar Tiberius arrived with his army and fleet before the mouth of the Elbe, without, however, setting foot on the Holstein shore. According to Tacitus, it may be stated that the Holstein Baltic coast was inhabited, as far as Mecklenburg and Schleswig, by seven petty German tribes, of whom the Angles and Warnes have preserved their names down to the present time, while the others have been melted down into that of the Saxons. In the fifth century, the Saxons and Angles united with the Jutes and Friesians, and migrated to England. (This is Low's colonization.) Subsequently the Holstein Saxons, who dwelt to the north of the Elbe, were called by the name of Normans, while the name of Holstein is not mentioned in history before eight hundred years after Christ. In 1128–'64, the Holstein province Uagrien was conquered and converted to Christianity, and partly peopled with strange colonists from Friesland, Holland, and Westphalia. The first Dutch colony in Germany, then called by the general name Thuringia, dates back as far as the year 528. From 801 to 864, St. Anskar, primate of Bremen, Hamburg, Holstein, etc., himself of Flemish birth, attracted many of his countrymen to those northern regions. Charlemagne also colonized Flemish peasants in the region adjacent to the shores of the Elbe. That stretch of teeming lowlands east of Bremen to the Baltic wore a vastly different face in those early days. Marshy and uncultivated, the coast edge of those parts stood exposed to the tender mercies of the sea to such a degree that even a slight breeze would suffice to cause immersion; while the inhabitants, through intestine wars, demoralized and habituated to strife and broil, evinced but little aptitude for the peaceful pursuits of husbandry. It was then that the attention of German princes was drawn to Holland, where similarly-situated regions had been brought to a high state of productiveness. The great tide of migration, however, did not set in till the twelfth and thirteenth centuries, from which period the origin of the fine grass-lands along the Elbe and the Weser must be reckoned. From these historical statements, it already appears that, with regard to its fitness as a grazing and cattle-breeding country, Holstein is of later date than Holland; which fact will appear the more prominent after some account has been given of the oldest inhabitants of Holland, and their pursuits. For this purpose I at once direct the attention of the reader to the coming of the Friesians and Batavians. The former were the oldest inhabitants of Holland, and were known as herdsmen, hunters, and fishermen Their history in this country goes as far back as three hundred years before Christ. The Batavians came down the Rhine two hundred years after, or one hundred years before Christ; and although they were likewise herdsmen, they occupied themselves more particularly with hunting and fishing. The lands of the Friesians comprised the whole country to the north of the Rhine as far as the shores of the North Sea, to which West and East Friesland belonged, composing the present Dutch provinces of Groningen, Friesland, Drenthe, and North Holland, besides the provinces of Utrecht, Overyssel, and a part of Gulderland and South Holland. Of all these provinces, Groningen alone appertained to East Friesland. Tacitus says of the Friesians and Batavians: They owned cattle not exceeding in beauty but in number. He further states, as does also Julius Cæsar, that the Friesians and Batavians paid each other in cows, sheep, and goats, and gave likewise to their children, as dowry, oxen adapted to the yoke and plow cattle, and horses. When they were subdued by the Romans in the first centuries of our era, the conquerors derived much advantage from this wealth in cattle, and imposed upon the Friesians an annual tribute, consisting of cowhides and meat, while they chose their most valiant warriors from among the Batavians. The Friesians and Batavians applied themselves to the draining of their marshy lands and their islands; created meadows on the reclaimed soil, while the first protected against inundation by raising hills, breakers, and dikes, of which the traces are everywhere discernible along the coast throughout West Friesland and Groningen. Something is even known regarding the color of their cattle, namely, that they held those white in religious veneration. It is a very plausible theory that the Friesians, who, at as early a date as three hundred years before Christ, peopled the north of the present Netherlands, and wrought those alluvial plains of Scandinavian clay into soil fit for the requirement of their cattle, did, in after centuries, spread themselves in more northerly and easterly directions as far as the Elbe; as we already know they did, in the fifth century, unite with the Jutes and Anglo-Saxons in emigrating to England; in addition to which, we must observe that these were probably East Friesians and not West Friesians. The East Friesians from Oldenburg and the country near the Elbe, both south and north of that river, were compelled, through the inclemency of those regions, then in their original condition of low, alluvial swamps, inundated at every tide, to desert them. It was owing to these local circumstances that the Romans were prevented from endeavoring to land their army. It can be shown that the inhabitants of this territory were unable to make sure provision for their own wants, because of the robberies and piracies committed by the Normans, dwellers on the west coast of Denmark, people from Holstein and Schleswig, Jutes and Angles. These were by no means peaceful breeders of cattle, as were the Friesians and Batavians, whose land they constantly plundered and laid waste, burning and ravaging their possessions, massacring the inhabitants, making them pay tribute, penetrating far inland to the mouths of the Rhine and Yssel, and everywhere giving unbridled vent to their ferocity and love of plunder. This was between the eighth and eleventh centuries. Giving due weight to these statements, which, from the nature of the case, must necessarily be brief, it can not be doubted that the cultivation of cattle in the Netherlands existed a long time before such a thing could ever be thought of in Holstein. It is also quite as certain that the colonists from Friesland, Holland, and Westphalia carried with them their cattle to Holstein. Hence we see that, first, the



YEARLING HOLSTEIN BULL.


D McNALLY CO.

HOLSTEIN HEIFER.



MODEL HOLSTEIN COW.

Dutch race of cattle date from an older descent than those of Holstein, while, probably, second, the Holstein cattle originated from the Friesian breed, and from that of the Dutch and Westphalian emigrants. After this colonization, we have our attention directed to another remarkable particular in the history of the Dutch cattle-cultivation. The Herdbook, unable to maintain the priority of the name Holstein from an earlier history of Holland and Holstein, might then, perhaps, seek its testimony in a later period, and the events to which your attention is now called. From the fourteenth on till the eighteenth century a large number of Danish oxen were annually turned for pasture into the grassy meadows of North Holland, formerly West Friesland, and sold at the weekly North Holland cattle-market. The oldest of these cattle-markets is that of the city of Hoorn. This market was already established in 1311, and, in 1389, the Danes and inhabitants of the Eyder were allowed by Albrecht, Duke of Bavaria, to hold a weekly market there. In 1605, the Danish cattle-market was removed from Hoorn and transferred to Enkhuyzen, where, in 1624, the number of 1,179 oxen were sold. There was also in Amsterdam a lean cattle market, beginning in the spring, in the month of April, but held at irregular periods, depending upon wind and weather, when cattle were allowed to be conveyed from Denmark and Holstein hither to graze. These were mostly brought by vessel. These importations of Danish and Holstein cattle into North Holland, to which the Herdbook might refer, did not consist of heifers, but of lean oxen, which were pastured on the fertile meadows of the Polders, and afterward sold at the markets of Hoorn, Enkhuyzen, and Amsterdam as fat cattle. As to heifers, either then or now, having been imported from Holstein into Friesland and North Holland for breeding purposes, no such thing is known. To withhold nothing and to put nothing in a distorted light, we may add that in the middle of the eighteenth century several importations took place into Friesland of Danish cattle, consisting of young calves. This was at the time of the raging of the cattle-plague, which desolating disease carried off thousands of the finest cattle in Friesland and Holland. For the purpose of keeping the cattle-trade alive, and to fill the places of those destroyed by the plague, small Danish breeds and German cows of a diminutive size were substituted and crossed with the remaining and recovered natives. They were, says Scheltma, Danish-Holstein and small German cows, of which the greater part were smaller in size than the native race. We also find that one was reduced to the necessity, in 1769, of purchasing the needful cattle in the county of Bentheim, in the districts of Oldenburg and Munster, in Hanover, and other parts of Germany. In the work, Present State of Friesland, it is mentioned, that owing to the cattle-plague, the people were compelled to import from abroad all kinds of small cattle, chiefly Danish. But, what was remarkable, however small and ill-favored these animals might be, when compared with the handsome Friesian horned cattle, as a natural consequence, an improvement of food induced a favorable development of body, and, from the mixture of the two breeds, good and choice milch-kine were attained within two or three generations of the introduction of the foreign blood, no matter how much the race had in the beginning deteriorated through the process, and, eventually, the type of Danish and German cattle was quite lost. This is, however, more than one hundred years ago. A fair consideration of what has been thus far stated will leave no justification of the Herdbook's imputation upon the antiquity and purity of descent of our Friesian or Dutch cattle, or its assumption that they are of Holstein origin. No, the genealogy of Netherland cattle is pure and unadulterated, and it is at least two thousand years old. I come now to the present time, and the question whether it is tenable to give to one variety of cattle the name of an entire group, and to reckon as appertaining to it all its several varieties or breeds, as, for instance, the Dutch, Friesian, Oldenburg, Holstein, etc., and would it not be imperative in such a case to give it the purely historical name by which it is generally known? If it could be desirable to give a general name to the cattle of the just-mentioned districts, then that of Holstein cattle would not be appropriate, and for it should be substituted that of Friesian cattle, whence all the varieties originated. The chief characteristics of this Friesian breed—its eminent milk-giving and fattening qualities—we find in all the just-mentioned districts, and extending still further southward, with this difference, however, that wherever the land is more fertile, the climate milder, and the tending, feeding, and breeding of the cattle observed with more care, in that measure, and according as these requisites stand to each other in the closest proportion and harmony, they are more developed, attain larger size, and are of a finer texture. If the intention be to convey a correct understanding of the true qualities of the several varieties or breeds mentioned in their own dwelling-places, it is better that each breed should retain the name by which it is known, and that no collective name, though an historical one, should be given them. In order to be able to readily classify a group of cattle of great extent, possessing the same chief qualities in form, Strum proposed, so long as fifty years ago, to give to a group, subject to the same conditions of soil and climate, a name indicating those conditions, and thus originated the designations mountain cattle, highland cattle, and lowland cattle. He also heads each of these divisions by the breed best representing the distinctive feature of its class, as its type. It is under the denomination of lowland cattle that he places the different breeds of cattle of the coast-lands along the North Sea. Schmalz, Pabst, and many subsequent writers, adopt this classification—some with a few modifications; but all find in the physical characteristics of the country to which they are indigenous, the general denomination of the collective group. According to Schmalz's statement, cattle, adopting Strum's classification, may be distinguished in the following manner: A. Lowland race.—Primitive cow; Dutch Friesian cow. B. Mountain race.—Degenerate; quite the contrary of A; Swiss cow. C. Middle race.—Highland race; forms the transition from A to B; Frankish cow. Schmalz says: To the race A belong the Dutch, as representative, the Friesian, the Oldenburg, and chiefly all lowland races, bearing the peculiar characteristics which identify it with the place of its sojourn. This is a purely natural division, and there is not the least arrogance in asserting, what history points out, that the Dutch cattle constitute the type of the oldest, purest, and best breed. All other varieties are of less intrinsic value; they are coarser or smaller, possess less productive qualities, though of local excellence in their native places. If cattle of the genuine breed are bought, imported elsewhere, and there bred, why is it not called by its native name, and why must an appellation be given to it quite foreign and unknown to it. One hears in Europe of lowland cattle, but purchases of them for the purpose of improving other breeds have, for the last hundred years, been only made in the chief Netherland provinces, where the choicest cattle of the lowlands are found. Thus, thousands of Dutch and Friesian cattle are annually sent abroad under the name of Dutch cattle. Finally, I beg to add quotations from Dr. George May, director of the agricultural establishment at Weihenstephan, who visited Holland about ten years ago. The Dutch cattle constitute the type of the properly so-called lowland race, which extends throughout Netherlands, Flanders, Normandy, Oldenburg, and Denmark. Further on he says: The Oldenburg cattle descend from the Dutch race, and are likewise distinguished as East Friesian cattle, as still partially found in Hanoverian Friesland. In the adjacent parts of Bremen it is called Bremen cattle. The Holstein and Breitenburg cattle in the Wilster and Rempner marshes are equal to them, but with respect to their square build, the Breitenburg cattle are, in their properties, more like the finer Dutch cattle. To return to the Holstein: as milking cattle, they are wonderful; as cheese makers they are superior, as butter makers, they do not stand the test so well. In fact Holstein breeders always tell how much milk their cows will give; the Ayrshire men, how much milk, butter, and cheese, their cows will make; the Jersey owners, how much butter and cream to the quart of milk. To show that the Holstein is not a butter cow the following is deduced from a table published by the London *Agricultural Journal*, the results of tests made by Mr. Amersfoordt, of Badhoeve, most competent authority, in the Lake of Haarlem, Holland, who tested the milk of forty-six cows in June, and forty-nine cows in November, with Prof. Fesser's lactoscope, which is claimed to give a close approximation to the actual fat in milk. In the table made by Mr Amersfoordt, the yield of each cow on the 15th of June and the 24th of November, is given, with the percentage of fat. The average yield of forty-six cows in June, is 13.87 litres, or thirty-one pounds each, and the percentage of fat 5.217. Six of the largest milkers gave 20.2 litres, or forty-six pounds per day, with 5.2 per cent. of fat. On the 26th of November, forty-nine cows gave an average of 6.24 litres, of 13.92 lbs., with 6.32 per cent. of fat. The largest percentage of fat was 7.50. If the lactometer of Dr. Fesser is accurate, this shows that the Holsteins give milk as rich as our native cows, whose milk will yield five per cent. of butter, on flush grass in June, and seven per cent. in November. So, considering the noble milking powers of this breed, and their well known ability as cheese makers, their outcome in butter should be considered satisfactory, in consideration of their many valuable qualities, for milk, beef and labor.

HOMESTEAD. The regular arrangement of farm buildings, including the house.

HOMINY. Corn, usually of the smaller white flint kinds, bruised in a hominy mill or a mortar until the external covering is removed and sifted. Samp is corn broken coarsely in a mill.

HOMOGAMOUS. When all the florets contain both sexes.

HOMOGENEOUS. Bodies, all the parts of which are similar in composition.

HOMOLOGOUS. Having the same ratio or proportion.

HOMOPTERA. The name of an order of insects, including those in which the wing-covers are of a uniform semi-membranous consistency.

HOMOTROPAL. In botany, having the same direction as the rest of the plant, or that part to which it belongs.

HONEY. Honey has been regarded, from the remotest ages, as a product of the first importance to man. Wild honey is eagerly sought by savage and barbarous tribes, and bees have been kept from the earliest ages by civilized man. Honey is the saccharine fluid of flowers, gathered by bees and deposited by them in the cells of the waxen combs. Honey undergoes slight modifications in the honey-bag of the bees, but although somewhat changed chemically it retains the flavor, and to some extent the aroma of the flowers from which it was gathered. Under a powerful microscope the pollen of the plants, from which the honey was gathered, may be, it is said, detected, and thus often referred to the plant to which it belonged. Hence certain districts have become famous for its honey, as Mount Ida, in Crete, and others again are noted for the poisonous quality of the honey, as that of Trebizond. The substances recognized in honey, are grape sugar, manna, gum, mucilage, extractive matter, a little wax, pollen, acid, and the substances producing the odor of honey. Honey, as it drains from the comb, is quite fluid, but as generally pressed out it contains a sugar identical with grape sugar. This, however, except its disposition to candy, is not essentially different from the fluid portion. All honey is disposed to crystallize with age, and also to become yellow. The adulterations of honey are numerous. Starch, chalk, calcined gypsum, and even pipe clay have been used. Of late years, however, the adulteration of honey consists chiefly in adding glucose, a sugar now manufactured largely from corn, but only containing about thirty-four per cent. of saccharine, calling cane sugar 100. The adulteration by means of starch, chalk, etc., may be easily detected by heating the honey and letting it stand, when the impurities will settle to the bottom. Honey adulterated with glucose is more difficult of detection. Combs once used are even filled with the mixture. For this reason, pure white comb, capped by the bees, commands fully double the price, in the markets, of strained honey.

HONEY-DEW. An exudation of sweet gummy matter from the leaves of plants, especially the oak, beech, linden, and hop.

HONEYSUCKLE. (*Lonicera periclymenum.*) A hardy, attractive, and fragrant flowering shrub, that used to be found in every garden, thriving under adverse circumstances, even under the shade of trees. Of late years, it is not so generally cultivated, having given place to more pretentious, but not more handsome climbers. They should form a part of the collection about every farm house in the country. The following are the older and better known varieties: *Periclymenum Americanum*, the evergreen honeysuckle; *P. Germanicum*, the German honeysuckle; *P. Italicum*, the Italian variety; *P. Semper virens*, Virginian honeysuckle, Trumpet honeysuckle, a beautiful and constant bloomer; *P. racemosum*, the yellow flowering honeysuckle, with showy fruit, this is not strictly a climber; *P. verticellatum*, a tree-like honeysuckle, with inflected branches, and coral colored flowers; *P. vulgare*, generally known as English honeysuckle, or woodbine; *Lonicera Japonica* is the so-called Chinese honeysuckle, a most valuable plant for covering arbors, trellises, and pillars, with delicate and fragrant flowers; *L. brachypoda*, or Japan honeysuckle, is still more attractive; *L. ciliata*, Twinberry, grows abundantly in the mountains of Oregon and Alaska, and the berries are used as food by the Indians; *L. Tartarica*, the Tartarian honeysuckle is upright, or bush-like, and is well known.

HOODED. Cucullate. A descriptive term in botany, to express the partial covering of a flower, etc., by a petal or leaf, which is curved over it

HOOVE. (See Blown.)

HOPS. *Humulus.* The importance of this crop in all civilized countries may be inferred, from its constantly extended cultivation, scarcely affording a supply for the increasing demand. Its principal use being in the manufacture of beer. In 1840 the entire product of the United States was 1,238,502 pounds; in 1850, 3,497,029 pounds; in 1860, 11,010,012 pounds; increased in 1862 to 16,000,000 pounds. Since this time its cultivation extended wonderfully in the West until it was attacked by the aphis, when it began to decline. In 1866, the planting in Wisconsin raged like an epidemic throughout many parts of the State, and in Sauk county, one of the principal localities where it was planted, the crop exceeded 4,000,000 pounds, returning $2,500,000 in one year. In 1869, the crop of the United States aggregated 25,456,669 pounds. Since 1869 the acreage steadily increased until, in 1876, it approximated that of England, which was nearly 70,000 acres. The hop crop reached its maximum in 1877, being 110,000 bales. The season of 1878 was a disastrous one to the crop, and the acreage since that time has been decreased, but is now again increasing. In relation to the cost, one difficulty in hop-growing in the West, was that farmers rushed into it, without properly understanding the care and expense necessary to produce the crop. Hence, while some cultivators made money others signally failed. As showing something of the cost of the crop when ready for market, the following data will be interesting: A convention of hop-growers in New England, at a late session, appointed three different committees to estimate the average cost of producing hops. Committee No. 1, allowed $100 per acre for the average value of the land; cost of poles, fertilizers, and cartage, $44.10; labor in cultivation, $18; harvesting and curing, $64,36; insurance and marketing, $11.83; boxes, etc., $2.98; total, $141.27. A crop of 1,000 pounds would at such a rate average 14⅛ cents per pound. Committee No. 2, allowing $80 per acre as the value of the land, estimated the average cost of 1,000 pounds at 12¼ cents. Committee No 3, at $100 per acre, and with a yield of 800 pounds, made the average cost 12 1-5 cents per pound. The average cost of producing hops in Kent county, England, a famous hop district, is estimated by a local authority at £5 or $24.30 per hundred weight (not quite twenty-two cents per pound). As an illustration of the change in conditions of production the following statement of a hop-grower in Sauk county, Wis., during the flush times of 1867, is given: His yard embraced four acres, and the capital invested, including land, poles, drying-houses, stove, presses, etc., amounted to $2,000. During the second year of his investment, 1867, he estimated his expenses as follows: Interest on capital, ten per cent., $200; cultivation, setting poles, etc., $100; harvesting, curing, etc., $943; total expenses, $1,243. Receipts, for 11,520 pounds of hops at sixty cents per pound, $6,912; net receipts for hop roots, $3,040; total receipts, $9,952; net receipts, $8,709, or 435 per cent. The history of the hop shows it to have been cultivated from most ancient times. Mesne, an Arabian physician who died about 846, mentions the hop vine in his writings. When it was first introduced into England is not known, but about 1525, a doggerel appeared as follows:

> "Hops, heresy, pickerel and beer
> Were brought to England in one year."

In 1528, Parliament was petitioned to prohibit its use, as spoiling the taste of beer, nevertheless its cultivation continued to extend, until it has become a crop of prime importance among agricultural products. The soil and manure best adapted to the plant, may be determined by the general character of its growth. The soil should be deep, friable, containing humus, never wet but at the same time one that will withstand drought. Clay soils, if tenacious, should be thoroughly drained, since the hop roots penetrate deep and will not stand wet. Wet soils, hot suns, and drying winds in conjunction are fatal to the hop. Rather firm, deep, rich, well drained alluvial soils, protected from sweeping winds, are natural ones and the best, nevertheless, hops will not succeed in a close atmosphere, they require air, but do not like sweeping winds. The cultivation of the hop may be pretty well understood from the following, compiled from numerous authorities: The sexes of the hop plant are not united in the same plant, but some are male and others female. Since the sexual relation of the strawberry plants has been so thoroughly discussed in the United States, the importance of having some male plants in the hop grounds will be generally admitted. The male flower grows in a loose panicle, whilst the female flower is compact, like the cone of the pine tree. Hop seeds produce plants, but as they are like fruit seeds, producing varieties of quite different qualities, the hop plants should be multiplied by slips from a well known and approved variety. At the base of each scale or leaf of the female blossom of the hop there is a flower, in which is the germ of the seed. As this seed matures the scales grow larger, and are covered with resinous aromatic balls, called lupuline. These are the fine yellow powder of the hop, and contain the bitter principle that renders the hop so valuable in preserving and flavoring malt liquors. This bitter principle is stronger or more delicately flavored in some varieties of the hop than in others, and in proportion as the seed is fully developed. This female blossom is vitalized by the pollen of the male plant. Though the pollen, says an English writer, from its extreme lightness, can be wafted to a considerable distance, and some seeds in each cone may be so fertilized, yet it would be well to rear a number of the male plants among the others, or along the hedges of the hop gardens, to insure the fertilization of all the seeds. A bushel of hops collected from plants of the fourth year, raised from seed, weighed thirty-six pounds, there being male plants near; a second instance, where the plants were raised from cuttings, weighed thirty-five pounds; while a bushel, grown in a garden where the male plants were always eradicated, weighed only twenty-two pounds. Besides the greater quantity of hops thus obtained, the aroma is much greater, (the lupuline, on which the aroma depends, is considered by Blanché to be the unappropriated pollen dust which has alighted on the scales of the females,) and the strength of the bitter much greater. On this point Mr. Rouse says: It is necessary that a small number of the male plants should be interspersed among the others, in order to give that energy and vitality to the seed which is essential to the perfection of the crop. If due care is taken in this particular, a seed will be found at the bottom of each petal of the blossom possessed of a most pungent aromatic flavor. Attention to this particular is, indeed, necessary to insure flavor and character to the product of the plant, giving it that fine aromatic bitter which is most desirable, and which it will not otherwise be possessed of, the petal or leaf of the blossom containing comparatively but little of the astringent quality of the hop. This consideration is one which I apprehend is too frequently overlooked by the inexperienced cultivator, who sometimes rejects the male plants as barren, to the great injury of the crop. He recommends one male plant to fifty female. In selecting the varieties of the hop to plant, two things are regarded in Great Britain—the flavor and the time of maturing. The strong growers are usually the largest bearers, but have not that delicacy of aroma that is found in smaller and less prolific varieties. In large plantations, where the picking season should be long, such varieties are selected as will give different times of maturity. In preparing to plant, it is best to bed in the spring the necessary sets, for by the fall they will have attained a year's growth, and whether they are set out in the fall, or in the following spring, it will be so much time gained. Then they are more certain to grow, will require a less number in the hill, and give much less trouble during the first year's growth after being planted. In Great Britain it is usual to plant in raised hills. But there the climate is moist; here the extreme droughts dry them too much. Hence, level cultivation, generally, has superseded hill cultivation, and the hop plant should not be an exception. In setting the plants, manure should not be put in the hill, especially new, unfermented barnyard manure, but a richer soil may be added, if the ground is not rich. The roots of the sets should be spread out carefully, fine mold put around them, the soil pressed firmly, and the earth heaped over them. Each hill should have two poles. In England, the number is determined by the kind of hop. The Farnham, Canterbury white bines and the Goldings are strong growers, and require large poles, from fourteen to twenty feet long. The Grape varieties are smaller, and need poles not exceeding ten to fourteen feet in length. As to the number of poles in Great Britain to the hill, the Cyclopædia of Agriculture says: When there are about 1,200 hills on an acre, and the poles all eighteen feet long and upwards, we should recommend two to each hill; with sixteen feet poles, every third hill to have three; with fourteen feet, alternately two and three poles; with twelve feet poles, three to each hill. But in this country, where ground is not so valuable as in England, a lesser number should be used, that more air and sunlight may be allowed, to lessen the evil of mold, and give greater vigor to the plant when held back by the aphis. The poles should be sharpened with a regular taper, and holes for them made by a heavy crowbar; and when two are in a hill they should be about a foot apart, the tops inclining somewhat apart, to give more room to each top, and prevent the branches from intertwining. The strongest poles should be selected for the outside, especially for that part of the plantation most exposed to heavy winds. In the spring the number of bines to each pole is selected. These should not be more than two; but it is best when the wire-worm is apprehended to reserve two more against their depredations, and until danger to them is past. The bine should be fastened to the poles, as their growth advances, with woolen yarn; and it is best when unraveled from a stocking, as it is more elastic. The grounds should be kept free of weeds or grass, and the hills almost level. The bines should be supported the first season on small poles, so that their better growth may be encouraged. In the spring following, the grounds should be well and deeply broken up, as soon as the soil is in a proper condition. Care should be taken not to do this when it is too wet. The furrow should be thrown from the hill, and the hill itself carefully weeded and pulverized, either with the cultivator or the hoe. The land should be leveled in the subsequent plowings with the cultivator. No better general directions can be given than to say that the hop should receive equal cultivation with the corn. A clean, mellow soil must be maintained. How to do this will require less or greater labor, according to the season, and the cultivation will be modified by it. Sometimes the cultivator is all that is needed after the first breaking up; at other times, when heavy, soaking rains have compacted the soil, it will be necessary to loosen with deeper working implements. Every operation demanded by the season should be performed in due time, and the more unfavorable the season is, the more cheerfully should be the labor given; for, in the cultivation of the hop, more than in all other crops, is the proverb true, that the hand of the diligent maketh rich. In such years, says Mr. Mainwaring, it will far better requite the labor bestowed, yielding a better price, by reason of their scarcity, than in fruitful years, when almost every ground produces hops. Industry and ingenuity are most encouraged and best rewarded at such times, but ignorance and sloth come off with loss. When the hops begin to change their color from green to brown, and emit a fragrant odor, they are ripe. Mr. Rouse says that the hop should be in full perfection before it is picked, and this is known when the seed has changed from a bright straw color to a pale brown, and emits a fragrant smell. Morton says: A hop may be considered ripe when it becomes hard and crisp to the touch; when the extreme petal projects in a prominent manner at the tip of the hop; when the color is changed from a light silvery green, to a deep primrose or yellow; and when, on opening the flower, the cuticle of the seeds is of a purple color, and the kernel, or seed itself, hard, like a nut. Even after the hop has attained a lightish brown color no real injury to its quality will have accrued, and, for many purposes, such hops are most esteemed in the market; but, after the hops generally attain a dark brown hue, a great loss, both in quality and weight, will be sustained. It is better to begin early than late in picking; but care must be observed lest the picking may commence too early. When in a proper stage of ripeness, four pounds of undried hops will make one of dry, and five pounds, scarcely ripe, are required to make one when dried. The hop, then, it will be seen, does not admit of a lengthened harvest, and hence, the hop-grower should timely secure all necessary aid; and that aid, when promised, under no circumstances should fail, as it so often does, in the harvesting of other crops. In England, the hops are commonly picked in large boxes, containing from twenty-four to forty bushels. These boxes are divided lengthwise by a thin partition, and then sub-divided into quarters. They are raised a little from the ground, and have handles at the ends to facilitate their removal from place to place, as may be desirable. One man and four girls are allowed to each box. Each girl deposits the hops she picks in her own division of the box. An industrious hand can pick twenty bushels in a day without difficulty. It is the business of the man to supply the boxes with poles, which he raises from the ground as needed, cutting the vines about a foot high; to see that the picking is properly done, to remove the empty poles, clear them of the vines, and stack them in a systematic manner. In picking, the hops should be kept free from stems and leaves, and all blasted or immature ones should be rejected. The boxes should be emptied at least once a day; at all events, no hops should be left in them over night. Three-fourths of the weight of the hops are water. So large an amount in so much bulk, and to which the air penetrates, demands that the drying should at once follow the picking, or heating and fermentation, when in bulk, will speedily follow. The hop house, or kiln, should be of a size proportionate to the quantity of hops to be cured, so that they may not accumulate on hand. To avoid this, it will generally be necessary to keep the kiln heated both day and night. It is commonly built of an oblong form, and of two stories, the lower part being occupied by the kiln and the press-room, and the upper part by the drying-floor over the kiln, and by a room of about an equal size for storing the dried hops, which will, of course, be over the press-room. Kilns are sometimes built of bricks or stone, of a circular form, with a round opening in the apex of the roof, surmounted by a movable cowl, or swinging ventilator, to enable the vapor of the drying hops to escape easily. If the building is of wood, the sides of the kiln should be lined with brick work, or thoroughly lathed and plastered. It is found to be most convenient and economical to heat it with stoves, from two to four of which will be necessary, according to the size of the kiln. The drying-floor should be ten feet from the ground, that there may be no danger of scorching the hops in drying. This floor is formed of slats about one and a half inch each in width, and the same distance from each other. They are covered with a strong, coarse cloth, of open texture, so as to admit of a free transmission of the heated air from the kiln below. The drying-room should be of comfortable height for a person to work in it, and the sides should be lathed and plastered, that there may be no irregularity of the heat in different portions of the room during high winds. A good ventilator should be provided in the roof, as described above. Openings should be left in the walls near the bottom of the kiln to admit fresh air from without, the draught to be regulated by means of flues, or sliding doors. The cloth for the drying-floor should be well stretched over the slats and firmly nailed. On this floor the hops are spread to the depth of six or eight inches. The proper thickness will depend somewhat on the condition of the hops; if they are very full of moisture, they should be laid on quite thin; but if gathered when fully ripe, and in fine weather, a depth of ten inches will be allowed. The great object, says Mr. Morton, with the hop-drier is to get rid of the condensed vapor from the green hops as quickly as possible, and the dry-houses should be so constructed as to effect this object perfectly. It must be borne in mind that hops should be dried by currents of heated air passing rapidly through them, and not by radiation of heat. This is a distinction of the utmost importance, since success is entirely dependent upon a strict adherence to the former principle. In order to accomplish this effect, the space above the hops must be kept hot, and all the lower parts of the kiln cold, whereby the greater density of the cold air will force the rarified air above, carrying with it the vapor from the hops, through the aperture or cowls upon the summit of the building. To aid this ascent of the heated air passing through the hops, a stream of heated air is sometimes thrown above the hops through a tube, thus adding greatly to the heat of the current passing through the hops, and giving it a greater ascending power. The hops being spread as evenly as possible, the fires are immediately kindled in the kiln, and the temperature regulated to one uniform degree of heat. This, however, may be quite high at first, as there will be at that time but little danger of scorching the hops if the floor is sufficiently high. If the hops are rusty, or discolored from any other cause, it is usual to burn a little sulphur under them, which will bring them to a uniform appearance. This is done as soon as the hops are well warmed through, and feel somewhat moist. Great prejudice formerly existed against the use of sulphur in drying hops; but no objection is now made to it by the brewers, and it is generally thought that the use of it improves the appearance of all hops, and that it also facilitates the drying. During the drying process the fires should be kept up, and there should be a free supply of fresh air below, sufficient to keep up a regular succession of heated air from the kiln, passing through the hops and out at the ventilator, carrying with it the vapor expelled from the drying hops. This will be found far preferable to a still, dead heat. As soon as the upper part of the hops appears to have felt the fire, the lower part may be considered as nearly dry, and will rattle a little. The heap may then be turned. Before this is done the heat should be suffered to abate a little, and increased again after the turning is finished. I am aware that many do not turn their hops while drying, nor suffer them to be disturbed at all until they are ready to be removed from the floor. Still, the better opinion, I think, is in favor of turning as tending to facilitate the drying and render it more perfect by the more effectually exposing every portion of the mass to the action of the heated current of air, than would be the case were they allowed to remain as at first deposited on the floor, containing many inequalities in density even when the utmost care is exercised in their distribution. If turned at the right time, and in a careful manner, there need be no injury done to the hops. When sufficiently dried they should be allowed to cool off a little, if time can be afforded, otherwise there will be great danger that they will break in moving, or a portion of them shell off and waste. Ten or twelve hours are required to dry a kiln of hops. Two kilns may be dried in twenty-four hours by keeping the heat up through the night. A twenty-foot kiln will thus dry 400 bushels in a day, as they come from the vines, making about 750 pounds of hops when dry. Let not the heat slacken, but rather increase it, till the hops are nearly dried, lest the moisture and sweat which the fire has raised fall back and discolor the hops. For these reasons chiefly it is that no cool air should be suffered to come into the kiln while the hops are drying. After the hops have lain about seven, eight, or nine hours, having left off sweating, and leap up when beaten with a stick, then turn them with a malt shovel or scoop made for that purpose; let them remain in this situation for two or three hours more, till every hop is equally dried. They must not be turned while they sweat, for that will scorch and cause them to lose their color; the fire may be diminished a little before they are turned, and renewed again afterwards; the heat should be kept as equal as possible. It may be of service to make use of a thermometer, by marking upon it the degree of heat proper for drying hops, as soon as that degree is ascertained by experiment. Mistakes are often exceedingly detrimental to the hops, and great attention is required by the drier, night and day, until finished. When they are thoroughly dry, which is known by the brittleness of the inner stalk, (if rubbed and it breaks short,) the fire should be put out, and the hops taken from the kiln into the cooling-room. Here they should be spread out not exceeding twelve inches in depth, and in a day or two will be ready to bale. Care should be taken to exclude a drying air from the cooling-room. The hops being dried, the next process is to bale them. This should not be done immediately after they are taken from the kiln, but they should be allowed to lie a few days in the store-room till they become a little softened, otherwise their extreme brittleness will cause them to be much broken in baling, and the sample be thereby greatly injured. The bales should be of a symmetrical and convenient form, and should contain about 200 pounds. They are formed in a box or bin prepared for the purpose, in the press-room, of such shape as will give the desired size and form. Across the bottom and sides of this box the baling cloth is first laid, and the hops are then let down into it from above and trodden down as they are dropped in until it is filled. Another cloth is then carried over the top, a follower applied, and the screws of the press turned down upon it until the whole is brought into a compact mass. The box is then taken apart, the cloth neatly secured around the bale, the screws are run up, the bale taken out, and the ends cased, when it may be considered finished, and the same process is repeated in forming another.

HOP CLOVER. (See Clover.)

HOP-HORN BEAM. (See Horn Beam.)

HORDEUM. The genus of barley grasses.

HORIZONTAL. Level. A plane parallel to the horizon.

HORN. Indurated skin, consisting for the most part, of modified albumen. It resembles hair in its chemical and agricultural properties, when shaved into thin strips, horn, whalebone, tortoise-shell, which are all similar, are readily softened by heat or hot water, and are then cut or molded into combs, handles for knives, rings, etc. Digested with water in an iron cylinder, under pressure, they are dissolved and yield glue. The horns of oxen and many other animals are only a covering over a bony process rising from the front bone of the head. This bone (horn pith) is remarkably porous, and full of blood-vessels, so that when it is cut or injured violent hemorrhage often follows, which is difficult to stop.

HORN BEAM. *Carpinus Americana.* Blue or Water Beech, or ironwood. Common along streams, growing from ten to twenty feet high. The trunk is ridged and the wood very white. The Hop-horn Beam, *Ostrya Virginica* is a larger tree, from twenty to forty feet high, bearing oval, oblong, hop-like fruit, rarer in the West than the Blue Beech.

HORNBLENDE. A dark green or black mineral, massive or crystallized in prisms, of glassy lustre, and readily scratched by a knife. It forms the basis of numerous minerals, and is found in several varieties, as augite, amphibole, pargasite, tremolite and actinolite.

HORNBUG. The beetles of the genus *Lucanus*, or stag beetles, especially *L. capreolus.* The grubs live in the trunks and roots of old trees.

HORNET. *Vespa maculata,* the American species. They build a globular nest of a substance like paper upon branches of trees, etc. It preys upon fruit, flies, etc. The European species is *V. carbro.*

HORSE. Zoologically considered the family to which the horse belongs consists of a single genus, *equus*, and is distinguished from all other quadrupeds by having only one apparent toe, and a single solid hoof on each foot, constituting the soliped, single-hoofed family of Cuvier's order, *pachydermata.* The different species of the genus *equus*, as the ass, zebra, quagga, etc., are all fertile together, and sometimes produce fertile hybrids. That between the male ass and mare, the mule is only second in importance to the horse for performing labor. From the ease with which the progeny of horses that have run wild for centuries, are broken in it is probable that horses were among the first animals domesticated by man. The time of the first domestication of the horse is, however, lost in the obscurity of the far past, but is first mentioned in history as being in use among the Egyptians some 650 years after the biblical account of the deluge. At the time of the exodus of the Israelites the horse certainly was used for draft. For at that time Pharaoh had numerous war chariots drawn by horses. It was from Egypt that Solomon received his great stud of horses, and Herodotus states that Xerxes obtained a portion of cavalry from Ethiopia, and that of his native Indian troops some were on horseback and others in chariots. The horse has so long ceased to exist in a purely wild state, that nothing has come down to us as to his original country, his habits, stature, or color. Of all the so-called wild horses, even those of Tartary are the progeny of animals escaped from a state of domestication. Few, if any, of our domestic animals have undergone such wide modification in size, color, and characteristics; or has become so widely spread over the earth as the horse. In Iceland and the Shetland Isles of the North, he is dwarfed to little more than the size of a large sheep, his limbs short but strong, his form uncouth from his shaggy hair, his mane and tail massive, coarse, and tangled; how different from the high bred racer of England and America, the mighty Clydesdale, or Norman, the long-backed Flemish, the active Barb, or the compact and beautiful Arab. A peculiarity of the horse, and one which should never be forgotten by the horse owner, is that he always breathes through his nostrils. Hence, in buying a horse, it should be especially noticed that his nostrils are capacious, open, and the covering thin and mobile. He is most sensitive to sound, his quick ear catching the slightest sound long before it is apparent to his master. The eye is also indicative of the character and temper of the horse. A bold, full, mild, but bright eye, shows the perfection of temper in a horse; if much of the white is shown, or if he has the habit of showing much of the white in looking behind, one may be pretty sure that he is a rogue and not to be trusted. In the wild state the horse is thought by some to have had no intermediate gait between the walk and gallop; this, however, is mere conjecture, and undoubtedly incorrect. The trot is to all appearances as much a natural gait as the walk, and generally used by colts of every breed, so in the domesticated horse the walk, trot, and gallop are the natural gaits, all others having been taught him, until through heredity, some of them, as the pace, may be called natural gaits. The age of the horse may only be told with any certainty by his teeth. The ancients understood this perfectly. Xenophon, in a work on horsemanship, alludes to the custom in selecting cavalry horses for the Grecian armies, to the rejection of such as have lost the dental mark. The examination of the teeth of horses to determine their age is also alluded to by various Roman writers, as Columella, Varro, and Virgilius. The teeth of the horse are forty-six nippers or incisors, two canines or tushes and twelve molars in each jaw. The mare lacks the canines. The dental system is: six incisors in the upper and six in the lower jaw; one canine in each side of the jaw of the male, female none; six molars in each side of the upper and lower jaw, thus making forty teeth in all. There are two sets, the temporary or milk teeth, succeeded by the permanent teeth. The canines are wanting in the colt's teeth, and in the permanent teeth of the mare, they seldom are apparent, though their rudimentary teeth may be found in the maxillary bone attached to the jaw. Three substances enter into the composition of the teeth, the enamel, the dental bone or ivory, and the cortical envelope surrounding the fang or root. The teeth, both incisors and grinders, are constantly being worn down at the crown by use, but this loss is supplied by gradual and continuous growth at the root. Thus upon this wearing away at the crown is based a perfected system by which the age of a horse may be pretty nearly told by an observing person. Mr. Youatt, than whom there is no better authority extant, in his treatise on the horse has very accurately described the teeth and their characteristics, which, with the illustrations will enable any one to judge correctly of the age of the horse. The statement is as follows: Seven or eight months before the foal is born, the germs or beginnings of the teeth are visible in the cavities of the jaws. At the time of birth, the first and second grinders have appeared, large, compared with the size of the jaw, seemingly filling it. In the course of seven or eight days the two center nippers are seen as here represented, Fig. 1. In the course of the first month the third grinder appears, above and below, and not long after, and generally before six weeks have expired, another incisor above and below will be seen on each side of the two first, which have now considerably grown, but not attained their perfect height. This cut will then represent the appearance of the mouth, Fig. 2. At two months, the center nippers will have reached their natural level, and between the second and third month the second pair will have overtaken them. They will then begin to wear a little, and the outer edge, which was at first somewhat raised and sharp, is brought to a level with the inner edge, and so the mouth continues until some time between the sixth and ninth month, when another nipper begins to appear on each side of the two first, making six above and below, and completing the colt's mouth; after which the only observable difference, until between the second and third year, is in the wear and tear of these teeth. These teeth are covered with a polished and exceedingly hard enamel; indeed it is so hard that it almost bids defiance to the action of a file. It spreads over that portion of the tooth which appears above the gum, and not only so, but as they are to be so much employed in nipping the grass, and in gathering up the animal's food, and in such employment even this hard substance must be gradually

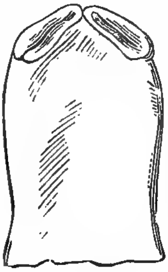


Fig. 1.

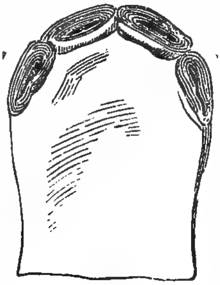


Fig. 2.

worn away, a portion of it, as it passes over the upper surface of the teeth, is bent inward, and sunk into the body of the teeth, and forms a little pit in them. The inside and bottom of this pit being blackened by the food, constitute the mark of the teeth, by the gradual disappearance of which, in consequence of the wearing down of the teeth, we are enabled for several years to judge of the age of the animal. The colt's nipping teeth are rounded in front, somewhat hollow toward the mouth, and present at first a cutting surface, with the outer edge rising in a slanting direction above the inner edge. This, however, soon begins to wear down, until both surfaces are level, and the mark, which was originally long and narrow, becomes shorter, and wider and fainter. At six months the four nippers are wearing to a level. The cut, Fig. 3, will convey some idea of the appearance of the teeth at one year. The four middle teeth are almost level, and the corner ones are becoming so. The mark in the two middle teeth is wide and faint, in the two next teeth it is longer, darker and narrower. In the corner teeth it is longest, darkest and narrowest. The back teeth or grinders will not guide us far in ascertaining the age of the animal, for we can not easily inspect them, but there are some interesting particulars connected with them. The foal is born with two grinders in each jaw, above and below, or they appear within two or three days after the birth. Before the expiration of the month they are succeeded by a third, more backward. The crowns of the grinders are entirely covered with enamel on the top and sides, but attrition soon wears it away from the top, and there remains a compound surface of alternate layers of crusted substance, enamel and ivory, which are employed in grinding down the hardest portion of the food. Nature has, therefore, made an additional provision for their strength and endurance. Fig. 4 represents a grinder sawed across. The five dark spots represent bony matter; the parts covered with lines of enamel, and the white spaces a strong bony cement uniting the other portions of the teeth. At the completion of the first year a fourth grinder usually comes up, and the yearling has then, or soon afterwards, six nippers and four grinders above and below in each jaw, which, with the alteration in the nippers we have just described, will enable us to calculate the age of the foal, subject to some variations arising from the period of weaning, and the nature of the food. At the age of one year and a half, the mark in the central nippers will be much shorter and fainter; that in the two other pairs will have undergone an evident change, and all the nippers will be flat. At two years this will be more manifest. The accompanying cut, Fig. 5, deserves attention, as giving an accurate representation of the nippers in the lower jaw of a two-year-old colt. About this period a fifth grinder will appear, and now likewise, will commence another process. The first teeth are adapted to the size and wants of the young animal. They are sufficiently large to occupy and fill the colt's jaws, but when these bones have expanded with the increasing growth of the animal, the teeth are separated too far from each other to be useful, and another and larger set is required. The second teeth then begin to push up from below, and the fangs of the first are absorbed, until the former approach the surface of the gum, when they drop out. Where the temporary teeth do not rise immediately under the milk teeth, but by their sides, the latter being pressed sideways are absorbed throughout their whole length. They grow narrow, are pushed out of place, and cause inconvenience to the gums, and sometimes to the cheek. They should be extracted. The teeth which first appeared are first renewed, and therefore the front or first grinders are changed at the age of two years. During the period between the falling out of the central milk teeth and the coming up of the permanent ones, the colt, having a broken mouth, may find some difficulty in grazing. If he should fall away considerably in condition, he should be fed with mashes and corn, or cut feed. The next cut, Fig. 6, will represent a three-year-old mouth. The central teeth are larger than the others, with two grooves in the outer convex surface, and the mark is long, narrow, deep and black. Not having yet attained their full growth, they are rather lower than the others. The mark in the two next nippers is nearly worn out and it is wearing away in the corner nippers. The ages

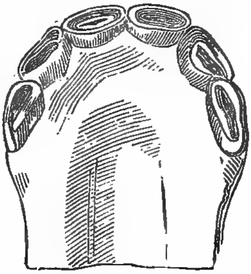


Fig. 3.

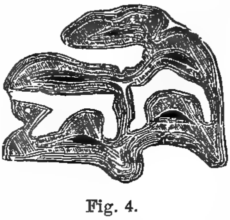


Fig. 4.

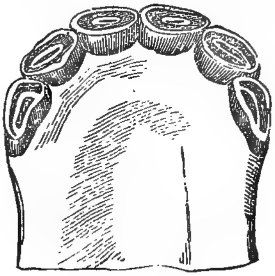


Fig. 5.

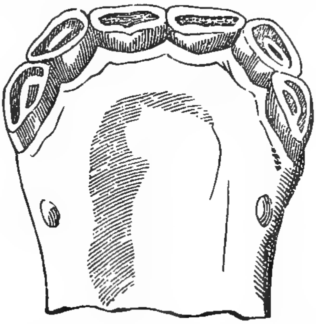


Fig. 6.

of all horses used to be reckoned from the first of May, but some are foaled even as early as January, and being actually four months over the two years, if they have been well nursed and fed, and are strong and large, they may, with the inexperienced, have an additional year put upon them. The central nippers are punched or drawn out, and the others appear three or four months earlier than they otherwise would. In the natural process they would only rise by long pressing upon the first teeth, and causing their absorption. But opposition from the first set being removed, it is easy to imagine that their progress will be more rapid. Three or four months will be gained in the appearance of these teeth, and these three or four months will enable the breeder to term him a late colt of the preceding year. To him, however, who is accustomed to horses, the general form of the animal, the little development of the forehead, the continuance of the mark on the next pair of nippers, its more evident existence in the corner ones, some enlargement or irregularity about the gums from the violence used in forcing out the teeth, the small growth of the first and fifth grinders, and the non-appearance of the sixth grinder, which, if it be not through the gum at three years old is swelling under it, and preparing to get through —any or all of these circumstances, carefully attended to, will be a sufficient security against deception. A horse at three years old ought to have the central permanent nippers growing, the other two pairs wasting, six grinders in each jaw, above and below, the first and fifth level, the others and the sixth protruding. The sharp edge of new incisors, although it could not well be expressed in the cut, will be very evident when compared with the old teeth. As the permanent nippers wear and continue to grow, a narrow portion of the cone-shaped tooth is exposed by the attrition, and they look as if they had been compressed, but it is not so. Not only will the mark be wearing out, but the crowns of the teeth will be sensibly smaller At three years and a half, or between that and four, the next pair of nippers will be changed, and the mouth at that time can not be mistaken. The central nippers will have attained nearly their full growth. A vacuity will be left where the second stood, or they will begin to peep above the gum, and the corner ones will be diminished in breadth, worn down, and the mark becoming small and faint. At this period, likewise, the second pair of grinders will be shed. Previously to this may be the attempt of the dealer to give his three-year-old an additional year, but the fraud will be detected by an examination similar to that which has been already described. At four years, the central nippers will be fully developed; the sharp edge somewhat worn off, and the mark shorter, wider, fainter. The next pair will be up, but they will be small, with the mark deep and extending quite across them, as in Fig. 7. The corner nippers will be larger than the inside ones, yet smaller than they were, and flat, and the mark nearly effaced. The sixth grinders will have risen to a level with the others, and the tushes will begin to appear. Now, more than at any other time, will the dealer be anxious to put an additional year on the animal, for the difference between a four-year-old colt and a five-year-old horse, in strength, utility and value, is very great; but the want of wear in the other nippers, the small size of the corner ones, the little growth of the tush, the smallness of the second grinder, the low forehand, the legginess of the colt, and the thickness and little depth of the mouth, will, to the man of common experience among horses, at once detect the cheat. The tushes are four in number, two in each jaw, situated between the nippers and the grinders, much nearer to the former than to the latter, and nearer in the lower jaw than the upper, but this distance increases in both jaws with the age. In shape, the tush somewhat resembles a cone; it protrudes from the gum about an inch, and is sharp-pointed and curved. The appearance of this tush in the horse may vary from four years to four years and six months. It can only be accelerated a few weeks by cutting the gum over it. At four years and a half, or between that and five, the last important change takes place in the mouth of the horse. The corner nippers are shed, and the permanent ones begin to appear. The central nippers are considerably worn, and the next pair are commencing to show marks of usage. The tush has now protruded, and is generally a full half inch in height; externally, it has a rounded prominence, with a groove on either side; and it is evidently hollowed within. The reader scarcely needs to be told that after the rising of the corner nipper, the animal changes its name. The colt becomes a horse, the filly a mare. At five years, the horse's mouth is almost perfect—Fig. 8. The corner nippers are quite up, with the long deep mark irregular in the inside, and the other nippers bearing evident tokens of increased wearing. The tush is much grown; the grooves have almost or quite disappeared, and the outer surface is regularly con-

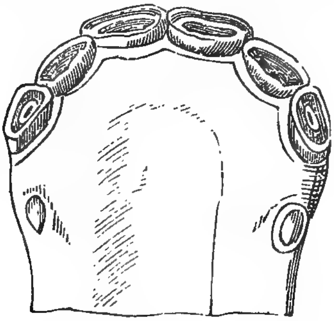


Fig. 7.

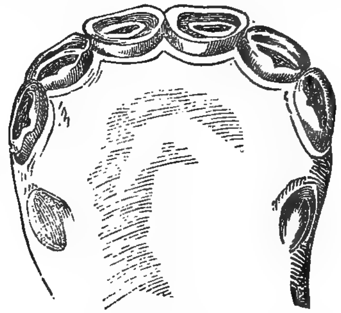


Fig. 8.

vex. It is still as concave within, and with the edge nearly as sharp, as it was six months before. The sixth molar is quite up, and the third molar is wanting. This last circumstance, if the general appearance of the animal, and particularly his forehand, and the wearing of the center nippers, and the growth and shapes of the tushes be likewise carefully attended to, will prevent deception, if a late four-year-old is attempted to be substituted for a five-year-old. The nippers may be brought up a few months before their time, and the tushes a few weeks, but the grinder is with difficulty displaced. The three last grinders and the tushes are never shed. At six years—see Fig. 9—the mark on the central nippers is worn out. There will still be a difference of color in the center of the tooth. The cement filling up the hole, made by the dipping of the enamel, will present a browner hue than the other part of the tooth, and it will be evidently surrounded by an edge of enamel, and there will remain even a little depression in the center, and also a depression round the case of enamel; but the deep hole in the center of the teeth, with the blackened surface which it presents, and the elevated edge of enamel, will have disappeared. Persons not much accustomed to horses have been puzzled here. They expected to find a plain surface of uniform color, and knew not what conclusion to draw when there was both discoloration and irregularity. In the next incisors the mark is shorter, broader, and fainter, and in the corner teeth the edges of the enamel are more regular, and the surface is evidently worn. The tush has attained its full growth, being nearly or quite an inch long, convex outward, concave within, tending to a point, and the extremity somewhat curved. The third grinder is fairly up, and all the grinders are level. The horse may now be said to have a perfect mouth. All the teeth are produced, fully grown, and have hitherto sustained no material injury. During these important changes of the teeth, the animal has suffered less than could have been supposed possible. At seven years—see Fig. 10—the mark, in the way in which we have described it, is worn out in the four central nippers, and fast wearing away in the corner teeth; the tush also is beginning to be altered. It will be found that it is rounded at the point, rounded at the edges, still round without, and beginning to get round inside. At eight years old, the tush is rounder in every way; the mark is gone from all the bottom nippers, and it may almost be said to be out of the mouth. There is nothing remaining in the bottom nippers that can afterward clearly show the age of the horse, or to justify the most experienced examiner in giving a positive opinion. Dishonest dealers have been said to resort to a method of prolonging the mark in the lower nippers. It is called Bishoping, from the name of the scoundrel who invented it. The horse of eight or nine years old—for his mouth, see Fig. 11—is thrown, and with an engraver's tool a hole is dug in the now almost plain surface of the corner teeth, in shape resembling the mark yet left in those of a seven-year-old horse. The hole is then burned with a heated iron, and a permanent black stain is left. The next pair of nippers are sometimes slightly touched. An ignorant man would be very easily deceived by this trick; but the irregular appearance of the cavity, the diffusion of the black stain around the tushes, the sharpened edges and concave inner surface of which can never be given again, the marks on the upper nippers, together with the general conformation of the horse, can never deceive the careful examiner. Horsemen, after the animal is eight years old, are accustomed to look to the nippers in the upper jaw, and some conclusion has been drawn from the appearances which they present. It can not be doubted that the mark remains in them for some years after it has been obliterated in the nippers of the lower jaw. There are various opinions as to the intervals between the disappearance of the marks from the different cutting teeth of the upper jaw. Some have averaged it at two years, some at one. Dr. Youatt was inclined to adopt the latter opinion, and then the age will be thus determined. At nine years the mark will be

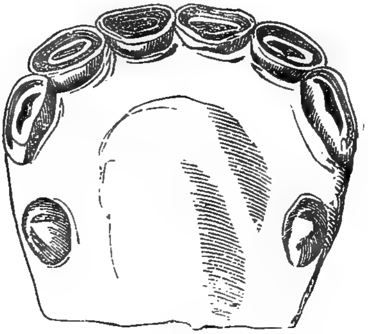


Fig. 9.

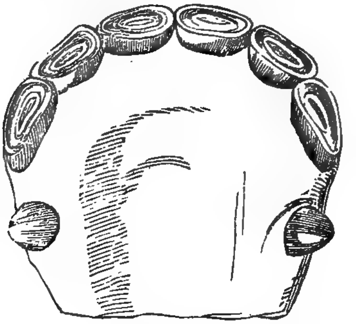


Fig. 10.

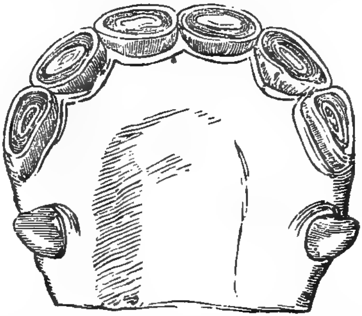
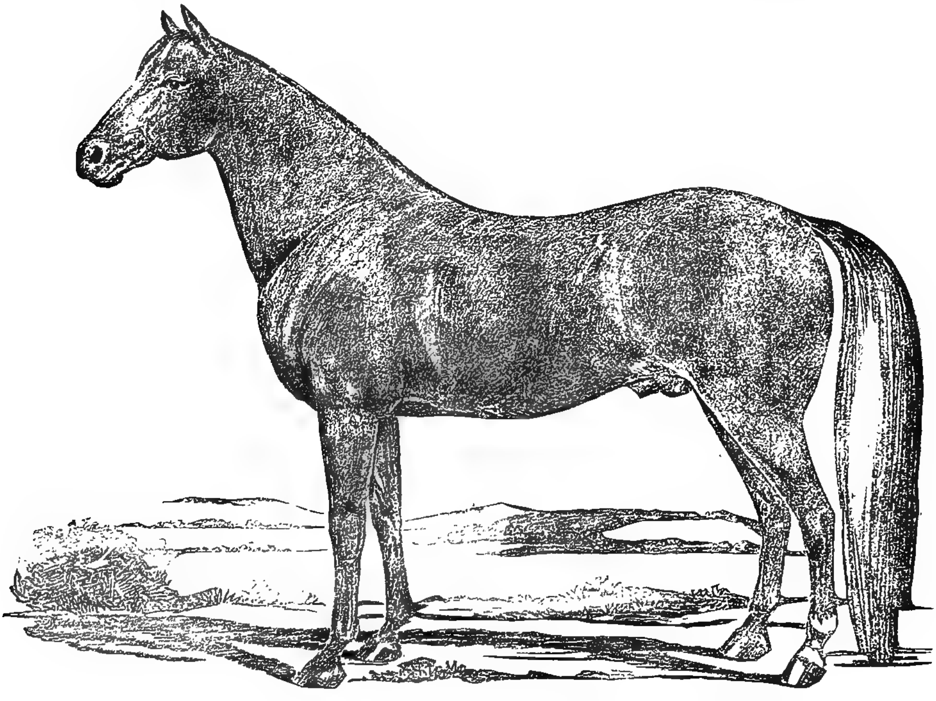


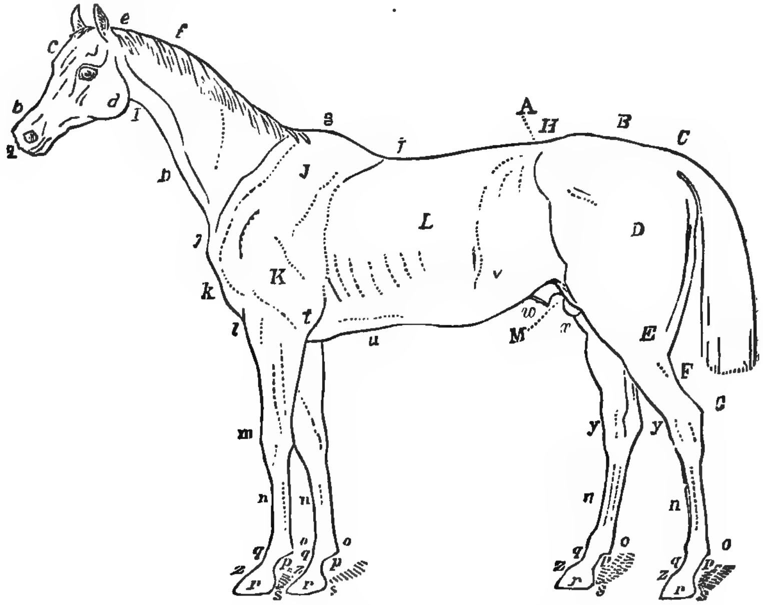
Fig. 11.

worn from the middle nippers, from the next pair at ten, and from all the upper nippers at eleven. During these periods the tush is likewise undergoing a manifest change. It is blunter, shorter and rounder. In what degree this takes place in the different periods, long and favorable opportunities can alone enable the horseman to decide. The alteration in the form of the tushes is frequently uncertain. It will sometimes be blunt at eight, and at others remain pointed at eighteen. After eleven, and until the horse is very old, the age may be guessed at with some degree of confidence, from the shape of the upper surface, or extremity of the nippers. At eight they are all oval, the length of the oval running across from tooth to tooth; but as the horse gets older, the teeth diminish in size—and this commencing in their width and not in their thickness. They become a little apart from each other, and their surfaces become round instead of oval. At nine, the center nippers are evidently so; at ten, the others begin to have the oval shortened. At eleven, the second pair of nippers are quite rounded, and at thirteen, the corner ones have also that appearance. At fourteen, the faces of the central nippers become somewhat triangular. At seventeen, they are all so. At nineteen, the angles begin to wear off, and the central teeth are again oval, but in a reversed direction; viz., from outward, inward, and at twenty-one they all wear this form. It would of course be folly to expect any thing like a certainty in an opinion of the exact age of an old horse, as drawn from the above indications. Stabled horses have the marks sooner worn out than those that are at grass, and crib-biters still sooner. At nine or ten, the bars of the mouth become less prominent, and their regular diminution will designate increasing age. At eleven or twelve, the lower nippers change their original upright direction, and project forward horizontally, and become of a yellow color. The general indications of old age, independent of the teeth, are the deepening of the hollows over the eyes; gray hairs, and particularly over the eyes, and about the muzzle; thinness and hanging down of the lips; sharpness of the withers, sinking of the back, lengthening of the quarters; and the disappearance of windgalls, spavins, and tumors of every kind. Horses, kindly and not prematurely used, sometimes live to between thirty-five and forty-five years of age; and Mr. Percival gives an account of a barge horse that died in his sixty-second year. As indicating what the best horses of the ancients were like, also as showing how near they approached to what would now-a-days be called a well muscled horse of all work, or a good roadster, the description of Xenophon in his instructions are as correct to-day as when written over 2,200 years ago, as follows: First, he says, we will write, how one may be the least deceived in the purchase of horses. It is evident, then, that of the unbroken colt one must judge by the bodily construction; since, if he has never been backed, he will afford no very clear evidences of his spirit. Of his body, then, we say that it is necessary first to examine the feet; for, as in a house it matters not how fine may be the superstructure, if there be not sufficient foundations, so in a war horse there is no utility, no, not if he have all other points perfect, but be badly footed. But in examining the feet, it is befitting first to look to the horny portion of the hoofs, for those horses which have the horn thick, are far superior in their feet



MEXICAN HORSE OR BRONCHO.

to those which have it thin. Nor will it be well if one fail, next, to observe whether the hoofs be upright, both before and behind, or low and flat to the ground; for high hoofs keep the frog at a distance from the earth, while the flat tread with equal pressure on the soft and hard parts of the foot, as is the case with bandy-legged men. And Simon justly observes, that well-footed horses can be known by the sound of their tramp, for the hollow hoof rings like a cymbal, when it strikes the solid earth. But having begun from below, let us ascend to the other parts of the body. It is needful, then, that the parts above the hoof and below the fetlocks (pasterns) be not too erect, like those of the goat; for legs of this kind, being stiff and inflexible, are apt to jar the rider, and are more liable to inflammation. The bones must not, however, be too low and springy, for in that case the fetlocks are liable to be abraded and wounded, if the horse be galloped over clods or stones. The bones of the shanks (cannon bones) should be thick, for these are the columns which support the body; but they should not have the veins and flesh thick, likewise. For, if they have, when the horse shall be galloped in difficult ground, they will necessarily be filled with blood, and will become varicose, so that the shanks will be thickened, and the skin be distended and relaxed from the bone; and, when this is the case, it often follows, that the back sinew gives way and renders the horse lame. But if the horse, when in action, bend his knees flexibly at a walk, you may judge that he will have his legs flexible when in full career; for all horses as they increase in years, increase in the flexibility of the knee. And flexible goers are esteemed highly, and with justice; for such horses are much less liable to blunder or to stumble than those which have rigid, unbending joints. But if the arms, below the shoulder blades, be thick and muscular, they appear stronger and handsomer, as is the case also with a man. The breast also should be broad, as well for beauty as for strength, and because it causes a handsomer action of the forelegs, which do not then interfere, but are carried wide apart. Again, the neck ought not to be set on, like that of a boar, horizontally from the chest; but, like that of a game-cock, should be upright toward the crest, and slack toward the flexure; and the head being long, should have a small and narrow jawbone, so that the neck shall be in front of the rider, and that the eye shall look down at what is before the feet. A horse thus made will not be likely to run violently away, even if he be very high-spirited, for horses do not attempt to run away by bringing in, but by thrusting out, their heads and necks. It is also very necessary to observe, whether the mouth be fine or hard on both sides, or on one or the other. For horses that have not both jaws equally sensitive, are likely to be hard-mouthed on one side or the other. And it is better that a horse should have prominent than hollow eyes, for such a one will see to a greater distance. And widely opened nostrils are far better for respiration than narrow, and they give the horse a fiercer aspect; for when one stallion is enraged against another, or if he become angry while being ridden, he expands his nostrils to their full width. And the loftier the crest, and the smaller the ears, the more horse-like and handsome is the head rendered; while lofty withers give the rider a surer seat, and produce a firmer adhesion between the body and shoulders. A double loin is also softer to sit upon and pleasanter to look upon, than if it be single; and a deep side, rounded toward the belly, renders the horse easier to sit, and stronger, and more easy to be kept in condition; and the shorter and broader the loin, the more easily will the horse raise his fore-quarters, and collect his hind-quarters under him, in going. These points, moreover, cause the belly to appear the smaller; which, if it be large, at once injures the appearance of the animal and renders him weaker, and less manageable. The quarters should be broad and fleshy, in order to correspond with the sides and chest, and, should they be entirely firm and solid, they would be lighter in the gallop, and the horse would be the speedier. But if he should have his buttocks separated under the tail by a broad line, he will bring his hind legs under him, with a wider space between them; and so doing he will have a prouder and stronger gait and action, and will, in all respects, be the better on them. A proof of which is to be had in men, who, when they desire to raise any thing from the ground, attempt it by straddling their legs, not by bringing them close together. Stallions should not have the testes large, and this ought not to be overlooked in foals. To conclude, in regard to the lower joints, of the shanks, namely, and the fetlocks and the hoofs, behind, I have the same remarks to make, and no others, than those which I have made above. Every horseman should thoroughly understand the points of a horse, and the terms by which these are designated. The above eloquent description of the horse has not been improved on since Xenophon's time. A study of the outline, and explanatory terms on page 498, will make the reader conversant with all that is valuable in the make-up of the horse, as seen in the exterior. A horse attains his greatest strength and vigor at nine or ten years of age, and continues in full vigor up to the age of fifteen, if he has been carefully used. Nine-tenths of the horses from being worked too young and from other abuse are often unserviceable before they attain the age of full vigor. At seven or eight years a horse is mature but has not arrived at his full vigor and strength. Their natural life is thirty years, but occasionally an individual lives to forty-five. If well cared for they will perform full work between the ages of eight and twenty years. An English writer, some twenty years ago, enumerates five horses in his stables whose ages respectfully were as follows: thirteen, twenty-one, twenty-six, twenty-nine and forty years. That they had been kept thus intact by good care, honest driving, and particular care in shoeing and attention to their feet. One of the best teams we ever owned were seventeen years old when bought, as lively as cats, and quite sound. They had been raised in the East by the farmer who drove them through from thence to Illinois before an emigrant wagon. The horse is the most perfect embodiment of strength and speed to be found in the animal kingdom. This is shown by his physiological development throughout. These have all been minutely described in many veterinary works, and in various encyclopædias. Hence a few extracts will here suffice. The skull is remarkable for the great width between the orbits, its flatness, the length of the face compared with the cranium, and the vertical depth of the lower jaw; the intermaxillaries project considerably beyond the nasal bones, the latter overhanging the cavity of the nostrils; the temporal arch is short, straight, and situated in the posterior third of the skull. The cervical vertebræ are of large size, and the posterior are oblong with short processes, so as to secure great freedom of motion in the neck; the dorsals are eighteen, with short transverse processes, and very long spines anteriorly to afford origins for the ligaments which support the head; the lumbar are six (but five in the ass), broad and firmly joined together, with remarkably developed processes, especially the transverse; the sacrum is a single bone, made up of five consolidated vertebræ, in a continuous line with the rest of the spine, and united to the last lumbar by the very large articulating oblique processes of the latter, securing a springiness in this region in leaping and galloping; the caudals vary from seventeen to twenty-one having the form of vertebræ only in the upper ones. The chest is capacious, compressed laterally in front, and prolonged in advance of the first rib so as to somewhat resemble the thorax of a bird; in the middle and posterior portions it is rounded, and extends far back toward the pelvis; the ribs are eighteen pairs, the anterior broad and massive (eight being true), and the posterior more slender. The clavicle is absent, and the coracoid process very rudimentary; shoulder blades, triangular, with a prominent spine, closely approximated to the chest, transmitting the weight of this half of the body perpendicularly to the ground; the arm bone is short and strong; the forearm consists almost entirely of the greatly developed radius, the ulna being a mere appendage consolidated in the adult animal to its posterior surface, though its olecranon process is of large size, affording a powerful purchase to the extensor muscles; there are no movements of pronation and supination, but only of hinge-like flexion and extension. The muscular system of the horse is very different from that of man, and has been described minutely in treatises on veterinary medicine. The panniculus carnosus, of which the platysma myoides of man is a rudiment, is greatly developed, and very movable, affording support and protection to various organs. The spinal muscles are of great extent and strength, especially in the neck and tail, which admit of much precision and grace of motion; the extensors of the forearm, the gluteus medius (the kicking muscle), and the muscles of the loins, extremities, and neck are generally very powerful; the muscles of the face, particularly those of the lips and nostrils, are largely developed, giving the well known variety of facial expression in this animal. The explanatory terms given below of points of the horse or the names of the several parts, will form an important study. They are generally recognized by horsemen everywhere, and should be correctly kept in mind by the reader, in that he may get a correct idea of the several parts.

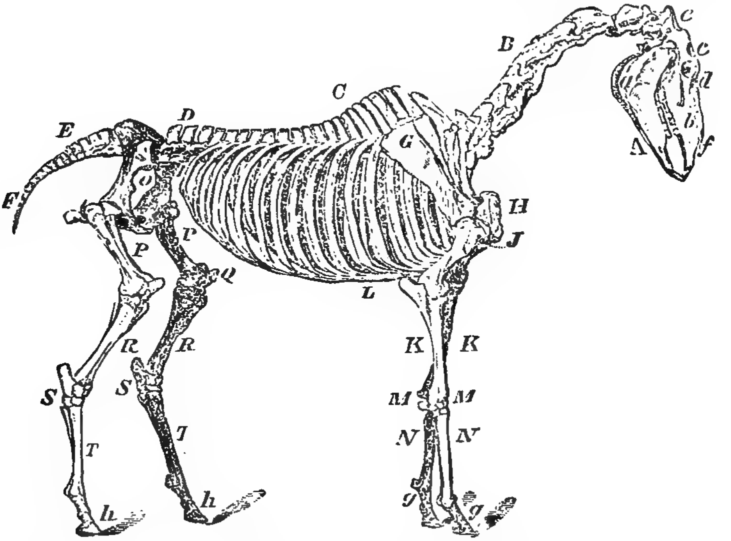


POINTS OF THE HORSE.

a, the muzzle.
b, the face.
c, the forehead.
d, the jowl.
e, the poll.
f, the crest.
g, the withers.
h, the windpipe or thrapple.
i, the back.
j, the point of the shoulder.
k, the breast or chest.
l, the fore-arm, called arm.
m, the knee.
n, the cannon bones.
o, the fetlocks.
p, the small pasterns.
q, the large pasterns.
r, the hoofs.
s, the heels.
t, the elbow.
u, the girth.
v, the flank.
w, the sheath.
x, the scrotum.
y, the hocks.
z, the coronets.
A, the hip.
B, the croup or rump.
C, the dock.
D, the quarter.
E, the thigh.
F, the hamstring.
G, the point of the hock.
H, the loins.
I, the gullet.
J, the shoulder.
K, the arm (*proper*).
L, the barrel (the ribs).
M, the stifle.

The skeleton of the horse is the frame work upon which is built the motive power of the animal. A study of the anatomy, and the names of the several parts, is important. The cut and explanations below will give these correctly and clearly:

A, the head.
a, the posterior maxillary, or under jaw.
b, the superior maxillary, or upper jaw; near the latter is a foramen, through which pass the nerves and blood-vessels, which chiefly supply the lower part of the face.
c, the orbit, or cavity containing the eye.
d, the nasal bones, or bones of the nose.
e, the suture dividing the parietal bones below from the occipital bones above.
f, the interior maxillary bone, containing the upper incisor teeth.
B, the seven cervical vertebræ, or bones of the neck.
C, the eighteen dorsal vertebræ, or bones of the back.
D, the six lumbar vertebræ, or bones of the loin.
E, the five sacral vertebræ, or bones of the haunch.
F, the caudal vertebræ, or bones of the tail, generally about fifteen in number.
G, the scapula, or shoulder blade.
H, the sternum, or chest.
I, the costæ, or ribs, seven or eight, articulated with the sternum, and called the true ribs, and ten or eleven united together by cartilage, called the false ribs.
J, the humerus, or bone of the arm.



SKELETON OF THE HORSE.

K, the radius or bone of the forearm.
L, the ulna, or elbow. The point of the elbow is called the olecranon.
M, the carpus, or knee, consisting of seven bones.
N, the metacarpal bones. The large metacarpal, or cannon and shank in front, and the smaller metacarpal, or splent bones, behind.
g, the fore-pastern and foot, consisting of the *os suffraginis*, or the upper and larger pastern bone, with the sesamoid bones behind, articulating with the cannon and greater pastern; the *os coronæ*, or less pastern, the *os pedis*, or coffin bone, the *os naviculare*, or navicular or shuttle bone, not seen, and articulating with the smaller pastern and coffin bones.
h, the corresponding bones of the hind feet.
O, the haunch, consisting of three portions; the ilium, the ischium, and the pubis.
P, the femur, or thigh.
Q, the stifle joint, with the patella.
R, the tibia, or proper leg-bone; behind is a small bone called the fibula.
S, the tarsus, or hock, composed of six bones. The prominent part is the *os calcis*, or point of the hock.
T, the metatarsals of the hind leg.

The salivary glands, especially the parotid, are remarkably developed; the stomach of the horse is simple and capacious; the intestinal canal is long, but short in comparison with that of the ruminants; but the colon is of enormous capacity, as also is the cæcum, apparently occupying the greater portion of the abdominal cavity; the small intestine is about fifty-six feet long, with a circumference of from two and a half to six inches; the cæcum is two and a half feet long, and two feet in circumference at the widest part; the colon and rectum are twenty-one feet long, the former averaging two feet in circumference; the whole canal, therefore, is about eighty feet long. The liver weighs between four and five pounds, having no gall bladder, and the spleen twelve ounces; the urinary bladder is small in comparison with the size of the animal, its circumference when moderately distended being about one and a half feet; the mammary nipples are two, inguinal, and have at the base a hollow cavity which permits the accumulation of a considerable quantity of milk, which is often removed by man as an article of diet, especially for invalids. The hoof of the horse presents an admirable adaptation to secure solidity and elasticity in an instrument of progression; the whole exterior horny covering, to which the shoe is attached, composed of modified epidermic structure, is a hollow cone truncated above, into which the coffin bone is received; highest in front, it gradually diminishes backward, where it is suddenly turned inward, becoming mixed with the sole, supporting the under parts of the foot, and protecting the sole and the frog from too rough pressure against the ground; this internal wall, called the bars of the foot, by its sloping direction distributes the weight of the body toward the sides of the hoof, with whose numerous perpendicular horny laminæ interdigitate similar processes from the vascular surface of the coffin bone. In the triangular space in the center of the foot, is an elastic horny mass called the frog, its base connecting the posterior curves of the hoof, the sides united with the bar, and the point extending about to the center of the sole;

on the sides are deep channels, to allow of its expansion and render the foot elastic; its actual thickness in horn is not so great as farriers seem to think, from the freedom with which they use the paring knife; in a well formed foot, the base of the frog ought to occupy a sixth part of the circumference of the circle of the hoof; in the center of the frog is a horny conical cavity of considerable depth, which protects the partially cleft foot from further rupture, adds to the elasticity, secures a firmer hold on loose soils, and passing above into the substance of the sensitive frog, serves to unite firmly the two halves of the foot, which are completely divided in ruminants; this horny cone has been called the frogstay or bolt. The sensitive frog falls into the inverted arch of the horny frog, which are thus held mutually in place and preserved from external shock. The sole is an irregular plate of horn, closing up the lower opening of the foot, of an arched form, abutting everywhere against the sides of the wall, another contrivance for securing elasticity. The foot of the horse, therefore, though solid in front, is partially cleft behind, so that the terms *solidungula* and *solipoda* can not strictly be applied to it; indeed a solid, continuous, unyielding circle of horn would be very painful if not entirely useless as an instrument of active progression. Immediately under the hoof are extensive cartilages, attached to the last two bones, protecting the upper part of the structure and adding greatly to the elasticity of the foot, and permitting the movements of the coffin bone within the hoof. Under the hoof is also a very sensitive and vascular layer, from which the hoof originates, analogous to the soft core of hollow horns and the matrix of nails. The eyes of the horse are large, and the sight excellent, and capable of distinguishing objects by night; the ears are large and very movable, and the sense of hearing very acute, as in other timid and comparatively defenseless animals; the sense of smell is also acute, as is seen in their selection of food and in the recognition of their masters; the cutaneous sense is very fine, and the tactile powers of their movable lips exquisite. The movements of the horse are many; besides the walk, trot, gallop, and amble, pace, or rack, some horses gallop with the fore legs and trot with the hind, others move each leg separately in succession, and others execute many artificial movements, the result of education. The horse is quick to perceive and has an excellent memory, two qualities which render his training easy and extensive; he is capable of deep. and lasting attachment. The neigh or voice of the horse is well known, the females exercising it less frequently than the males. In compact form, elegance of proportions, and grace of movement, combining speed and strength, it is surpassed by no animal; sculptors and painters have made the horse the subject of their chisels and pencils, and poets, sacred and secular, have sung its praises from time immemorial. Almost every part of the horse, after death, is useful to man; his skin is valuable for gloves, his hair for making cloth, his bones for buttons and for grinding into fertilizers, his flesh as food for dogs, his hoofs for making glue, and his intestines for the manufacture of delicate membranous tissues; so that the horse, said in ancient fable to have been created by Neptune as the animal most useful to man, can safely lay claim to being of the greatest value to the human race. It is an error to suppose there were wild horses found in America at the time of its discovery. The so-called wild horses of America are undoubtedly of Spanish origin escaped from the earlier Spanish adventurers, those of North America from the chargers abandoned by De Soto, and those of South America liberated at the abandonment of Buenos Ayres. This of course is mere conjecture, as to the exact source from whence they sprang. Certain it is, that no trace of horses were discovered by the first navigators visiting our shores. The same is true of the islands of the Pacific, and Australia, nevertheless, fossil remains of the equine race have been found, but they became extinct long before the historic period. Those which escaped from the Spaniards, however, soon multiplied, and congregated into vast droves in the tropical and semi-tropical regions north and south of the equator, where they live in a semi-wild, and even fully wild state.

HORSE-CHESTNUT. *Æsculus hippocastanum.* This tree is remarkable for the beauty of its figure, flowers, and early foliage. The wood is soft and of little value. The nuts contain much nutritious matter, which is combined with a disagreeable bitter. The Buckeye is of this genus, or, rather, of the sub-genus *Pavia.*

HORSE OF ALL WORK. The horse of all work may be designated as that class used principally on the farm, specially adapted to farm labor, but which being stout and true at a heavy pull, will at the same time be a tolerable saddle horse; and which on the road, besides drawing loads at a fair even pace, shall at the same time be capable of moving off at the rate of six or seven miles an hour, with the family carriage, if necessary. If to these qualities the animal, in addition should possess a handsome shape and carriage, he will indeed be a prize. It must be confessed that such animals are very rare, and when obtained are regarded by their owner with especial favor. In fact, such do not long remain on the farm; some acute horse buyer is sure to pick up all such animals for sale in cities, as light carriage-horses and horses of light draft. The horse of all work is, of course, always of mixed blood, that of the thoroughbred on the ordinary cold blooded mares of the country producing the largest number. As a rule, from want of care in breeding, they are apt to be weedy animals, really unfit for anything except light work. The horse of all work should be not less than fifteen hands high, and from that to sixteen hands, with a good head, a neck of medium length, well set on, rather oblique shoulders, withers rather high, a chest neither narrow nor broad, clean limbs, short bodied, round barreled, the rump and haunch long and muscular, and the tail set on rather high. A large, handsome roomy mare, stinted to a staunch, muscular thoroughbred makes, to our mind, the perfection of a horse of all work. A cross of a Cleveland Bay stallion.(which now-a-days possesses a strong dash of thorough blood,) crossed with a good sized, active, roomy, mare should produce animals that will do the work of the farm and road until six years old, and then be most salable horses for city work, either for the carriage, coupe, express work, or light draft, according to the style and make-up which they possess. In breeding for such horses, however, the farmer must have studied horses carefully, to become successful; far more so than the generality of farmers do. The greatest mistake made, is in breeding to thoroughbreds, weedy, or otherwise unfit for any profitable work. A stout, muscular thoroughbred, if he be handsome, and yet not speedy enough for the one or two-mile course, would be just the thing, and yet the most of the thoroughbreds used by farmers, who are horse breeders, are animals that can not possibly "stay" for more than a quarter, or at most half a mile. Two and three mile racers, stout and muscular, are wanted to assist in forming the horse of all work for our country districts, North and South. In the South, the horse of all work is especially a feeble and weedy animal. That section of the country lacks, essentially, the powerful work horses found almost everywhere in the North. Another class of horses suited to produce horses of all work, are stout, compact, large trotting stallions. Such are muscular, and of good bottom, and if, in addition, they are from fifteen and a half to sixteen hands, will leave their impress wherever used. If the farmer would select good sized, roomy mares to breed to such stallions, it would soon result in a class of farm horses, which, while doing the work of the farm, would, when ready for the market, command quick sale, and good prices.

HORSE'S LIMBS AND FEET. It has been said that however superior the horse's body, lungs, and digestion, that he becomes an inefficient servant without these are accompanied with the most excellent limbs, and good feet; limbs are useless if the feet are unsound. It is, therefore, of the first importance that the greatest care be taken, not only of the limbs, but especially of the feet, since these latter are most liable to injury. In the article, Spavin, will be found cuts of the upper or larger bones of the limbs, showing diseased bony growths. It will only be necessary here to show the limbs below the hock and knee, including the hoof, to give an idea of the importance of the limbs. Fig. 1 shows the bones of the fore leg, side view; *a*, bones of carpus; *b*, splent or splint bone; *c*, cannon bone; *d*, sesamoid bone; *e*, pastern bone; *f*, coronet bone; *g*, coffin bone. At Fig. 2 is shown bones of hind leg, front view; *a*, *b*, *c*, *d*, *e*, bones of the tarsus; *f*, cannon bone; *g*, pastern bone; *h*, coronet bone; *i*, coffin bone. Fig. 3 shows a side view of hind leg; *a*, bones of the tarsus; *b*, splint bone; *c*, cannon bone; *d*, sesamoid bone; *e*, pastern bone; *f*, coronet bone; *g*, coffin bone. It will be seen that below the knee and hock, the names of the bones are similar. Thus, with the cut of skeleton previously given, the reader will not only get a perfect idea of the proper location of the bones but their correct names. Following is a comprehensive statement relating to the foot of the horse, as found in the correspondence of the United States Department of Agriculture, which we illustrate with references. Immediately below the carpus and tarsus is a single large metacarpal or metatarsal bone, called the cannon bone. Upon either side of this is a rudimentary bone, the splint bone. These two splint bones, expanded at their upper

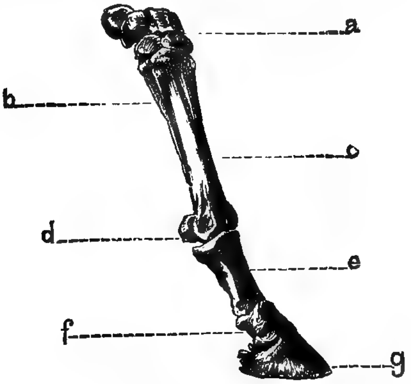


Fig. 1.

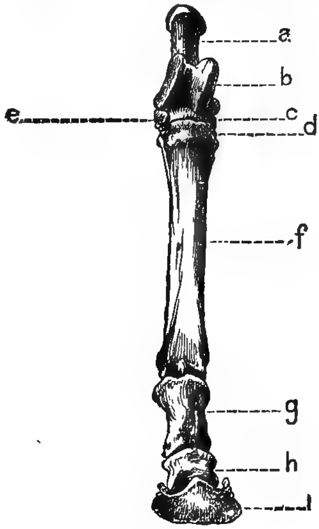


Fig. 2.

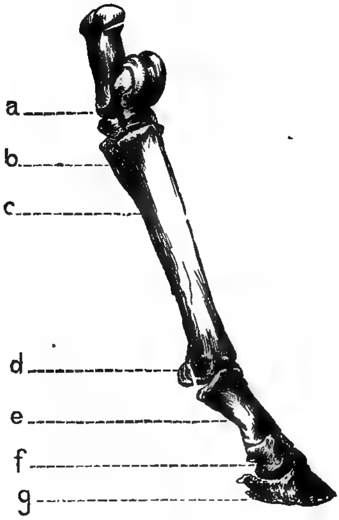


Fig. 3.

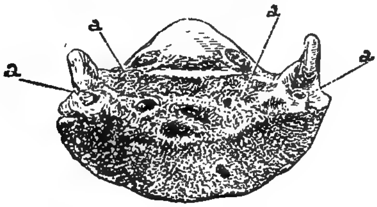


Fig. 4.

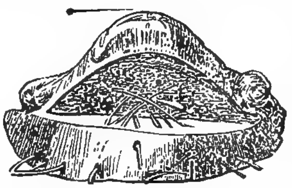


Fig. 5.

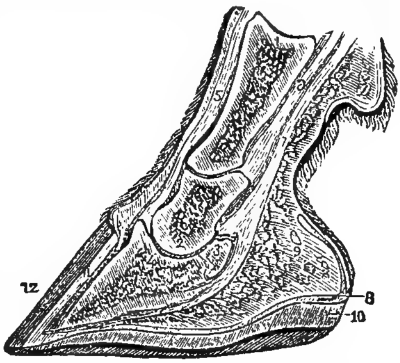


Fig. 6.

extremities, where they enter into the formation of the knee and hock joints, grow gradually smaller as they pass down by the side, and rather to the rear of the main bone, and terminate before reaching the fetlock joint. Below the cannon bone, taking an oblique direction anteriorly from it, is the pastern bone, long pastern, (*os suffraginis*). In length it is from one-third to one-half that of the cannon bone. Below this is the coronet bone, short pastern, lower pastern, (*os coronæ*) which is nearly square in form; its transverse diameter being however, greater than its vertical. The last bone terminating the extremity is the coffin bone, (*os pedis*). This bone has been described as having a body and wings. Its general outline is semilunar anteriorly, superiorly in its convex, and posteriorly and inferiorly it is concave. In texture it is light and spongy, perforated throughout by canals, (Figs. 4 and 5,) through which blood-vessels and nerves are abundantly distributed to the soft and sensitive tissues that cover it. The wings extend directly backward from the body, and support the lateral cartilages. Upon its superior aspect is a smooth and concave surface, placed obliquely to the body of the bone for articulation with the middle phalanx or coronet-bone. Applied to the joint between the coronet and coffin bones, posteriorly, and lying in the concavity of the coffin bone, is a small bone of peculiar shape—the navicular, (Fig. 6). This is a sesamoid bone, being contained in, or attached to, the tendon of the deep flexor. It is from two to two and one-half inches long, three-fourths of an inch in width at its widest part, and half an inch in thickness. Two surfaces of this bone, meeting in front at an acute angle, are covered with cartilage and synovial membrane. The posterior surface is rough for the attachment of the tendon of the deep flexor. Attached to the upper edge of the wings of the coffin-bone are the two lateral cartilages. They are irregular in form, elastic, and extend backward, giving form, substance, and elasticity to the heel upward as high as the pastern joint, and forward, so that only the width of the great extensor tendon of the foot separates them. In fact, the fibrous investment of the tendon is attached to these cartilages. The Cyclopædia of Anatomy and Physiology says, this widely distributed cartilage may be observed passing downward and surrounding on every side the rough and knotty extremities of the heels of the coffin bone, entering and filling up its sinuosities and taking strong attachment to these processes. It then extends horizontally inward, passing over the horny sole and bars, and, meeting the sides of the sensitive frog, intimately unites with it, forming one inseparable mass and filling together the whole interior area described by the sides of the coffin bone. The upright or lateral portion of the cartilage forms with the horizontal portion passing inward a right angle, thus making together a hollow space or receptacle at the back of the coffin bone that contains the spongy, elastic stuffing of the heels, together with the tendons, vessels, and nerves passing through the sole of the foot. The upper surface of the horizontal process of cartilage is full of scabrous elevations and depressions that defy dissection, among which is found a quantity of gelatino-ligamentous tissue. Beneath, or to the under surface of this horizontal layer, the sensitive sole and bar are adherent. As it approaches the frog or center of the foot, it loses its cartilaginous nature and becomes coriaceous, or rather ligamento-coriaceous, in texture, agreeing in this with the internal frog. The horizontal portion or process of the cartilage, known by veterinary writers as the stratiform process, is of greater thickness and substance than the other parts. It is also of coarser grain and more elastic nature. Both portions together communicate the general boundary of form to the lateral, posterior, and inferior parts of the foot. When the bars and the frog are thrust upward by pressure from without, they are acting against this same horizontal flooring formed by the cartilage and the frog, and are met by the depression of the bones of the foot forced down by pressure of the weight of the animal. The whole can then dilate exteriorly along with the posterior and more elastic parts of the hoof. Several important purposes are answered by this extensive distribution of elastic fibro-cartilage—1, the interposition of a layer of elastic tissue between the hard hoof and the hard bone prevents shock and jar to the body as the foot strikes the ground in walking or running; 2, the coffin bone not extending posteriorly much beyond the middle of the foot, except by its projecting wings, a large portion of the hinder part of the foot is made up of soft elastic cartilage instead of bone, breaking the force of the blow of the tread; 3, the distribution of elastic cartilage serves to equalize the pressure of the bones of the foot upon the broader surface of the hoof; and, lastly, this arrangement of an elastic cushion, increasing in thickness toward the posterior aspect of the foot, affords an elastic support to the movements of the coffin bone in the hoof, thereby aiding the elastic laminæ upon the superior convex surface in support of the bone. While the toe of the coffin bone is comparatively stationary, there is considerable motion of the heel upon the toe as a center, thereby contributing to the extent, freedom, and ease of movement of the foot. Molded upon the surface of the coffin bone, over its entire extent, is a thick, villous, highly vascular, and sensitive membrane having the general name of the sensitive foot, besides having several local names derived from the part of the hoof under which it lies, as sensitive laminæ, sensitive sole, and sensitive frog. This tissue is derived mainly from the skin. It may be said to be a process from the skin, covering the coffin bone, and altered in its structure to adapt it to its office as an excretory membrane. It exactly corresponds to that portion of the human skin which produces the nails. The proper skin of the leg, as it arrives at the foot, becomes thickened and altered in its structure, constituting the mass around the summit of the hoof, to which veterinary writers have given the name of coronary band. This is lodged in a groove seen around the upper edge of the horny wall, and from this the straight fibers of the wall are secreted. From the coronary band there is a prolongation of the skin downward over the coffin bone. This tissue is thrown into permanent folds or laminæ, the sensitive laminæ, between five and six hundred in number, arranged lengthwise of the foot. They secrete matter which enters into the formation of the horny wall, to the laminæ of which they are very closely united. According to Virchow, each lamina corresponds to a single papilla, as seen on the surface of the skin. Similar tissue, thickly studded with secreting papillæ, covers the inferior surface of the coffin bone, the fibro-elastic frog, and the widely distributed cartilages, already mentioned. This tissue is richly supplied with nerves and blood-vessels, the latter forming large plexuses which extend to and above the margin of the hoof. The elastic laminæ are found around the whole convex surface of the coffin bone, having a breadth of about one-tenth of an inch, and a length of about two inches in front, decreasing to an inch at the heels. These laminæ, much reduced in size and importance, are continued over the bars into the center of the foot. Each laminæ consists of a single plait or fold of two layers of membrane, which apply closely to, and are firmly attached to, two corresponding surfaces of the laminæ of the horny hoof. Either in the laminæ themselves, or in the fibrous membrane on which they rest, and which is the medium of their union with the bone, great elasticity resides, so that the coffin bone, with the weight it sustains, receives a large part of its support from the laminæ, acting as hundreds of elastic springs It is this structure and arrangement that aid greatly in obviating shocks and preserving the integrity of the soft tissues at the bottom of the foot. By taking two strips of paper and folding them together in regular, even plaits, we have an illustration of the method of union between the soft and sensitive and the horny laminæ. If, in addition, one of the layers be considered elastic, the philosophy of the elastic suspension of the foot would be obvious. The tissue constituting the sensitive sole, averaging, perhaps, one-eighth of an inch, thinner over the frog and thicker over the heels, is even more fibrous, vascular, and sensitive than the laminæ. It is closely connected with the fibrous tissue of the sensitive laminæ in front and the covering of the heels and frog behind. From it the horny sole and frog are secreted. The sensitive tissues that invest the bones of the foot are covered and protected by a thick, dense, horny cap or box, the hoof. The physiological relation of the hoof to the parts which it covers is essentially the same as that of the human nail to the parts covered by it. Functionally, its relations are more extensive and complete, and whatever differences exist in structure, in form, or extent of development, come from modifications for special use. The hoof consists of three portions, which are so closely united as to seem but one; yet, by maceration, or by boiling, they can be separated. These are the wall or crust, the sole and the frog. The wall (Fig 7, *e*, *e*, *e*) is all that part of the hoof that is visible below the hair when the foot is placed upon the ground. It is in the form of a cylinder, cut across obliquely at the top. It is deepest in front, from three to four inches, and grows gradually less in depth toward its posterior aspect. This wall, which is secreted mainly by the coronary band, and partly by the sensitive wall beneath, is in front about half an inch in thickness, becoming thinner on the back side as it extends around the foot. It has an edge bearing upon the ground of about half an inch around the outside of the bottom of the foot, (Fig. 7, *e*, *e*). Upon the inner side of the foot the wall is thinner than upon the outside. The explanation will show the relative parts: Ground surface of hoof, *a*, toe,; *a* 1, inner toe; *a* 2, outer toe; *b* 1, inner quarter; *b* 2, outer quarter; *c* 1, inner heel; *c* 2, outer heel; *d*, *d*, *d*, sole; *e*, *e*, wall of the hoof; *f*, *f*, the bars; *g*, *g*, the commissures; *h*, *k*, *l*, the frog; *h*, part under the navicular joint; *k*, boundary of the cleft; *i*, *i*, the bulbs of the heels. The wall is divided into toe, quarters, heels, and bars, superior or coronary border, inferior or solar border, and laminæ. Passing any special description of the borders, the laminæ deserve more particular attention. The lamina or *lamellæ*, are the very numerous, narrow, and thin plates which cover the entire interior aspect of the horny wall. They are in length from two inches in front to less than an inch at the heels. They

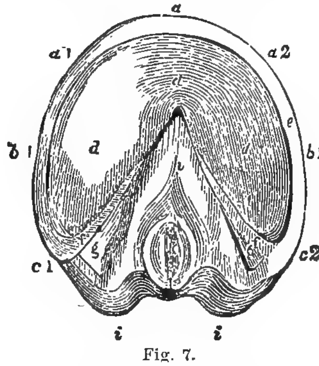


Fig. 7.

are also visible over the bars. They have a very constant width of about one-tenth of an inch, and extend from the lower to the upper border of the hoof, are essentially parallel to each other, and have a free edge and two free surfaces. Each lamella is received into, and is very closely united to two of the lamellæ of the sensitive wall. By this arrangement the surface by which the horny wall is attached to the sensitive hoof is very largely increased, (by exact calculation of Dr. Evans, increased by twelve times), and this attachment, while possessing great strength, has great elasticity, and admits of considerable motion between the horny sole and the coffin bone contained in it. The toe (Fig. 7, *a*) constitutes about two-thirds of the wall, and is sometimes subdivided, for minute description, into toe, inner toe, and outer toe, (Fig. 7, *a*, *a* 1, *a* 2). It is the deepest and thickest part of the wall, and stands at an angle, in the average of good feet, of about forty-five degrees. When the angle of inclination is much greater than this, the feet are designated as flat and weak. Flat and weak feet usually obtain in large and heavy animals, and it has been thought that as the foot is flattened, the anterior wall will be drawn down, by the weight, at length becoming fixed. The quarters (Fig. 7, *b* 1, *b* 2) are the portions on each side, midway between the toe and the heels, and are designated as the inside and outside quarters. The fibers composing them run obliquely upward and backward, parallel to those of the toe. The quarters slope downward and backward, and become thinner as they approach the heels. The heels (Fig. 7, *i*, *i*,) are the two protuberant portions of the wall by which it is terminated posteriorly. The wall here is shortest and thinnest, the fibers being only about an inch in length, and not exceeding the fourth of an inch in thickness. While, in its natural state, there is some degree of elasticity in the entire wall, there is much more in the portion that covers the heels. The bars (Fig. 7, *f*, *f*,) are reflections of the wall in toward the center of the foot, on its ground surface. They gradually approach each other, and come together a little in front of the center of the foot. The bars are usually regarded as parts of the sole, but maceration shows them to be separable from the sole, but inseparable from the wall. In the natural, healthy foot, that has never been shod, the bars appear as sharpened prominences, like braces, between the center of the foot and the heels. The best writers agree that they are well adapted to keep the heels open, and prevent contraction of the hoof. In the unshod foot, the bars have a bearing upon the ground, second only to that of the edge of the wall. The sole (Fig. 7, *d*, *d*, *d*,) fills the space between the wall and the bars. It is in the form of an irregular arched plate, the concavity being toward the ground. It is firmly attached, by its outer convex edge, to the inner surface of the solar border of the wall, while its inner straight edges are attached to the bars. It has been described as joining the frog, but throughout its whole extent the bars intervene between the sole and the frog. The center of the sole is the thinnest portion of it, and it also constitutes the summit of the arch. The lower circumference of the arch, which is also the thickest and strongest, everywhere abuts against the sides of the wall. The result of this mechanism is, that at every step, as the weight is thrown upon the foot, the coffin bone descends, elongating the elastic fibrous tissue connected with the sensitive laminæ, and, pressing upon the highly elastic tissue of the sensitive sole, which rests upon the arch of the horny sole, causes the latter to yield and descend. The wall being elastic, especially toward the heels, is readily pressed outward, so that the ground surface of the foot is larger while bearing the weight than it is when the pressure is removed. Whenever the weight is taken off, the wall springs back, and the sole recovers its arched form. By this means the step is rendered elastic, jarring is obviated, and injury to the sensitive sole and sensitive frog is prevented. The frog (Fig. 7, *h* ,*k*, *l*,) is a wedge-like mass filling the angular space between the bars, and consists not of solid horn, as might at first seem, but of a series of elastic arches. It has been not inaptly compared to an elastic keystone received into an elastic arch, communicating in some cases, and admitting in all, the springing movements of which such an arch is capable. The base of the frog lies between and connects the posterior curved portions of the hoof, limiting to some extent their action. The sides are connected with the bars by their upper edges, leaving upon the ground surface two deep channels between the lower border of the bars and frog, which have been termed the commissures of the frog (Fig. 7, *g*). The horny material arching over these channels is called the arch of the commissures. In the center of the frog, as we look upon its ground surface, is a deep, narrow depression, the cleft of the frog, (Fig. 7, *k*,) which extends further into the soft tissues of the foot than the commissures. This cleft is arched over in a similar manner, and the cone-like mass, as viewed on its inner upper surface, has received the name of frog stay or bolt. Looking upon both the exterior and interior surface of the frog, we see that with the bars it forms three elastic foldings, which act as springs to keep the heels apart and the foot well spread. In the natural, unshod foot, the frog, though protected to some degree by the solar border of the wall and by the sharp prominences of the bars, must still receive pressure at each step. The order of force in which the different parts of the foot press the ground in walking, running, etc., has been stated to be as follows: First, the solar border of the wall; second, the bars; and third, the frog. In the foot that has never been shod the frog has nearly if not quite as much pressure in the full step as the wall. In rapid stepping, the edge of the wall, which is nearest the point of the coffin bone, receives the first force of the blow, while the frog, which mainly rests upon the elastic heels, a much more yielding substance, receives the weight as the foot settles back to its level. The effect of pressure is to flatten the arches of the commissures and cleft, to widen the frog, throw out the heels, and keep the foot freely expanded. The elasticity of the step of the horse is the result of a highly compound arrangement—first, the elasticity of the sensitive laminæ; second, the greater elasticity of the sensitive sole; third, the elasticity of the horny wall; fourth, the arch of the sole; and, fifth, the triple-spring formed by the foldings of the frog and the manner of its union with the bars. The movements of the foot are produced by two sets of muscles, flexors and extensors, similar to the distribution of a single finger in man. The flexors are two in number, and are situated upon the posterior aspect of the leg. In the fore legs these muscles are the *flexor sublimis perforatus*, (Fig. 6, 6,) and the *flexor profundus perforans*, (Fig. 6, 7,) also called in works on farriery *flexor pedis perforatus* and *flexor pedis perforans;* also familiarly designated as the common and deep flexor muscles. These muscles take their origin in common from the internal protuberance of the humerus, and are united for a considerable distance down the arm, when they separate to form two distinct tendons. Of these, that belonging to the perforatus runs beneath the annular ligament of the carpus, to be inserted into the upper and back part of the lower pastern or coronet bone. Just before reaching the pastern joint, this tendon divides, to allow the tendon of the perforans to pass through it. Each division where it plays over the joint has in it a sesamoid bone. The tendon of the perforans, lying deeper above, passes between the divided tendon of the first-named muscle, to be inserted into the posterior concavity of the coffin bone. Attached to this tendon, as it passes over the joint formed by the coronet and coffin bones, is the navicular bone, considered as a sesamoid bone in this tendon. Two supplementary flexors, the accessores, are described as arising from the posterior and inferior aspect of the ulna and the radius, and uniting below with the two main flexors. These muscles flex the foot upon the leg. As antagonists to these, there are three extensor muscles situated upon the front of the leg, corresponding to the *extensor communis digitorum* and *extensor minimi digiti* of the human arm. The *extensor communis*, otherwise called in hippotomy *extensor pedis*, arises from the external condyle of the humerus, and from contiguous fascia, and from the upper and lateral part of the radius, and has a strong, fleshy belly, which terminates in a single tendon which passes down over the front of the leg to be inserted into the coronal process of the last phalanx—the coffin bone. It unites by a slip with the tendon of the next muscle. The *extensor proprius minimi digiti* is represented in the horse by two muscles. One of these, called the extensor of the pastern, is inserted by a strong tendon into the side of the first phalanx, the pastern bone. The second muscle, placed between the two preceding muscles, furnishes a strong tendon which passes down in front of the carpus and becomes united with the communis at an acute angle. The united tendon (Fig. 6, 5) passes behind the coronary border of the hoof to its insertion in the coffin bone. The office of these muscles is to extend the foot upon the leg. Another muscle, the *adductor longus pollicis*, called in hippotomy the oblique extensor of the cannon, by its insertion into the base of the cannon bone, acts as an extensor of the foot. A similar arrangement exists in the muscles of the hind leg. The tendon of the *plantaris*, of great strength, has a divided insertion corresponding to that of the *flexor sublimis perforatus* of the fore leg, while the *flexor perforans* sends its single strong tendon between the two divisions of the preceding muscle to be inserted into the terminal phalanx. These flexors of the foot are assisted by the tendon of the *flexor hallucis*, which unites with the tendon of the perforans. The extensor tendon of the hind leg, of great strength, is furnished mainly by the *extensor communis* muscle. The *extensor brevis* is represented by a few fibers which come from the cannon bone, and unite with the tendon of the *communis*. The united tendon passes, as the corresponding one of the fore leg (Fig. 6, 5) to its insertion in the coffin bone. The arteries of the foot are branches of the radial, in the fore, and of the tibial in the hind legs. The former descends along the radius, accompanied by the radial nerve, to a point a little above the knee, where it divides into the large and small metacarpal arteries. Of these the large metacarpal is the principal trunk, passing under the posterior annular ligament. While passing down the cannon bone it divides into three branches. The middle one is distributed to surrounding tissues, while the other two become the plantar arteries, internal and external. The plantar arteries of the fore leg result from a division of the metacarpal, and in the hind leg from a similar division of the metatarsal, and the terminal distribution is alike in both. They descend to the lower part of the cannon bone (Fig. 8) pass the fetlock joint by the side of the sesamoid bones, in company with veins and nerves of the same names, and pass into the substance of what is sometimes called the fatty frog. They then pass the extremities of the coffin bone and enter the foramina on the posterior concavity of the bone. (Fig. 4, *a, a, a, a*). The branches of the plantar arteries are very numerous, and no part of the body is more fully supplied with blood than the foot (Fig. 5). The veins of the foot constitute a very intricate net-work of vessels. The veins of the frog, the sole, the laminæ, the superficial and deep-seated coronary veins, unite to form coronary and plantar plexuses (Fig. 8), from which are formed plantar veins, which, by their union, constitute metacarpal and metatarsal veins, which lie anterior to, and by the side of, the plantar arteries. Dissection of the horse's foot is shown at Fig. 8: 1, general integument, turned back; 2, fatty mass, forming a cushion behind the great pastern joint; 3, wall of hoof turned back, showing the vertically laminated processes pro-

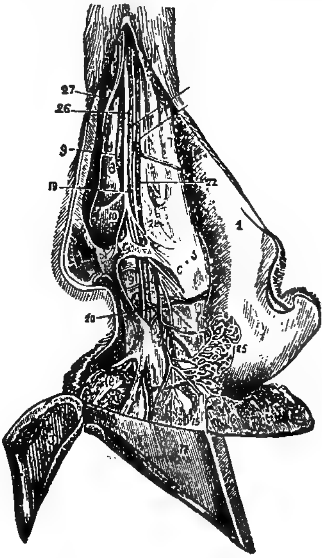


Fig. 8.

jecting from its inner surface; 4, section of wall of hoof; 5, the articulation between the cannon and pastern bones; 6, 6, 6, aponeurotic tissues; 7, 7, extensor tendon of the foot; 8, 9, 10, flexor tendons of the foot; 11, 12, 13, 14, 15, expansion of the great cartilage of the foot; 16, the coronary band raised from the hoof; 17, the vascular or sensitive hoof; 18, elastic cushion of the heels; 19, 20, 21, plantar artery; 22, 23, plantar veins; 25, part of coronary venous plexus raised from its position; 26, 27, 28, plantar nerves. The nerves of the foot are known by names corresponding to those of the blood-vessels which they accompany. The plantar nerves (Fig. 8) lie by the side of and behind the corresponding artery, and, as they descend into the foot, are distributed to the same organs and regions. The final branches enter the foramina in the coffin bone, minutely subdivide in it, pass through its many canals, and escape at the edges of the sole to the sensitive parts of the foot, in company with the terminal twigs of the arteries as shown in figure five.

HORSE-TAIL. The genera *Equisetum*, or scouring rush, and *Hippuris*, remarkable for the large amount of silica they contain. They grow in rich, wet places, and are of value for polishing.

HORTICULTURE. In defining agriculture, in another part of this volume, we stated it as embracing all that pertained to the working of the earth, dividing it into two great branches, husbandry and horticulture. This latter is again subdivided into pomology, vegetable gardening, the raising of nursery stock, floriculture and landscape gardening. These are the most elegant, as they are the most fascinating employments relating to agriculture. Horticulture is never practiced by man, until husbandry has become a true art, nor until such a state of civilization exists in a nation, as not only to call for great variety in the culinary art, but elegance and ornament about the homes of the people. Ancient horticulture was but crude as compared with modern, as was their civilization, if we except the unqualified superiority of Greek sculpture, and not until within the last one hundred years has horticulture become more than a crude art, either in the superior variety of fruits cultivated, the excellence of vegetables, or in the talent displayed in the adornment of the landscape. Horticulture, like agriculture, not only has its practical but its scientific sense also. The uniting of the practical with the scientific is what makes the finished workman in every art or profession in life. Thus, horticulture was divided by the late W. C. Flagg, one of the most eminent horticultural writers of the West, while President of the Illinois Horticultural Society, into distinct branches, and grouped together, from which we extract, (Illinois being implied, but which with allowances for soil and climate will do generally for the West): I. Useful, comprising Fruit Growing, which includes: orchard culture; vineyard culture; small fruits and their culture. Vegetable or market gardening, including vegetables cultivated for their roots or tubers, as potatoes, onions, beets, etc.; vegetables cultivated for their leaves or stems, as cabbage, asparagus, etc.; vegetables cultivated for their fruit, as tomatoes, melons, peas, etc. Tree Growing, including hedging; belts, or wind breaks; timber plantations and woodlands; nursery culture. II. Ornamental, comprising ornamental tree planting; flower gardening; landscape gardening. III. Scientific, comprising collections of fruits, vegetables, trees, flowers, and plants generally, made not so much for profit or ornamentation, as for experiment and to gratify a scientific taste. Horticulture requires special attention to the choice of soil and climate. The soil for nearly every horticultural product should be warm, deep, dry, and not too rich in humus, nor yet too sandy. The chief difficulties of tree growth in the northern part of the State and in States farther north, seem to be rather of the soil than of the climate. The soil, in some cases, is so loose as to freeze to the depth of six feet in hard winters, and very imperfectly protects any plant standing in it through the winter, whilst so rich as to start a late growth on very little provocation. Soil of a finer and closer texture would evidently be preferable in both respects. Our best soils, as a rule, are those of lighter color, on which forest trees are growing, or will most readily grow. The situation for all horticultural purposes should be as elevated as possible above the surrounding country, so as to avoid the late frosts of spring and the early frosts of autumn; and that the winds may have access during the humid, still heats of early summer, which are detrimental to most horticultural growths. It should be distinctly understood that the summer needs of the fruit tree and its fruits are plenty of air and sunshine. Horticulture demands foresight. The question of a market for one's products, of the varieties of fruit that will be profitable twenty years hence, but that must be chosen and planted this year; of the future effect of a clump of trees, and the prospective value of a given kind for lumber; these and many other points involving one's future prosperity and success must all be forecast by one who would proceed wisely and well. Lord Bacon said that, he who hath a wife and children hath given hostages to fortune. Hardly less is this the case with him who plants an orchard, a vineyard, or a forest. Horticulture, in all or nearly all its branches, demands very deep and thorough preparation of the soil for its best success. Shallow culture on most soils is to be deprecated in agriculture, much more so in horticulture, where the ground in some cases will not be replanted for many years, and where, in any event, the expense of seeding and culture per acre is much greater than in agriculture. But where deep preparation of ground is for any reason omitted, continuous stirring of the surface in clay soils, at least, has an excellent result, and probably for many smaller plants is a good, if not sufficient substitute. Of useful horticulture fruit growing is the branch most attractive to the masses of the people, and perhaps, as a rule, the most profitable. Of these, orchard fruits comprise the apple, pear, quince, peach, nectarine, cherry, apricot, and occasionally other fruits growing on trees planted in order in a separate plantation or field. Of these we must say, in their favor, that once established they require comparatively little care in their after culture, and in many cases yield their fruit year by year gratuitously. On the other hand, they are less easily protected from sudden changes of weather than vines or shrubs, or from the attacks of insects and diseases. Of these orchard fruits, the apple is in most civilized countries the most important, and probably as ancient as any. It is found in the remains of the lake dwellings of the Neolithic period, apparently cultivated. The pear is also widely distributed, but gives evidence in a greater variety of names of having been domesticated by more different nations. But it seems less flexible in its organization, and in the New World, at least. not to withstand extremes of humidity and dryness, of heat and cold nearly so well as the apple. The quince may be grown at a profit, at least in small quantities, in the damper and richer soils. The success of a few, and the fact that it blossoms late and so avoids frost, would seem an argument that it can and will be more extensively grown in the years to come. But if so, it should be grown as a bush, and not with a trunk. The peach, south of 40° at least, is sufficiently hardy to be cultivated with moderate profit in many localities, and in some places large returns may be realized. This fruit, which is referred to by Confucius, and also, says De Candolle, mentioned as early as the tenth century before Christ, is believed by later authors to be a modified form of the almond. For growing the peach the most favorable points should be selected; such as the heights of the bluffs along our great rivers, the tops of the hills, the mounds, and other elevated points. The varieties having large blossoms seem to be almost invariably the hardiest. The cherry, in one or more of its varieties, is grown throughout the State, and occasionally with considerable profit. The hardy varieties of Early Richmond and Common Morello may be grown almost anywhere and under great neglect. The sweet cherries can be grown in many localities where the subsoil is open and the upper soil not too rich. But the cherry needs a cool summer for the best results, and the buds of the sweet cherry are often nipped by the frost. The plum is quite tender in the bud, except in the Chickasaw, from whose varieties we may expect our best and most complete success in plum growing, just as we have found to be the case with native rather than foreign grapes. Vineyard culture has been wonderfully advanced, both by the discovery and dissemination of more reliable varieties, and in a better teaching and practice of modes of culture. The grape is a profitable fruit, but demands inexorably high culture, timely pruning, training, and pinching. Yet, its culture is specially attractive to the cultivated taste, and remunerative to the good manager. The American grape is a fruit of wide range. The frost grape grows as far north as latitude 50°, three degrees farther north than Quebec, on the Saskatchawan; and the Southern Fox and summer grapes extend down quite to the southern extremity of the United States. Consequently, if we can guard against some of the extremes of cold, which are injurious to the vine, by covering with loose earth, or even laying close to the ground, and can secure the leaves and fruit against the cool nights and hot humidity of the growing season, we can grow grapes nearly everywhere. Our continental climate is one of great extremes. Humboldt, in his Cosmos, intimates that we are fated, as Dante says in the third canto of the Purgatorio:

> To suffer torments both of cold and heat,

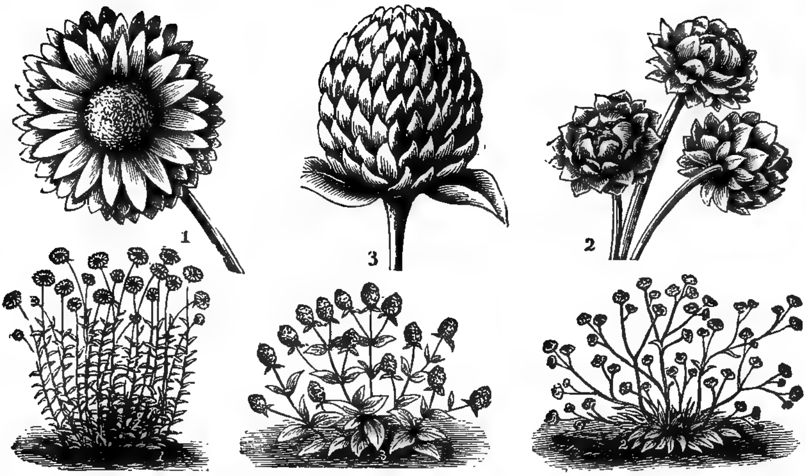
or, as Milton has it, condemned

> To feel by turn the bitter change
> Of fierce extremes; extremes by change more fierce.

We can not fully guard against these extremes, especially the saturation of soil and atmosphere that sometimes takes place in the season of most rapid growth. It is a curious fact, by the way, that some of the finest fruit is grown in these regions of greatest extremes. The finest apples of Russia are said to come from the Crimea, where the thermometer goes up to 100° of summer heat, and the cold of winter is intense. The like is true of the finest fruit countries of Asia, which are all, presumably, continental in their climates The small fruits, including under that name the strawberry, raspberry, blackberry, currant, and gooseberry, (and we might include the cranberry and whortleberry,) are in many respects desirable and valuable crops. The strawberry, from its early returns, fruiting heavily one year from planting, is a desirable crop for the person of small means, or for any one desiring early returns. As it is a low plant, its conditions can be more easily controlled than those of any other fruit by mulching or covering. The raspberry and blackberry bear some fruit in the second year, sometimes amounting to a good crop, and are desirable for that reason. The currant and gooseberry come later into bearing, and are valuable chiefly for their involving small expense in culture and being hardy and productive, rather than high-priced. The strawberry is, without doubt, the most valuable of the small fruits, and the raspberry least so. Vegetable or market gardening near the cities and large towns and to a certain extent where there are good facilities for shipping, is a remunerative though a laborious business, and is associated to a certain extent with fruit growing to advantage. In many cases it borders close upon ordinary agriculture. But in many instances again it requires the best skill of the horticulturist for success. Vegetables grown for their roots or tubers are such as the beet, carrot, onion, parsnip, potato, radish, ruta-baga, sweet potato, and turnip. Vegetables grown for their tops or stems, are such as the asparagus, cabbage, cauliflower, celery, and rhubarb. Vegetables grown for their fruit are the bean, corn, cucumber, egg-plant, melon, pea, squash, tomato, and watermelon. Tree growing, for timber and other purposes, comes late in horticultural progress, and does not look to very immediate results. Yet the attention given to it by governments and individuals in the Old World, evinces its importance and warns us to provide for the future of our own country. We should have trees growing on every declivity too steep for profitable cultivation, and on the west side, at least, of every farm. Hedging, under the impetus it has received from the high prices of fencing, and from the better knowledge of its management is getting on satisfactorily, and the abundant and cheap supply of Osage Orange plants, is fast surrounding our prairie, and even our forest farms with a living wall. The Osage Orange is the surest, and, so far north as its culture can be safely carried, seems to be the best. Very beautiful as an ornamental hedge, and perhaps sufficient for a fence, is the *Pyrus Japonica*. As in other horticulture, deep and thorough preparation of ground, careful planting, and clean cultivation are prime necessities. Belts or wind breaks have been highly extolled and somewhat planted in our prairies. For these belts immediate utility and rapid growth are generally prime requisites, and hence trees of an inferior quality of timber, such as the soft maple, cottonwood, white willow, etc., are planted. But it is evident that evergreens and some of the better deciduous trees should be planted under their lee, to finally replace them. Ornamental horticulture, though very attractive, of course, makes comparatively slow advance in any new country. It appeals to the æsthetic part of our nature, and, therefore, can only receive due attention after hunger is satisfied, and the more immediate necessities of life provided for. Ornamental tree planting, with the exception perhaps of some faint attempt at flower growing—the pathetic effort of a wife or daughter to redeem the arid desert of a corn and hog-grower's front yard, naturally comes first. An ornamental tree or shrub, in a farmer's eye has the immense advantage after once established, of taking care of itself. In ornamental tree planting we may plant many trees not very valuable on account of their beauty of form or foliage. The white elm is a conspicuous example of this kind. The linden is one of the finest, and the white and burr oak are magnificent species, combining the picturesque with the beautiful. The study of these trees, singly and in mass; their characteristics of height and outline; shape of foliage; its shade of green and its autumn colors, as well as the effect of their blossoming, are important as preliminary to the grouping and contrasts of landscape gardening. As a rule, trees of heavy foliage and dense shadow, like the catalpa and linden, with pendant rather than horizontal spray, as the white elm and the willow, and of varied tints, as the locust, in the different shades of its younger and older leaves, or the sugar maple in its change from summer to autumn hues, are most admirable for planting singly. Flower gardening can only be commended in its results. Modern art has compassed the globe, and brought to our homes the floral treasures of ancient Asia and the isles of the sea. But flower culture, attractive as it is to the more refined tastes of woman, and all who sympathize with her, commends itself to us as one of the most innocent of amusements, and one of the most instructive and refining of pursuits. It has too—though that seems little thought of, its market value; and the increasing demand for flowers by those who can not or will not grow them, will give an added interest to the occupation. Landscape gardening may be said to include the whole, of which ornamental trees and flower culture are parts. Here we bring under consideration the configuration of the surface; the surrounding landscape; the effects of grouping and massing trees, shrubs, and flowers of different colors and shades of color; the massing of single colors, and uniform outlines, and one knows not how many intricate æsthetic questions. For landscape gardening is painting in living colors. Longfellow addressing the children at their play, said

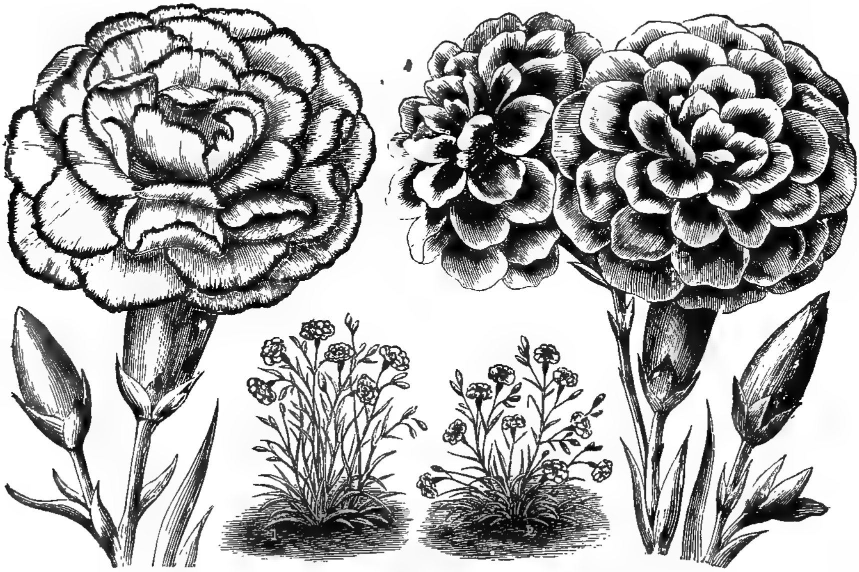
> Ye are better than all the poems
> That were ever sung or said,
> For ye are the living poems,
> And all the rest are dead.

Landscape gardening is better than the painter's work in the same way. It is the reality of which the other is but the shadow. And, though the breadth of surface and the means of carrying out its more elaborate designs are generally beyond private means, there is yet a great neglect of what might be done easily and cheaply, with only a little foresight and thought. A little clump of trees planted on an eminence, costs but a few dollars, yet it may be a point of beauty in the landscape, for a lifetime. A chance elm that has sprung up in a distant corner of the farm, may be staked about and protected in a few minutes time, yet hangs like a green cloud on the horizon for long years to come. Still more will a little work effect great things in the clearing of woodlands. The trees that may be saved, and in one way or another made to subserve the adornment of a home, are grown for our purpose and we gain a generation's time, and see with the eyes of our children. Scientific horticulture is carried on with the primary purpose of increasing knowledge. It aims at the truth, whilst ornamental horticulture seeks the beautiful, and useful horticulture the good. Collections of trees form an attractive pursuit. Arranged botanically, even a single straight row of trees, representing the more common and hardy species, may be made instructive. In conclusion, Mr. Flagg says: In all time, horticulture has been the favorite pursuit of the more advanced races and of the foremost men. It was, we are told, the occupation of our first parents, and our second ancestor planted a vineyard, if he did not make an altogether commendable use of the product. The hanging gardens of Babylon were the wonder of the ancient world, and the sculptures of old Egypt reveal the esteem in which the art was held in that dim and distant time. The Homeric poems with their Garden of Alcinous, whose fruit never perishes, nor does it fail winter or summer, lasting throughout the whole year; but the west wind ever blowing makes some bud forth and ripens others—their Isle of Calypso, where four fountains flowed in succession, with white water, turned near one another, each in different ways, but around there flourished soft meadows of violets and of parsley—bear witness of other and ancient days, as did Theocritus, and Virgil, and Horace, in their time. It was Lord Bacon who said: God Almighty first planted a garden, and, indeed, it is the purest of all human pleasures. It is the greatest refreshment to the spirits of man, without which buildings and palaces are but gross handiworks; and a man shall ever see that when ages grow to civility and elegance, men come to build stately sooner than to garden finely, as if gardening were the greater perfection. Thomas Jefferson—one of the greatest and certainly the most influential in his own and subsequent generations of American statesmen, whose declaration of the absolute equality of man hung on the horizon like the mene tekel upharsin on the wall of the feasting Belshazzar, and won the battles of the second as well as the first revolution—kept a record through the eight years of his presidency of the first appearance and the disappearance of the various vegetables in the Washington markets, and spent his rural hours at Monticello in gardening. Our veteran poet, Bryant—it seems to run in the family—delights in tree planting, and wrote the poem, The Planting of the Apple Tree. Hawthorne, Emerson, Lowell, Mitchell, and many others, living and dead, of our eminent men, have a warm side toward horticulture. Thus, says



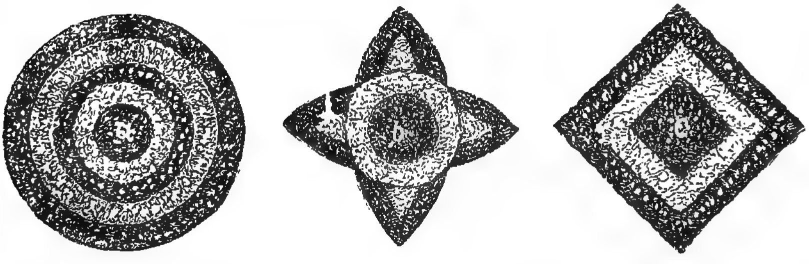
1, Acroclinium. 3, Gomphrena. 2, Ammobium.

EVERLASTING FLOWERS.



Picotee. Garden Pink.

CARNATION-LIKE PINKS.



FORMS OF FLOWER BEDS.

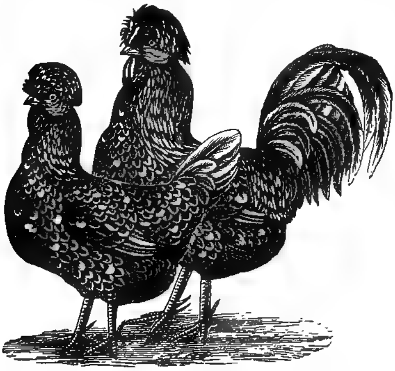
Alcott in his Tablets, we associate gardens and orchards with the perfect condition of mankind. Gardeners ourselves by birthright, we also mythologize and plant our Edens in the east of us like our ancestors—the sacredness of earth and heaven still clinging to the tiller of the ground. Him we esteem the pattern man, the most favored of any. His labors have a charming innocency. They yield the gains of self-respect denied to other callings. His is an occupation friendly to every virtue; the freest of any from covetousness and debasing cares. It is full of honest profits, manly labors, and brings and administers all necessaries, gives the largest leisure for study and recreation, while it answers most tenderly the hospitalities of friendship and the claims of home. The delight of children, the pastime of woman, the privilege of the poor man, as it is the ornament of the rich man, the praise of the scholar, the security of the citizen; it places man in his truest relations to the world in which he lives. He who is insensible to these must lack some chord in the harp of humanity, worshiping, if he worship, at some strange shrine. In conclusion, let us look for a moment at the relation of agriculture to horticulture. Some years ago, the editor presented the subject before the horticulturists of Illinois, in an address, from which extracts are made, as embodying his ideas now as then, and is as follows: The wild man is a brute, the educated one is a God, as pagans understand the term. The first subsists in a precarious manner upon such animals as he may overcome in the chase; but the second harnesses even the elements, and makes them subservient to his will. Both possess bone, sinew, muscle and blood, nerve and brain. The wild man acquires fair proportions, but the brain force is latent. The educated one, however, has fed both his physical and mental nature, and therefore is in the full stature of a man. In rising to a state of barbarism, the savage gathers flocks and herds, cultivates the soil in a rude way, and begins to fix his habitation. Emerging into civilization, art is developed. Enlightenment ensues. Science is born. Brain force becomes superior to physical power. The printing press stores up the knowledge of foregone generations. The flint and steel of mind upon matter knock out scintillations, illuminating the pathway of mankind, assisting one and another in the study of the material and the spiritual in nature. The savage becomes first the herdsman, then the husbandman; soon the arts of horticulture follow, and lastly come beautiful flowers and landscape adornment. The sum of these is agriculture. The poetry of agriculture is horticulture, and beautiful flowers are the religion of agriculture. A mere husbandman may know nothing about horticulture. A horticulturist may know but little of husbandry, but he must necessarily know a good deal about agriculture. An agriculturist must understand all. The farm destitute of some adornment looks sorry and cheerless indeed. The villager's house, with its little parterre and vine-clad bower, pleases and cheers the passer-by, while the costly and naked magnificence of the citizen's mansion is scarcely regarded at all. But if, in passing along a country road, you come to a farm where the wealth of the owner has enabled him to beautify and adorn the landscape and rural surroundings, the exclamation at once comes forth—How lovely! How beautiful! The farm after all is the place for effective landscape adornment, and the farmer who is a horticulturist as well may add much, and at comparatively little expense, to the attractiveness and beauty and comfort of his home. He perhaps moves into a new country, poor enough,—his team, household effects, honest hands, and a quarter section of wild prairie, his all. He ploughs, sows, reaps, feeds cattle; this is husbandry. Of timber there is none. He prepares his rows and plants hedges for fencing, nuts for timber; grafts and buds, strikes cuttings, and rears orchards and vineyards. Curves a drive-way winding about his buildings and offices; makes a lawn shaded by spreading elms and lindens, with here and there other deciduous and evergreen trees; leads the streamlet into the hollow and forms the lake; builds, with advancing wealth, a green house, a conservatory, an aboretum. This man, and only this, is an agriculturist. There are many farmers, who if, as they were growing rich, had devoted some of their money and leisure to these subjects, would not now be lamenting that they had not sooner commenced to be agriculturists instead of mere farmers. We only need to remember that the finer the production, the more care should be bestowed upon it. That the delicate fruit or succulent vegetable forced into an abnormal condition by high cultivation, can not be expected to continue to improve or even hold its own without continued high culture and care. We pay high prices for new wheat, rye, barley, oats and corn, from year to year, and yet after a few seasons of cultivation they become as the old sorts. It is because we have not given them the same cultivation that they had previously received to bring them up to the selling and actually to the economical standard. A man plants an orchard, turns in his cattle to trim it, and his hogs to cultivate it, and feeds it, as he does his cattle, on grass. It is not strange that his orchard is unproductive, and he thinks his is not a good fruit country; while, if the facts were known, there are but few farms in the West but what might produce what fruit is consumed, which is also hardy in their climate; and yet how few farms at the present day in the West produce their own fruit, and at the same time how difficult it is to find any section of the country, but that some farms in them produce fruit, and in abundance! It is simply because we do not give enough attention to diversified agriculture; we either run all to stock, or grain, or fruit, or some one of the principal productions of agricultural art—while more variety in our crops would give greater exercise to the mind, and more varied enjoyment as well, Oh! that the farmers of America might wake up to the great possibilities that lie before them; that our rural youth would study those sciences that pertain to agriculture, the mysteries of vegetable physiology. Why the same air, earth and water produce sound grain or smut, perfect fruits or loathsome corruption. The simple and certain means which nature uses to convert noxious and deleterious matter into plant food. To find the means of attracting to the soil or plant, decomposing and rendering useful at will the latent elements, in air, earth and water. That the earth from becoming more and more barren each year, or relatively, in other words, losing the power of absorption and assimilation, shall grow fatter and fatter, more and more productive, until it shall be again re-instated in its original fertility. If the problem of a higher social existence is solved, it must be solved by applying science, practical science, to industrial pursuits, and which must be founded upon the dignity of labor. The present generation want to reap some benefit from agricultural education. How shall this be done? First, by lectures upon practical agriculture, the management of the farm, orchard, and other rural pursuits, rotation of crops, improvement of seeds, stock breeding and rearing. Management of the dairy, and all that pertains to in-door farm life. Surface and under-draining, their principles and effects. Mechanical and chemical action upon soils. Cultivation of timber. How climates are changed by the settlement of the country, and what may be done to bring it into a more equable condition. The phenomena of atmospheric and aqueous influences so far as we know them. Upon the propagation, rearing and pruning of fruit trees, shrubs, and vines, their habits and culture, gathering, marketing, and use. The forcing cultivation, marketing, and uses of vegetables. The cultivation of ornamental, medicinal and flowering plants. Glass and other structures for forcing. Landscape gardening, rural architecture and ornamentation. Upon the sciences connected with agriculture, their uses and appropriate places so far as discovered. The mapping out and recording upon experimental farms, gardens, and in proper structures, from year to year, of all that is new in agriculture, horticulture, and floriculture. Experimenting, from year to year, upon improved methods of cultivation, and acclimating, instituting comparisons, and reasoning therefrom—the chemist, the botanist, the geologist, the entomologist, the veterinarian, and other professions, down to the humble delver in the soil, being actuated by one motive—the advancement of agricultural science—which, disseminated throughout the land by means of the public press, finds its way to every fireside in the country; while at the same time the young men appointed to enter the different classes in our agricultural schools, will gradually eliminate the dross from the pure metal, and give us something else besides that obnoxious word, empiricism, which we translate, quackery — the pretensions of ignorant men to skill. We have happily supposed that agriculture was somewhat scientific; we had supposed that intimately connected as it was with chemistry, botany, and kindred sciences, that it must necessarily partake somewhat of science itself. But, alas! this agriculture, which in itself is really the sum of all science—the science of life—toward which every known science, more or less, intimately tends, is looked down upon. Why should it be? Every fact in nature, which is constant, is science. Any certain knowledge is science. Bakewell and the Collings were scientific stock breeders. The fruit grower who saves his crop under adverse circumstances, by the application of certain knowledge, is scientific. So of the husbandman. The florist is decidedly scientific, who forces plants to bloom in an artificial atmosphere, under artificial conditions; and so also is the landscape gardener, who makes a paradise of a desert—even pure science, as mathematics, must enter here.

HORTUS SICCUS. An herbarium, a collection of dried plants.

HOT BED. The laying up of heated manure or other vegetable substances, which will ferment in such a manner that heat will be given up slowly, continuously, and for a considerable length of time, is termed a hot bed. The bed or beds are then surrounded by a frame, and covered with sashes filled with glass, for the double purpose of drawing the heat of the sun and retaining it, and also the heat of the fermenting manure. Market gardeners in the North, when lettuce and that class of plants are to be forced all winter, make the walls of their beds permanent, double, and lined with tan bark. A situation being selected, so the bed may be sufficiently underground, and so the sash will be just above the surface on the lower side, and about four or five inches higher at the back, In these the young plants are pricked out about the first of December, and successively as they mature for market. Upon the farm, the first of March is time enough to construct the hot bed. Select fresh manure from the horse stable, long and short together, and lay it into a compact heap near where you want your bed, and in sufficient quantity so it will be about sixteen inches thick when properly laid and compacted in the bed. If, at the end of three days, it throws up a strong heat, turn it over evenly, and again put it in a compact heap. If it still shows a rank heat, turn it again; if not, it is ready for use. If the land is dry, so that no water ever stands within two feet of the surface, excavate to the depth of a foot, and a trifle larger than the dimensions of the frame, throwing the most of the earth to the back of the bed. Upon some still day proceed to lay the manure in the bed, shaking out all hard lumps, patting it down from time to time with the back of the fork, to discover the soft places, and keep all uniform. So proceed until you have the bed finished Put on the frame, cover the manure with three inches of the best soil you have; place the glass on the frames, and, as soon as the heat begins to rise, add five inches more of rich, friable soil. When the thermometer shows a heat of 70° or 80°, the bulb being placed in the soil, the bed is ready to plant. The frame may be made of rough boards, —the back six inches higher than the front, to allow the water to pass freely off the glass. The frame should be nailed to two-by-four posts at the corners, and stayed at proper intervals by nailing a strip two inches high by one inch wide on an inch strip three inches wide,—the last made flush with the top of the frame. These will make way for the sash to rest and slide upon. The sash should be made of the best clear two-inch stuff, and to accommodate four rows each of eight-by-ten glass. No cross-bars should be allowed,—one light of glass being lapped over another, commencing at the bottom and working toward the top. The glass should be well tinned and puttied, and the sash should have not less than two coats of good paint. The soil excavated should be used to bank against the frame, even with its top, and, if the soil is wet, the bed must be made entirely above ground; in which case, the manure must be laid a foot wider, all around, than the frame, and the whole banked up with manure flush with the top of the frame. The day heat, when it rises, should mark about 70° or 80°. This temperature you can raise or lower at will by keeping the glass close, or giving air. The temperature for cabbage, cauliflowers, lettuce, radish, celery, and other hardy plants, should not be greater than about 70°. For all tender plants, as the egg-plant, tomato, melon, pepper, cucumber, etc., the heat may go to 80°. At night the temperature should not go below 50°, although 40° or lower will not injure hardy plants. Before sowing the bed, the earth must be raked in the nicest manner, throwing out all lumps, however small, and bringing the soil perfectly smooth and into fine tilth, and with a slight descent from rear to front. Proceed to sow your seed in regular drills, two and one-half or three inches apart. Sow thickly, for the surplus is easily thinned out, and you can not afford to have a poor stand. Cover the seed heretofore named, except cucumber, about three-eighths of an inch, and cucumber one-half inch, deep. Water well after sowing, from a pot with a fine nose, so as not to drench or wash the surface, sufficiently so the water will reach the bottom of the soil, and yet not run down into the manure beneath. Sow all seeds of hardy plants, following one after another, so that the hardy and the tender sorts may not be together, for the hardy must have more ventilation and much less heat than the tender. The ability of plants to stand cold, beginning with those most hardy, is as follows: Radish, cabbage, cauliflower, lettuce, celery, tomato, cucumber, and egg-plant. This latter is injured by a temperature much below 50°, and either of the three preceding will be killed by white frost. Always have your drills run across the sash—never lengthwise. Water always with tepid water, or with that about the temperature of the bed. Water often and lightly while the plants are young, and more seldom and more heavily as they attain age and size; and preferably, in the afternoon, when the glass is to be closed for the night. Remember, in watering, that the heat of the soil, the ventilation, and the leaf-surface of the plants, combined, are the measure of the evaporating power. Give air at all favorable times—always, however, avoiding a direct current upon the plants. This may easily be done by tilting the sash against the wind, rather than toward it; and the stronger the force of the wind, the less will be the opening needed for ventilation. In fact, when the wind is strong, little or no ventilation will be required during the early part of the season. Close the bed early so the heat may be raised sufficiently to carry it through the night; and, unless safely protected, against dogs, shutters must be used in addition to the other covering at night. Straw or cane mats are the best covering, but slough-hay, laid over the glass and held in place with boards, is clean and easily raked off. After raking, the glass should always be swept with a broom. Thus we have protected extensive ranges of glass from frost, getting a full supply of lettuce and other vegetables from February until they could be raised in the open air. Rain must never be allowed to fall on the soil of the bed, except it be, perhaps, late in the season when the weather is fairly settled; and it is better not then, since the bed is always much warmer than the atmosphere, and there is danger of chilling the plants and drenching the soil. Weeding the bed and thinning the plants must be done with the thumb and forefinger, and nothing more will be needed for loosening the earth between the rows than a steel-tined fork and a table-knife. Thin the plants before they are crowded, to about half an inch apart. This is essential, since, if it be not done, your plants will draw, and will become spindling, and weak. Once they get drawn it will be difficult thereafter to make them again strong. In this connection, it will be proper to say that the closer you can grow the plants to the glass the better. It is usual, when the bed is planted, to have the glass about ten inches above the earth. This is a good distance, and if provided for, it will not be necessary to raise the sides of the frames, to give more room, until the last transplanting, when this becomes necessary, the whole, frame and sashes, can be pried up, and suitable blocks laid underneath at proper intervals. We advise that you buy tomato, egg-plants, etc., if possible, of some market gardener. If so, take them when the plants are about two inches high. Twenty-five to fifty, each, of tomato, peppers, and egg-plants will be sufficient. One hundred and fifty celery plants will also be ample for an early supply of this vegetable. The others named heretofore, and such as you may wish, you may easily raise yourself. To prick out plants in the bed, take an inch piece, three inches wide, and of a length so that it will easily go in the bed when a sash is removed, or, say, a little shorter than the width of the sash. Along one edge bore three-eighths-inch holes, two and one-half inches apart, and along the other edge bore holes of the same size three inches apart. Into these holes fit pins to project three inches. This is your marker, and will enable you to plant correctly two and one-half and three inches apart; or double these distances, prepare, also, a board, a foot wide, that will go easily into the bed,—this to stand on while planting. Have also pieces of siding, five and six inches wide, and you are ready for planting. Put in the wide board to stand on; lay down the five or six-inch strip, as the case may be, six inches from the rear of the bed; draw a light drill as a guide on each side of the strip; turn the strip over twice, mark again, and so prepare six drills. With the marker, press the holes for the plants, and, if the plants are to be two and one-half inches each way, make intermediate marks between those already made. The plants for pricking out are best kept in a basin of water, since it insures their remaining fresh. Take a plant by the top; drop the root into one of the holes, a little deeper than it naturally grew, commencing at the left side of the bed,—enlarging the hole for the plant, if necessary. Press the earth about the root, by inserting the forefinger of the right hand just beyond the plant, and pressing to the plant; or make a pointed dibble of the proper size, with which to enlarge the holes, and press the earth to the plants, thrusting it somewhat diagonally, and below the bottom of the plant, in pressing the earth to them, being careful to get the earth firmly about the roots. Water as you proceed, and shade from the sun, always selecting a mild, still day for the work. When one sash is planted, cover close with the glass, and give no air until they cease to wilt under the sun. Cover with a piece of thin muslin, or a little hay, so as to admit light, but not the direct rays of the sun, and you will soon have your plants growing nicely. All this may seem tedious, but it is more quickly accomplished than described; indeed, an expert hand will plant about as fast as one can count. Economy of space in forcing plants is a matter of especial importance. After a due knowledge of the proper conditions and treatment of plants is acquired, the next thing of consequence is this question of distances at which plants shall be grown. Lettuce is the principal crop raised. It is not only a fashionable salad, but also one of the most grateful to the palate. Five inches each way between plants is ample, and will give milder and more succulent heads than will a greater distance; and yet the most of gardeners persist in giving six inches, and many of them even eight inches of space. Let us figure a little on this: A sash six feet long by three feet four inches wide will give 2,880 square inches. Plants five inches apart will occupy, each, twenty-five square inches of space. Thus, in a sash, you may get 115 plants. At six inches apart, you get eighty plants; and at eight inches apart, you have only forty-five plants. Thus you have more than two and a half times the number of plants at the lesser distance than you have at the greater. And, of course, you increase the value of your glass nearly in proportion to these distances. So, where the one system might actually run you in debt, the other would give you ample profit. So with all other plants. The closer you grow them, transplanting always before they crowd each other, the greater the profit.

HOT-HOUSE. A general term for glass structures used in gardening and including greenhouses and conservatories. (See Greenhouse.)

HOUDAN FOWLS. This is one of the French breeds introduced into the United States. In France, the Houdans are held in as high estimation as are the Dorkings, in England, being noted there for the excellence and quantity of eggs laid, and as excellent in their flesh. They are supposed to have descended from the Dorking and Padone fowls, and, like the Dorkings, they should have the fifth toe. This characteristic is not constant, but is required in all fowls for exhibition purposes. The color is white and black, evenly mixed. Occasionally stained feathers will appear, but red ones should never be tolerated. The head is crested, the comb double-leafed, giving the birds a rather fierce look, which is heightened by the whiskers and beard, growing well up on the face of both cock and hen. The legs are spotted leaden gray, and the weight of the fowls medium. Altogether, there are many inferior breeds to this one, and they are certainly as handsome as they are agile, and able to take care of themselves. The other French breeds are Creve-cœurs, handsome, and a heavier breed than the Houdans, short-legged, easy fatteners, and steady layers. Both cock and hen should be entirely black, the head crested, the comb distinctly forked, sometimes antlered. The La Fletch has been called a Malay in height, a Spanish in color, and a Dorking in size. They are firmly knit, legs long and strong. The body is angular, rather than round, and very closely feathered. A peculiarity of this breed is a spike of feathers placed behind the comb, appearing like a double horn, and peculiar dwarf protuberances between the nostrils, which are much expanded. The wattles are long and pendant, the ear lobes large, white, and opaque. The general color is black, the breast, wings, and upper tail feathers, and hackles, reflecting violet and green-black. Legs, slaty blue. The Guilders are sometimes called French fowls, though they are from Holland, as their name denotes. There are white, black, and cuckoo varieties, all medium-sized fowls with prominent breasts and flowing tails. The legs are partially feathered, the wattles long and pendulous, and the head with scarcely any comb. The plumage is close and compact, and the thighs well covered and vulture-hocked.



HOUDAN FOWLS.

HOUND. Dogs of chase are so called.

HOUND'S TONGUE. The genus *Cynoglossum;* rough-leaved weeds of little value.

HOUSEHOLD. The members of a family, and those who dwell under the same roof, including laborers and servants. In agricultural pursuits the household are naturally drawn closer together, and live nearer on terms of equality, than do the servants in any other industry or condition in life. In agriculture, they are generally not servants in any other sense, except that often they do more of the ordinary labors of the farm and house than the master and mistress and the members of the family. Upon the average farm this labor is divided pretty equally among all, and the help often mingle, in many respects, upon terms of perfect equality.

HOUSELEEK. Exotic plants of the genus *Sempervivum,* with succulent leaves, which are mucilaginous. Some of the Sempervivums are valuable.

HOVEL. A shed for farm stock.

HOVEN, HOOVE. (See Blown.)

HUCKLEBERRY. (See Whortleberry.)

HUMATES. Salts of humic acid. (See Humus.)

HUMECTATION. Moistening.

HUMERUS. The upper bone of the arm.

HUMIC ACID. (See Humus.)

HUMIDITY. (See Meteorology, Rain, Dew, Moisture.)

HUMIFUSUS, HUMIFUSE. Spreading over the ground, procumbent, like the stem of the melon, sweet potato, etc.

HUMILIS. Low, humble, applied to small species.

HUMMING BIRD. The humming birds of America are, to this continent, what the sun birds are to the Oriental countries they inhabit, beautiful and brilliant creatures of the air. The most brilliant of the family are natives of the tropics, the principal species visiting the North being the Ruby-throated humming bird, (*Trochilus colubris.*) The humming bird was formerly supposed to live entirely on honey. Such, however, is not the fact; its food is largely made up of minute insects always found in flowers, which it takes with its tongue. Dissections of the stomachs of these birds show this fact. Only seven species are known to inhabit or visit the United States. These are the Ruby-throat, common everywhere North in summer; the Mango humming bird, found rarely in Florida; the Broad-tailed Flame-bearer, of Texas and Mexico; the Purple-throated, the Anna and Coste's humming bird of California and Mexico, and the Nookta Sound humming bird of Oregon and the Northwest coast. They are all insectivorous, and the most beautiful of our feathered tribes.

HUMOR. In anatomy, fluid secretions natural to the eye, or other parts of the body.

HUMUS. Finely divided organic matter, found in rich soils, not so much directly nourishing to plants, but which has the power, under moisture and heat, of rendering matter soluble. (See Soils.)

HUNDRED WEIGHT, or **CWT.** 112 pounds avoirdupois. In the United States 100 pounds is a hundred weight.

HUNGER-ROT. Disease occasioned in sheep by bad keeping or starvation.

HUNGRY SOIL. Poor, sandy, or gravelly soil, requiring frequent manuring.

HURDLE. A light, movable fence of wood, iron, or wire. Hurdles are made in sections and moved on the pasture as occasion requires.

HUSBANDRY. That branch of agriculture which includes the raising of farm crops, stock, the feeding and fattening of animals, dairying, etc., is denominated husbandry. (See Agriculture.)

HUSK. The dry exterior of fruits.

HYACINTH. All the varieties of this favorite flower are seedlings of *Hyacinthus orientalis*, a native of the Levant. Since its introduction into cultivation, about the year 1590, new varieties have become innumerable, both single and double, and of great variety of color and exquisite perfume. For out-door blooming the bulbs should be planted in October, and have a covering of mulch during winter, to be removed in the spring, and again given each succeeding winter. The bulbs should be taken up once in three years, separated, and again planted immediately. For winter blooming none but the finest dry bulbs should be selected. These should be potted in four or five inch pots, and placed in a half light cool cellar, until they show the beginning of the flower spike, when they should be brought to the heat and light. For succession, they may be potted every ten days. Thus they will begin to bloom before Christmas and give succession until spring. After the bulbs are brought to the light, water liberally and remove the offsets, if extra fine bloom is desired. The bloom having disappeared, withhold water, let the bulbs ripen, and save dry for next winter's blooming. They are also grown in hyacinth glasses, in water, but thus the bulbs are destroyed and the bloom is not so fine.

HYALITE. A variety of glassy quartz of a gray or yellowish color, and concretionary.

HYALOID. A transparent membrane.

HYBERNATION. The torpid condition in which numerous animals and reptiles exist during winter; they usually retire in a fat state, and become very lean by spring, the fat being consumed in maintaining the temperature necessary to preserve life.

HYBRID. The offspring of two animals or plants of the same genus, but of different species. As the ass and the mare, the buffalo and cow, the cashmere and common goat, etc. Cross breeding is the progeny between varieties of the same species, as between the race horse and the ordinary breed of a country, or between the Devon and Short-horn, etc. (See Hybridizing.)

HYBRIDIZING. Hybridization has, of late years, come to be a distinct branch of agricultural art, in the production of grains, plants, fruits and flowers. In animals, it has been practiced, in the production of mules, between the ass and mare, the buffalo and cow, Brahmin bulls with Short-horns, Alpacas with the Llama, the dromedary and camel, the common goat with the cashmere. So far, however, the results have not been valuable, if we except the mule proper, and the progeny between the male cashmere and the common goat of the country. The plan of proceeding is too simple to need explanation, except that the male animal should be used, to which the progeny is desired to most resemble. The progeny between the ass and mare gives a valuable mule; that between the horse and hinny, does not. Hybrids are not fertile as to the progeny. Hence, in the hybridization of plants, the progeny must always be propagated by layers or cuttings. The same is true to a great extent in the cross-breeding of plants, the seed can not be depended upon to come true. Indeed in hybridization there is always degeneration to a certain extent, so that in the majority of cases greater care is necessary with the hybrids than with the original parents. In vegetation, in the United States, hybridization and cross-fertilization has hitherto been chiefly confined to the grape, strawberry, and to flowers. Of late years, it has extended in other directions. As showing the difficulty in obtaining hybrids, from plants of different species, and the impossibility of obtaining species that shall continue fertile each with the other, Dr. Hooker, in discussing the relations and distribution of species of plants, lays down the following propositions as axioms: 1. That all the individuals of a species have proceeded from one parent (or pair) and that they retain their distinctive (specific) characters. 2. That species vary more than is generally admitted to be the case 3. That they are also much more widely distributed than is usually supposed. 4. That their distribution has been effected by natural causes; but that these are not necessarily the same as those to which they are now exposed. Hybridization has been supposed by many to be an important element in confusing and making species. Nature, however, seems effectually to have guarded against its extensive operation and its effects in a natural state, and, as a general rule, the genera most easily hybridized in gardens are not those in which the species present the greatest difficulties. With regard to the facility with which hybrids are produced, the prevalent ideas on the subject are extremely erroneous. Gärtner, the most recent and careful experimenter, who appears to have pursued his inquiries in a truly philosophical spirit, says that 10,000 experiments upon 700 species produced only 250 true hybrids. It would have been most interesting had he added how many of these produced seed, and how many of the latter were fertile, and for how many generations they were propagated. The most satisfactory proof we can adduce of hybridization being powerless as an agent in producing species, (however much it may combine them,) are the facts that no hybrid has ever afforded a character foreign to that of its parents, and that hybrids are generally constitutionally weak and almost invariably barren. Unisexual trees must offer many facilities for the natural production of hybrids, which, nevertheless, have never been proved to occur, nor are such trees more variable than hermaphrodite ones. The following will show some of the principal facts connected with hybridizing plants, taken from the work of George William Johnson, of England, on Gardening. The seed vessel is not altered in appearance by impregnation from another plant; therefore, no hasty conclusion of failure is justified by that want of change. The color of the future seed, not of that first hybridized, seems to be most influenced by the male plant, if its seeds and flowers are darker than those of the female. Mr. Knight found, that when the pollen of a colored-blossomed pea was introduced into a white one, the whole of the future seeds were colored. But when the pollen of a white blossom was introduced to the stigma of a colored blossom, the whole of the future seeds were not white. Capt. Thurtell, from his experiments on the pelargonium, also informs me, that he has always found the color and spot of the petals to be more influenced by the male than by the female parent. Indeed, all experience proves that the progeny usually, though not invariably, most resembles, in color, the male parent. Large stature and robustness are transmitted to the offspring by either parent. It does not absolutely matter for obtaining this characteristic, whether it be the male or female which is large; but Mr. Knight generally found the most robust female parent produced the finest offspring. Capt. Thurtell, from lengthened observation and experiment, has ascertained that the form of the petals follows most closely that of the female parent. Mr. Knight says that the largest seed from the finest fruit that has ripened earliest and most perfectly, should always be selected. In stone-fruit if two kernels are in one stone, these give birth to inferior plants. The most successful mode of obtaining good and very distinct varieties, is to employ the pollen from a male in a flower grown on another plant than that bearing the female parent. To avoid previous and undesired impregnation, the anthers in the female parent, if they are produced in the same flower with the pistils, must be removed by a sharp-pointed pair of scissors; and the flower inclosed in a gauze bag, to exclude insects, until the desired pollen is ripe. Another effectual mode of avoiding undesired impregnation, is bringing the female parent into flower a little earlier than its congeners, and removing the anthers as above described; the stigma will remain a long time vigorous if unimpregnated. Although the fertility of all the seed in one seed vessel may be secured by applying pollen only to one style, even where there are several, yet the quantity of pollen is by no means a matter of indifference. Koelreuter found, that from fifty to sixty globules of pollen were required to complete the impregnation of one flower of *Hybiscus Syriacus* but in *Mirabilis jalapa*, and *M. longiflora*, two or three globules were enough; and in the case of pelargoniums, Capt. Thurtell says two or three globules are certainly sufficient. M. Haquin, a distinguished horticulturist at Liege, has impregnated flowers of the azalea with pollen kept six weeks; and camellias with pollen kept sixty-five days. He gathers the stamens just previously to the anthers opening, wraps them in writing-paper, places them in a warm room for a day, collects the pollen they emit, and preserves it in sheet lead in a cool, dry place. M. Godefroy suggests, that two concave glasses, like those employed for vaccine virus, would be better. The globules of the pollen must not be crushed. M. Haquin thinks the pollen of one year will be effective, if preserved until the year following. Mr. Jackson, of Cross Lanes Nursery, near Bedale, says, he has found the pollen of the *Rhododendron Smithii tigrinum* retain its fertilizing power even for twelve months. It is easy to discern whether impregnation has been effected, as in such case the stigmas soon wither. The stigmas which have not received the pollen remain for a long time green and vigorous. Whenever double flowers may be desired, if a double flower should chance to have a fertile anther or two, these should be employed for fertilization, as their offspring are almost sure to be very double. Superfœtation has been doubted; but as it occurs in the dog, we see no reason for disbelieving its possibility in plants. Capt. Thurtell thinks it may be done by the bee introducing mingled pollens at the same instant. Then why not if a similar mixture is inserted by the camel's-hair pencil of the cultivator? Plants nearly related, that is, closely similar in the structure of their various parts, are those only which will immediately impregnate each other; but it is impossible, at present, to say what families of plants may or may not be brought into fertile union through intermediate crosses. A very short time ago, the azalea and rhododendron were thought incapable of such union, but this opinion is now exploded, for *rhododendron ponticum* has been fertilized with the pollen of *azalea sinensis* and the progeny between the first, an evergreen, and the latter, a deciduous shrub, is the previously unknown phenomenon, a yellow rhododendron. In cross-fertilization and hybridizing, suitable male and female plants are to be selected, and which blossom at the same time. The plant to be impregnated is to be carefully divested of its stamens, if it have any, and the pollen from the male plant dusted upon the female organ. The flower is then to be isolated from any possible contact with the pollen of other plants, and the seed taken, when ripe, carefully labeled, saved, and at the proper time sown. To return to animals. Wilson observes that every mule is a compound of two species, and seems to be, to a certain extent, a malformation of each, and a type of neither; and while unable to reproduce the specific form of his dam, or of his sire, he is wanting in a sufficient specific character of his own to be the proper subject of reproduction. Nor do mules exhibit a true blending of the specific properties of their parents; but as regards the most important properties, such as size, form, constitution, temper, and habits, they generally possess a closer resemblance to their dam than to their sire. Buffon says, in the case both of mules and hinnies, that they retain more of the dam than of the sire, not only in magnitude, but in the figure of the body; whereas in the form of the head, limbs, and tail they bear a greater resemblance to the sire. The same naturalist infers, from various experiments respecting cross-breeds between the he goat and ewe, the dog and the wolf, the canary bird and the goldfinch, that the male transmits his sex to the greatest number, and that the preponderance of males over females exceeds that which prevails where the parents are of the same species. Any two species of the equine genus will hybridize with each other, but some do so with facility and willingness, and others with difficulty and repugnance. Mules have been generated between the horse and the quagga. They are readily produced between the horse and the ass, as is well known; but they are very reluctantly and sparingly produced between the ass and the quagga. In an experiment related by Pennant, a he ass and a she zebra were for some time unsuccessfully kept together with a view of their hybridizing; but after the ass was taken aside and painted in such a manner as to resemble a zebra, and conducted back to his companion, they united and produced a mule; another ass and zebra mule was produced at Turin, but it died as soon as it was born; and another, a well-formed female mule, was produced in a menagerie at Paris, from a Spanish ass of the largest size, and a female zebra, and became larger than its dam, acquiring a form somewhat similar to that of its sire, and was remarkable for docility. In another experiment a female zebra was covered by a stallion and became pregnant, but died in the eighth month of her gestation, and when her body was opened the fœtus was found to be a male without hair, and marked on the head with black and white stripes. The same authority, after referring to the similarity of the name in different languages of the true mule, produced by the jack crossed upon the mare, tells us that the mule has considerably more resemblance to the horse than to the ass, and often, in the south of Europe, is a very fine animal of from fifteen to seventeen hands high. Its head has generally a clumsy form and a heavy appearance, and is the most exceptional part of the whole system. These animals are considered by naturalists to be distinct, but nearly allied, species. According to the latest authorities they are members of two genera, though formerly the horse and the ass were both included under one. The scientific name of the horse is *Equus caballus;* of the donkey, *Asinus vulgaris;* and the zebra, or quagga, is called *Asinus zebra* by Baird. In every country the mule is sure-footed and hardy. In Spain it has the finest form and appearance; in Savoy it has a remarkably large size; in Egypt it is about equal in value to a medium horse; and in the mountain regions of large portions of both Europe and South America it is far more serviceable than the horse could be, and completely supersedes the horse for packing, and often even for the saddle.

HYDATID. A race of entozoic animals resembling a small bladder, and infesting the liver, brain, uterus, and other parts of mammals. (See Sheep.)

HYDRACIDS. Acids containing hydrogen, as muriatic acid, etc.

HYDRAGOGUE. Violent cathartics, which cause an expulsion of much fluid.

HYDRANGEA. A highly ornamental class of plants, deciduous shrubs, not hardy in the northern portion of the United States, but requiring protection from frost during winter. The best plan for saving the plants over winter is to take them up with plenty of earth about the roots, and placing them in pits covered with glass, giving a little air in mild weather, and keeping them pretty dry. South of 40° they may be sheltered with straw where they grow. The whole genus are very impatient of drought and sun. Hence it is usual to plant them where they may have a moist atmosphere and shade. One of the most beautiful species is Hydrangea Otaksa. *H. Hortensis* is the variety usually cultivated. The principal point in the cultivation of Hydrangeas is to give them plenty of water during summer and to thoroughly ripen the wood for winter. It has been recommended to form a basin of clay all around the plants, eight or ten inches underground, and in dry weather keep this thoroughly saturated.

HYDRATES. Compounds in which water combines, as an acid in its equivalent of nine, as hydrate of lime, or water slacked lime.

HYDRAULICS. The science which treats of the movement and mechanical effects of water and liquids.

HYDRO. A chemical prefix, indicating the presence of hydrogen; as hydrochloric, hydrobromic, hydrocarbon, and hydriodic.

HYDROCARBONS. A general term for the oily, waxy, and resinous products of vegetation, which are rich in hydrogen, and often contain hydrogen and carbon only.

HYDROCELE. A collection of water in the scrotum.

HYDROCHLORATES. An old term for chlorides.

HYDROCYANIC ACID. Prussic acid, a pellucid fluid, of strong odor, one of the deadliest poisons known. Ammonia is the best antidote.

HYDRODYNAMICS. The science which shows the methods of applying the properties of fluids to mechanical purposes.

HYDROFLUORIC ACID. A pungent, gaseous acid formed of one equivalent, fluorine, and one hydrogen.

HYDROGEN. A natural element, one of the constituents of water which is always formed when hydrogen gas is burned in combination with atmospheric air, or with oxygen gas. It is known to us, in its simplest form, only in the state of gas, and is speedily fatal to animal life when it is breathed unmixed with atmospheric air. It is, however, a component of animal matters, and it forms a very essential part in the economy of vegetable substances, in which it is always found. Thus sugar contains 6.90 per cent. of hydrogen; gum 6.93; beeswax, 12.672; wood of the oak, 5.69; wheat starch, 6.77; acetic acid (the acid of vinegar), 6.35 per cent. It is the lightest of all ponderable matter, 100 cubic inches weighing only 2.15 grains. No known degree of cold has been able to condense it to a liquid. It can not support combustion, but is combustible in conjunction with atmospheric air. It constitutes one-ninth of the weight of water. Most vegetable structures contain hydrogen in the form of water, but the hydrogen essential to this constitution can not exist in the form of water. That hydrogen gas exerts a considerable influence upon the leaves of plants, was first noticed by Dr. Priestley. Sennebier found that plants which lose their green color in the dark, preserve it under those circumstances, if a small portion of hydrogen gas is present in the atmosphere in which they are placed; and Dr. Ingenhous noticed that its presence, when they are growing in the light, renders their color of a deeper green. Humboldt has noticed that plants growing in the galleries of the coal mines, preserve their green color, although vegetating in the dark, and that, in such situations, the atmosphere contains a proportion of hydrogen gas.

HYDROMETER. An instrument for measuring or determining the specific gravities of liquids, and thence the strength of solutions, spirits, and all substances of which water forms the principal part.

HYDROPHILIDÆ. Aquatic, pentamerous beetles; vegetable feeders.

HYDROPHOBIA. This dreadful disease, which seldom appears in domestic animals, and then only communicated by the bite of a canine animal, appears in the horse in from fifteen days upwards; in cattle, in from twenty to thirty days; in sheep and swine, from about the twentieth day after being bitten. An attempt to swallow liquid will bring on spasms of the throat, which throws the animal into convulsions. The animal trembles and staggers, the eye is wild, and, at last becoming frantic and mad, it dies. The disease is always fatal, and hence it is useless to attempt a cure. If hydrophobia is suspected, place the animal in a secure place where it can not harm any one, and as soon as the symptoms are those of pronounced hydrophobia, kill it at once and bury deeply.

HYDROSTATIC BALANCE. Balance furnished with a scale for determining the weight of any substance to be weighed in water.

HYDROSTATICS. The science which explains the mechanical properties of fluids.

HYDROSULPHURIC ACID. Sulphuretted hydrogen. Hydrosulphurets are the sulphurets or sulphides of metals and bases.

HYGIENE. The arts necessary to the preservation of health.

HYGROMETER. An instrument which indicates the degree of moisture or vapor present in the atmosphere, or its relative degrees of dampness and dryness.

HYGROMETRIC, HYGROSCOPIC. Having the quality of absorbing moisture during wet, and partially losing it in dry weather.

HYLOBIUS. A genus of tetramerous beetles, resembling the curculios, and infesting trees.

HYMENIUM. The gills or porous membranes in which the pores of fungi are placed.

HYMENOPTERA. An order of mandibulate insects, comprehending those which have four membranous wings with few nervures.

HYPERTROPHY. An unusual increase in size of any organ of the body.

HYPOCHONDRIUM. The region of the body under the cartilages of the false ribs. The liver lies in the right, and the spleen in the left hypochondrium.

HYPOCRATERIFORM. Salver-shaped. A corolla consisting almost entirely of a tube.

HYPODERMIC SYRINGE. A small syringe with a needle point, pierced with a delicate canal, for injecting medicated liquids under the skin, directly into the circulation. In operating it is used to allay violent pain, and for prompt and energetic action, and of late years has proved valuable with animals as for a long time with the human family. Shave the hair from the part to be operated upon, pinch up the skin, make a slight cut in the edge of the ridge, insert the point of the syringe, the full length under the skin, in the loose tissue, withdraw it half way and inject the contents. It should be used under the advice of a veterinarian.

HYPOGASTRIUM. The portion of the abdomen reaching from the lowest parts to near the navel

HYPOGYNOUS. Stamens, or other organs, attached below the base of the ovarium.

HYPOPHYLLUM. A partial leaf, clasping the stem, and without lamina.

HYPOTHESIS. A speculation not based on facts, but explaining certain phenomena.

HYSSOP. *Hyssopus officinalis.* A perennial rooted labiate plant, of aromatic and bitter properties.

HYSTERIA. A nervous complaint, attended with convulsions and peculiar flatulency. (See Blackwater in Horses.)

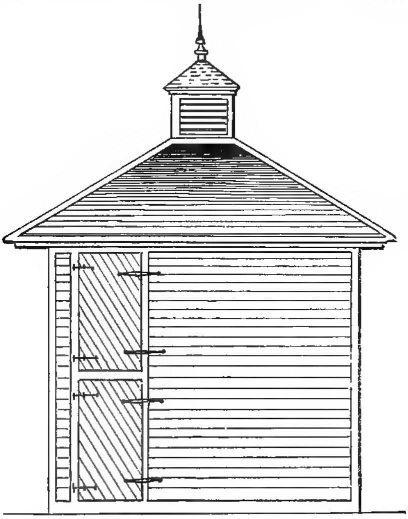
HYSTRICIDÆ. The family of *Rodentia,* to which the porcupine belongs.

I

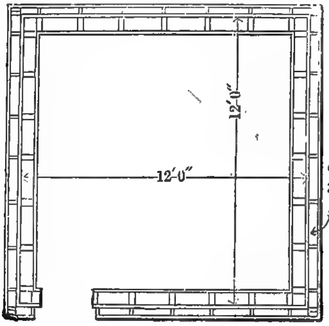
ICE. Water congeals at and below 32° Fahrenheit, and expands one-ninth of its volume at 40° Fahrenheit; hence when freezing occurs in the pores of rocks, the earth, etc., it often produces disruption of the particles. It is this action that mellows lands ploughed in the fall.

ICE HARVESTING. In harvesting ice the proper tools should be purchased. These are, a marker for marking lines, an ice plow for deepening the furrows; ice chisels and bars for separating the cakes; ice picks, an ice saw, and two sets of grappling hooks. One set of tools will be sufficient in cutting ice for a whole neighborhood, so that by coöperation the cost will be light to each individual. The ice is first marked with the marker into straight lines one way, a boy leading a horse to a line, thereafter the gauge will keep the whole straight. Turning, then mark across, thus dividing your fields into squares. Then deepen the grooves, more or less, according to the thickness of the ice, when the whole field may be divided into strips with the bar, floated to where it is wanted and then easily broken into perfectly square cakes. Pack these carefully in layers in the house, and as high as the plates. Cover with a foot of coarse sawdust, or eighteen inches of slough hay, and close the house tight, leaving only ventilation above the covering at the peak. If no proper tools can be had, ice can be cut with tolerable accuracy by stretching a line and marking it with an ice-pick or pike-pole. So proceed over the field, making your lines regular and twenty inches apart; with the saw, cut into strips, and again into squares, when these may be drawn out by means of a board a foot wide, having pins at one end for holding the ice when the board is thrust under it. Few farmers realize the importance of a supply of ice during the summer. It will fully repay the interest on the cost of the house and implements, and the labor of hauling, even for a considerable distance. (See Ice.)

ICE HOUSE. Near all situations where a supply of ice may be had in winter, an ice house will be found one of the best paying investments that can be made. From it, in summer, the water carried into the field for drinking may be cooled, meat and other food may be kept fresh and sweet, indefinitely, and it will be found useful in many ways especially in case of sickness in the family. In dairying ice is absolutely indispensable. Many farmers are deterred from erecting an ice house from want of accurate knowledge how they should be built. The plan we give will hold from thirty to thirty-five tons of ice, is cheap and as good, so far, at least, as saving ice is concerned, as the best, and, if necessary, will preserve ice two years.

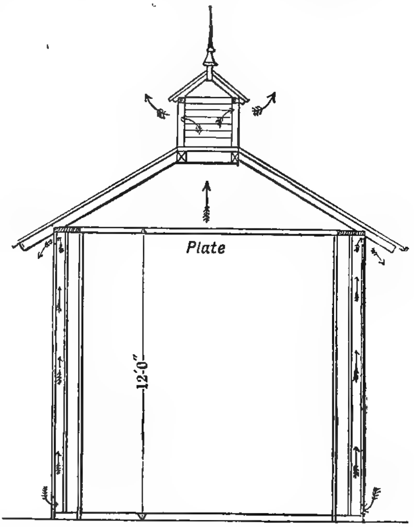


ICE HOUSE.



GROUND PLAN.

The house should be built upon a dry foundation where the drainage is perfect. If the soil is not sufficiently porous to allow water to pass off freely drainage should be provided by means of tile or a foot of rock, gravel, etc., should be laid down with a drain leading away from it. The specifications are as follows: Sills to be 2 by 12, bedded level on the ground, the inner studs, 2 by 6, sheathed on both sides with common boards, the outside to be covered with felt paper, the space formed by sheathing to be filled with tan bark or saw dust. The outer studding to be 2 by 4, spiked to outside of sheathing and covered with common siding, leaving a space under frieze and above base of three inches. The floor to be constructed by spreading from four to six inches of tan bark or saw dust, level the same and cover with common boards, leaving a three-quarter inch space between each. The plates to be the same as studs, 2 by 12, rafters, 2 by 4, roof shingled. Ventilators in top should be 2 ft. 6 in. square. Doors doubled and filled with saw dust. Below we give the full bill of lumber: 8 pieces, 2 by 12 by 14, for sills and plates; 30 pieces, 2 by 6 by 12, for inner studs; 5 pieces, 2 by 6 by 12, for hip rafters and collar beams; 38 pieces, 2 by 4 by 12, for outer studs; 20 pieces, 2 by 4 by 12, for rafters and the ventilator; 750 ft. siding, 14 ft. long; 2,000 ft. common boards, for sheathing, floor, roof, etc.; 24 pieces fencing, surfaced, 12 ft. long, for corner boards, etc.; 80 yds. building paper; 3,000 common shingles.



ELEVATION.

ICHNEUMON FLIES. Small hymenopterous insects, which lay eggs in the bodies of aphides, caterpillars, and other insects, and even in the eggs of these; the young eat and destroy the creatures in which the egg is deposited.

ICHOR. A thin, purulent, and acrid discharge.

ICOSANDRIA, ICOSANDROUS. Flowers with twenty stamens.

ICTERUS. Jaundice; hence *icteroid*, yellowish, like the color of the skin in jaundice.

IDIOPATHIC. Independent of other diseases.

IDIOSYNCRASY. A peculiarity of constitution.

IGNITION. Combustion, burning.

ILEUM. The lower portion of the small intestines.

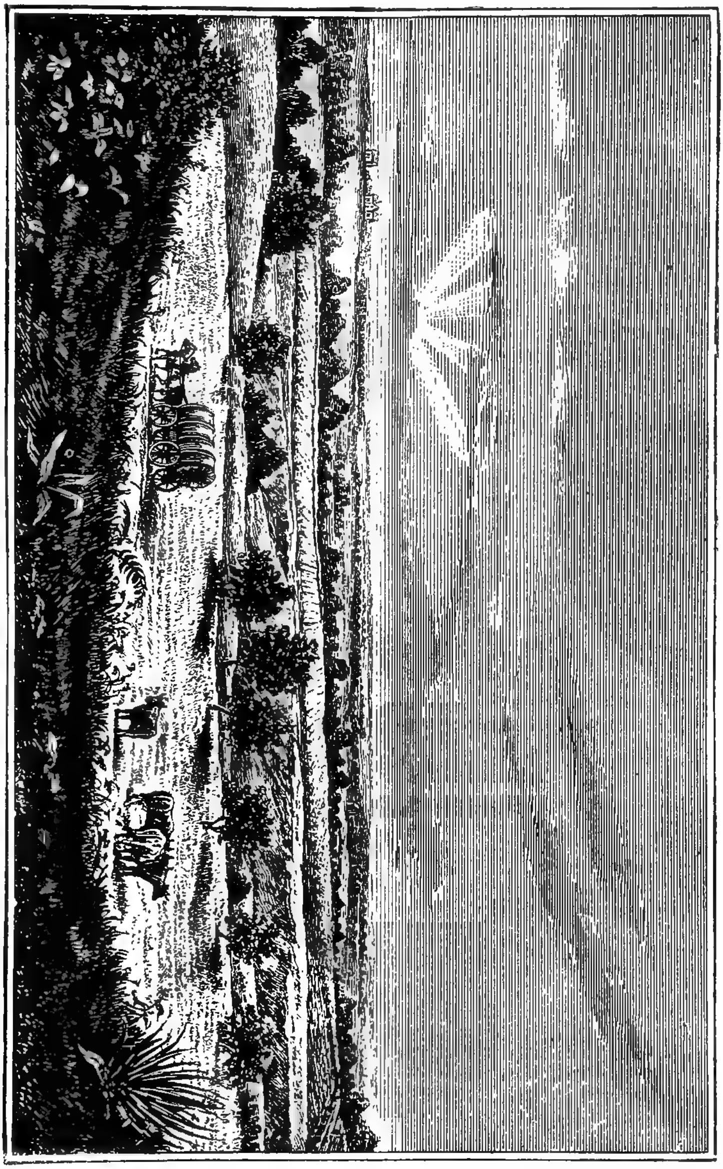
ILEX. (See Holly.)

ILIA. The lower sides of the abdomen; hence *iliac, iliacus*, related to the ilium.

ILIUM. The haunch bone.

IMAGO. The winged insect.

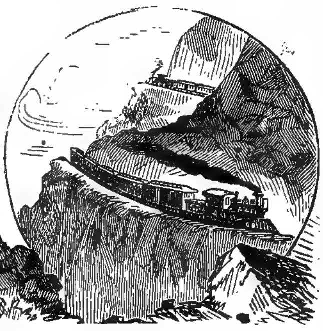
IMBRICATED. Overlapping, like the shingles of a roof.



IMMIGRATION INTO THE FAR WEST.

IMMIGRATION. The history of Immigration, into the United States, furnishes a most curious study, as showing to how many nations of the earth we are indebted for our wonderful growth and prosperity. In the West, the influx has been most constant and marked, and has exercised a commanding influence in the tastes and habits of communities. In this the Germans and their descendants, and the Irish and their descendants predominate with this difference: The Irish element is chiefly found in and about our cities, while the German element is distributed in both cities and country. As agriculturists, they form the bulk of our emigrant population in the country. Honest, laborious, quickly acquiring property, their families soon become Americanized. Since the late war, and especially within the last three years, the influx has been immense, and since the emigrants from the Continent of Europe, and in fact all the emigrants, except comparatively few, bring with them respectable sums of money, they not only add to the productive industry of the country, but add also to its immediate wealth. Prior to 1820, the number of emigrants arriving in the United States is stated at 250,000; from 1820 to 1830, the number arriving was 151,824; from 1831 to 1840, 599,125; from 1841 to 1850, 1,713,251; from 1851 to 1860, 2,598,214; from 1861 to 1870, 2,491,451, making an aggregate of 7,803,856. Of this the total from Great Britain was 3,857,850; 2,700,493 of this number being from Ireland. Germany contributed, 2,276,500; Prussia, 100,983; Sweden and Norway, 153,928; France, 245,812; other European countries ranging from 61,572, in the case of Switzerland, to 4,695 for Portugal. Again, from 1868 to 1875, the emigrants arriving in the United States, were, 2,531,596. Of these Great Britain sent nearly four-tenths, and Germany nearly as many. The entire world made contributions to our population, but except the Teutonic nations, Great Britain and France, they constitute but a small fraction of the emigration. It will readily be seen, therefore that the genius of our civilization remains English and German, than which, there is no higher on the face of the earth. The influx of population to the United States, and the hegira across the country to the West, constitutes the wonder of modern times. The greatest wonder being that peoples of every nation, and of so many varying, tastes, should settle down together and live in quiet and harmony, and without jarring discord. Its effect on Western production has also been wonderful. In 1850, only five per cent. of the wheat crop of the country was produced west of the Mississippi. In 1876, forty per cent. of the wheat crop of the country was raised west of the Mississippi. In 1878, the wheat crop of the United States reached 420,122,400 bushels. Of this amount, 194,046,960 bushels were raised in the States west of the Mississippi. In the same year, 1,388,218,750 bushels of corn were raised in the United States. Of this 510,836,800 bushels were raised west of the Mississippi. Without this material emigration from the enlightened countries of Europe, the West to-day would be fully twenty years behind its present development.

THE OLD.



THE NEW.

IMPACT. The concussions of one body on another.

IMPACTION OF THE STOMACH. (See Blown; also Gastritis.)

IMPENETRABILITY. An essential property of matters, whereby one molecule only can occupy a given space at a certain time.

IMPERMEABLE. In physics, means capable of resisting the passage of gases as well as fluids.

IMPETUS. The force or momentum of a body in motion.

IMPHEE. (See Sorghum.)

IMPLEMENTS, FARM. (See Farm Implements.)

IMPONDERABLE. A term used to express light, heat, or electricity, which are destitute of any discoverable weight.

IMPOSTHUME. An abscess.

IMPOTENCE. The breeding of animals has, in many cases, been carried to such a high degree of fineness, and close inter-breeding is so much practiced, that impotence is not now an unusual occurrence among the higher caste of the finer breeds. In many cases, however, this is not so much the result of degeneration as from precocity in accumulating fat, and is especially noticed in females, and then again from being unduly forced with feed while yet young. The feeder's profit lies in fattening animals as young as possible. It is not unusual to see Short-horns made fat and ripe for beef at from eighteen months of age to that of two years, and, at three years past, just the age that cattle should begin to be useful as breeders, steers and heifers, are found in our markets fully matured as heavy weights in beef. It is true they are occasionally fattened to immense weights, between three and six years of age, but herein lies no profit to the feeder. Another prolific cause of impotency would seem to be the mania, that raged some years since, to increase the size of animals by selection, coupled with high feeding. Here, two causes worked against fertility. They were kept constantly fat; and this, in connection with the selection of immense animals, as breeders, led to deficient vigor; so it was not unusual to find a bull at five or six years old—just when he should be in his prime—past value as a stock getter. The feeding of animals in such a way as to develop excellence in the best degree, does not mean fattening. They should have food sufficient, and of variety sufficient, to give full vigor without unduly loading with fat. It is true high feeding and warmth will produce wonderful animals to look at. So will high cultivation, watering, and hot-house forcing do the same with plants, but they are deficient in constitution, and unproductive in seed. The best breeders have found out this fact, long known to gardeners and hence of late years, while breeding animals have been liberally fed, they have not been denied due exercise. And the causes of impotency having been removed, the disability has disappeared.

IMPREGNATION Conception. In horticulture, the contact of pollen with the stigma is called impregnation; without this, no seed is produced. Artificial impregnation is hybridizing.

INANITION. A state of languor, emptiness.

INARCHING. A system of grafting by the wood of young, vigorous trees, planted near an old one, so the inner bark of each will meet.

They are bound together until union takes place. This is sometimes done to form a curious object, but is of no practical benefit, except in the case of a rare tree or fruit, which it is desirable to save.

INCANDESCENCE. A luminous heat.

INCANOUS. Hoary; covered with a whitish down.

INCH. The twelfth part of a foot.

INCIDENT. The meeting of one body with another. The angle of incidence is formed by the direction of the light to a line perpendicular to the plane of the surface on which it falls.

INCINERATION. Burning to ashes.

INCISIONS IN TREES. Drawing a sharp knife through the bark, down to the new wood of plum, cherry, and other trees, is often very serviceable when they are bark-bound. It should be done in summer, and the incision made from the branches to the earth.

INCISORS. The sharp cutting or nipping teeth placed in front in the jaws of animals.

INCOMBUSTIBLE. Not capable of burning. Cloths and wood are rendered almost incombustible by soaking in a solution of borax, alum, sal ammoniac, phosphate of soda, etc. The metallic salts used in preserving timber render it incombustible; it smoulders, but does not burn with flame.

INCOMPATIBLES. Substances which can not exist in solution without decomposition.

INCUBATION. The brooding of eggs until hatched, is called incubation. When performed by the mother fowl which laid the eggs, or by another fowl, it is natural incubation. Artificial incubation, a term now applied to the hatching of eggs by artificial heat, has long been practiced in Egypt, and some other Oriental countries, and is now extensively applied, in all civilized countries, in the hatching of chickens. The successful hatching of eggs, either by artificial or natural heat, requires good judgment and careful attention to secure good results. In hatching chickens by the mother hen, she should always have a place by herself, separate and apart from all others, and where she will not be likely to be disturbed. The nest should be about fifteen inches square for a large fowl, and if the eggs are to be hatched early in the season, the nest should have well broken, soft straw for the bottom, and this covered with feathers. After the first of May, in the North, the bottom of the nest should be placed on an inverted sod, properly hollowed, upon which is placed soft, short straw. The nest should be secluded, and it is better that it have a covered yard attached, containing food, water, and a dust bath. No hen should be allowed more eggs than she can completely cover. Early in the season from seven to nine eggs will be all that can be kept uniformly warm. In warm weather a large hen will cover thirteen easily enough. Artificial eggs are sometimes given for a day or two with a young hen, or until she sits steadily. The hen should leave the nest every day for a short time that the eggs may receive air. Seven or eight days after the hen has commenced sitting, the eggs may be examined with an egg tester, or by standing in a rather dark place and holding them up in the partly closed hand against a strong light. The fertile eggs will have a cloudy appearance. Those not fertile should be discarded. In warm weather, or if the hen is sitting in a very dry place, it is a good plan to sprinkle the eggs lightly with tepid water once a day, during the last four days of incubation. Always set a hen in the evening, and never set one which will leave the nest when you come near, or even if you examine the eggs under her. If the nest becomes verminous, sprinkle sulphur through it, and also on the back of the hen. If a dust bath is allowed, and the nest be sprinkled with sulphur at the time it is made, but little trouble will be experienced with vermin. The food to be given during incubation should be sand, corn, and oats whole, and pure water. Artificial incubation is performed by means of a variety of machines patented, and also the provision for artificial mothers in raising the chicks, the most difficult part of the business. The Egyptian plan was to hatch them in ovens. In France the system of hatching by means of fermenting manure, is still practiced to some extent. Modern ingenuity has devised means to furnish the heat from the top, as is natural, the germ of the future chicken floating at the top of the yolk. A perfect incubator should furnish heat at the top, have means of quickly determining the degree of heat by means of thermometers, and be provided with artificial mothers This is simply a box so contrived as to furnish a retiring place of cotton-wool, down, or other soft substance, that may be kept at a uniform degree of heat, with an enclosed yard, provided with food and water, where the chickens may take exercise.

INCUMBENT. In botany, leaning against.

INDEHISCENT. In botany, a fruit which does not open when ripe, as succulent berries.

INDIAN PONY. The name Indian Pony is rather a vague term, by which to designate any particular race of Indian horses. Those formerly known in the New England States, along the chain of the great lakes, both on the Canadian and States shores, were, and so far as they now exist, undoubtedly the descendants of the earlier French horses, dwarfed by generations of semi-wild life, and hard fare; those of the South were undoubtedly the descendants of the earlier Spanish adventurers, which had escaped from confinement. Those of the Indians of the plains, and of Texas, are the descendants also of Spanish horses resembling quite closely the mustang. Certain it is, the Indian pony of the North does not show Spanish blood, while those of the South, as we saw them many years ago, do. The Indian pony of the plains, of all the breeds of Indian horses, shows the most strongly his Spanish origin. The Indian pony is, as a rule, rounder and shorter barreled than the Canadian, and seldom over thirteen hands high. The neck is short and thick; the mane thick, coarse and heavy; the forelock often almost concealing the eyes. The legs and hoofs are strong and like steel, being fully equal to the Shetland in this respect. They carry their heads high, are docile, intelligent, sure-footed and courageous in a journey to a remarkable degree. The Indian pony, however, must not be confounded with the better class of pony horses, called Canadian ponies. Wherever found, they are dwarfed descendants of once larger horses. The ponies of Western Canada, of the West and of the South-west, have evidently been imbued with the Spanish blood of the plains, but as we go east we see more and more of French blood in them. They are now, however, as a race, nearly extinct. Hence, the description given by Frank Forester, as he saw them when they were comparatively plenty in the country, will not be uninteresting: On my first visit to Canada, he says, I had an opportunity of seeing great herds of these ponies, running nearly wild on the rich meadow lands about the Grand river, belonging to the Mohawk Indians, who had a large reservation on that river, near the village of Brantford, which took its name, I believe, from the chief, who was a son of the famous Brant, Thayendanagea, of ante-revolutionary renown. These little animals, which I do not think any of them exceeded thirteen hands, had all the characteristics of the pure Canadians, and, except in size, were not to be distinguished from them. They had the same bold carriage, open countenance, abundant hair, almost resembling a lion's mane, the same general build, and above all, the same iron feet and legs. I hired a pair of these, I well remember, both stallions, and they took me in a light wagon, with a heavy driver and a hundred weight, or upwards, of baggage, over execrable roads, sixty miles a day, for ten days in succession, without exhibiting the slightest distress, and at the end of the journey were all ready to set out on the same trip again. I was new at the time in America, and was much surprised and interested by the performance of this gallant little pair of animals. They were perfectly matched, both in size and color, very dark brown, and twelve hands and a half in height; and where the road was hard and good, could spin along at nearly nine miles in the hour. They were very merry goers. It was their wonderful sure-footedness, sagacity, and docility, however, which most delighted me. They were driven without blinkers or bearing reins, and where, as was often the case, bridges seemed doubtful, the bottom of miry fords suspicious of quagmires, or the road otherwise dangerous, they would put down their heads to examine, try the difficulty with their feet, and, when satisfied, would get through or over places, which seemed utterly impracticable. Whence this pony breed of Canadians has arisen, I am unable to say; but I believe it to be almost entirely peculiar to the Indian tribes, wherefore I am inclined to think it may have been produced by the dwarfing process, which will arise from hardship and privation endured generation after generation, particularly by the young animals and the mares while heavy in foal. These animals had, I can say almost positively, no recent cross of the Spanish horse; but I have seen, since that time, ponies approaching nearly to the same type, which showed an evident cross of the mustang; and I have seen animals called mustangs, in which I was convinced that there was Canadian blood.

INDIAN BREAD. (See Acorn.)

INDIAN CORN. (See Maize.)

INDIAN CRESS. (See Cress.)

INDIAN TOBACCO. *Lobelia.*

INDIAN TURNIP. *Arum triphyllum.* Wake-robin. A common marsh plant, the bulbous roots of which contain much starch, and are occasionally eaten, after being dried, but it is acrid when fresh.

INDIA RUBBER. Caoutchouc. The dried milky juice of the *Siphonia elastica,* and other euphorbiaceous trees. It is a compound of ninety carbon and ten hydrogen.

INDIGESTION. Indigestion in horses is of two principal forms, one caused by engorgement of the stomach, or from feeding musty hay and grain. In colts, it is often occasioned by teething, and in older horses from decayed or defective teeth. The remedy is obvious, attention to the food, examination of the teeth, lancing the gums, if needed, in young horses, and the removal of defective teeth in old horses. Indigestion from engorgement, may be removed by mild purges, assisted, if necessary, by injections. If allowed to go on, it often results in affections of the brain, sleepy staggers, stomach staggers, and even in fatal forms of apoplexy. When the indigestion is chronic, first examine the teeth, feed only on light nutritious diet, and never enough so the animal will gorge itself. Give a light physic of a pint of linseed oil, followed by a tonic, twice a day, of one-half ounce each of bicarbonate of soda, and of powdered gentian, and twenty grains of nux vomica. If the indigestion is acute from engorgement, to the pint of linseed oil add twenty to thirty drops of croton oil, to be given at a dose. Foment the belly by means of blankets wrung out of hot water, and assist the physic with injections of soap and water. Since the only way to relieve the overloaded stomach, in the horse, is by the intestines. If sleepy staggers come on, stimulants, whisky half-pint doses, warmed with ginger may be given.

INDICATION. The particular treatment indicated by the symptoms of a disease.

INDIGENOUS. Native plants are so-called.

INDIGO. *Indigofera.* A vegetable dye, embracing a large industry in the East and West Indies, and Central America, from whence the indigo of commerce is obtained. The varieties cultivated in Hindostan are principally *I. nerium tinctorium* and *I. tinctoria argentea.* In the West Indies and Central America the variety *I. anil* is mostly planted. In Georgia, and other Gulf States this variety has run wild. *Baptisia tinctoria* is also indigenous in the South. In the last century indigo was extensively cultivated in the South. In 1731, 100,000 pounds were exported from Charleston, S. C. This was yearly increased up to the time of the Revolutionary war the yearly export reached 107,660 pounds. In 1794, 1,550,880 pounds were exported from the United States. The introduction of the cotton gin, and the profits arising from the cultivation of cotton, is undoubtedly one of the prim. causes of the decline of indigo-raising in the United States. Near Orangeburg, S. C., there are six indigo farms carried on. Indigo requires rich but sandy land. It sprouts annually from the roots, requiring to be sown but once in seven or eight years. With capital and careful management there is no doubt but that the cultivation of indigo might again be made a paying industry upon suitable lands in the Gulf States. In regard to the culture and manufacture of indigo in this country, Porcher, in his work on the Resources of Southern Fields and Forests, (1869,) says, that the soils best adapted are the rich, sandy loams, though it grows on most lands moderately well, provided they are not wet. The ground should be well broken, and kept light and free from grass by the plow. The nature of the manure exerts a great influence upon the quantity and quality of the coloring principles. Those substances which act as stimulants to vegetation, such as lime, poudrette, ashes, etc., favor the growth of the plant without injuring the coloring matter.

Where barn-yard manure has been largely used a crop of grain should first be raised on the land. The seed should be mixed with ashes or sand and sown in drills fourteen inches apart, four quarts of seeds to the acre. In the climate of middle Georgia the seed should be sown the 1st of April. When it first comes up it should have the grass picked out with the hand. When an inch or two high the grass between the rows should be cut out by the hoe or scraper and the soil loosened about the roots. These weedings are enough before the first cutting, which should commence as soon as the plant throws out the bloom. It is so easily injured by the sun after being cut that the operation should be commenced and end in the afternoon. After cutting with the reap hook it is put under the shed until it can be put in the vats. In Georgia, two cuttings yielded sixty pounds of indigo to an acre, provided the roots were not injured in the first cutting, which, at three acres to the hand, would be one hundred and eighty pounds. It is said that among the Arab cultivators in Egypt and Morocco the seed is sown only once in seven years, and that two crops a year are obtained. Among these people the process of manufacturing or extricating the coloring matter from the plant is given as follows: Three wooden vats are provided and so placed at different levels as that the contents of the first can be readily transferred to the second, and again from that to the third. The upper vessel is called the steeping vat, and in this the plants are loosely laid, in sufficient quantity to cover the bottom, and water poured over them to the depth of two or three inches. In about eighteen hours fermentation begins and the plants swell and give off large quantities of gas, which tinges the water with a lively green color. After all the coloring matter, or grain, as it is technically called, is extracted, the turbid liquor is drawn off into the second vat where it is violently agitated and beaten in order to separate the grain from the water. A great quantity of air-bubbles are driven off by this beating, and the color of the contents of the vat changes from green to deep blue. When the grain has subsided to the bottom of the vat the supernatant liquor is drawn off and the grain is discharged into the third vat, where a further subsidence and drawing off ensue, and the grain is next transferred to sacks and hung up to drain. It is then placed in wooden boxes and exposed to the air and sun until all the moisture is evaporated, when the process is completed and the indigo is packed in chests ready for shipment. In the great indigo-factories of Bengal some part of the drying is effected by the agency of fire. The following process of manufacturing indigo in small quantities for domestic use is given by the Southern Agriculturist: Cut the indigo when the under leaves begin to dry, and while the dew is on them in the morning; put them in a barrel and fill this with rain-water, and place weights on to keep it under water; when bubbles begin to form on the top and the water begins to look of a reddish color, it is soaked enough and must be taken out, taking care to wring and squeeze the leaves well, so as to obtain all the strength of the plant; it must then be churned (which may be done by means of a tolerably open basket with a handle to raise it up and down) until the liquid is quite in a foam. To ascertain whether it is done enough, take out a spoonful in a plate and put a small quantity of very strong lye to it. If it curdles, the indigo is churned enough, and you must proceed to break the liquor in the barrel in the same way, by putting in the lye (which must be as strong as possible) by small quantities, and continuing to churn until it is all sufficiently curdled; care must be taken not to put in too much lye, as that will spoil it. When it curdles freely with the lye, it must be sprinkled well over the top with oil, which immediately causes the foam to subside, after which it must stand till the indigo settles to the bottom of the barrel. This may be discovered by the appearance of the water, which must be let off gradually by boring holes, first near the top and afterward lower, as it continues to settle; when the water is all let off and nothing remains but the weed, take that and put it in a bag (flannel is the best) and hang it up to dry, afterward spreading it to dry on large dishes. Take care that none of the foam, which is the strength of the weed, escapes; but if it rises too high, sprinkle it with oil.

INDIGO BIRD. *Cyanospiza cyanea.* A summer bird at the North. The males are of an indigo blue. Their food is the seeds of weeds and small insects. They make their nests in low bushes, generally near the habitation of man. They lay four or five eggs, nearly pure white, and but one brood is reared in a season.

INDUCTION. The process of arriving at generalizations, or laws, by a judicious investigation of numerous facts. In electricity, it is the influence one electrified body exerts on another, whereby its nearest surface is made to exhibit a kind of electricity differing from that of the excited substance.

INDUMENTUM. The coating of feathers on birds.

INDUSIÆ. The cases of certain water insects; they are silicious, calcareous, or ferruginous.

INDUSIUM. The thin membrane covering the fruit of some ferns.

INDUSTRIAL EDUCATION. The subject of industrial education has been partially discussed under the head of Agricultural Colleges. The idea of industrial education, that is, such education as would best fit the student for grappling with the sciences which underlie mechanical operations and agriculture, has long been mooted in the United States. (See Agricultural Education). At length, through the efforts of Hon. Justin Morrill, of Vermont, the popular agitation took form in the Act of Congress endowing colleges in every State with public lands for teaching such branches as are related to agriculture and the mechanic arts, including military tactics. In Europe, the subject of industrial education has spent itself chiefly in the direction of agricultural colleges. In our own country where agriculture is the paramount industry far above any other, after the matter was fully considered, it was found impossible to pass a bill through Congress for agricultural colleges without tacking to it the other industries, and a loop hole was left, eagerly seized by the scholastics to so mould these institutions of learning that they would *per se* follow in the old scholastic grooves of learning. The people, however, were closely watching the progress of these schools, and the major part have been kept somewhtt near the lines they were intended to follow. In this respect, the Agricultural College of Michigan has held to the popular idea, as understood and advocated by the most advanced practical thinkers. Each year there is progress being made in bringing these schools nearer and nearer to institutions where agriculture and the mechanic arts, or rather the sciences, relating to them, shall become the paramount studies. Industrial schools have long been known in Europe and America. One of the sophistical reasons, given by those who sought to change the name of the Industrial University of Illinois into that of the State University, was that the term industrial was generally regarded as being something savoring of crime or pauperism. It is hardly to be supposed that a State would erect a great university upon which more than $1,000,000 has been spent, to give education to this class. To show that the term industrial is not so understood in Europe, the following from the American Encyclopædia will show that the term Industrial Schools is used to designate three classes of educational institutions. These are as follows: First. Scientific schools, such as the *école des arts et métiers* at Paris and Berlin, and the polytechnic schools of the same cities; the schools of metallurgy, manufacturing, mining, and the chemical arts, so numerous on the continent of Europe; schools of civil engineering, architecture, and agriculture. Their number is constantly increasing, but they have nowhere else attained so high a development or so thorough a course of instruction as in Prussia, Saxony, Bavaria, and the duchy of Nassau. It is owing to the chemical and mechanical skill, and the tact and taste in the arts of design, developed by these schools, that the continental nations of Europe have been able to maintain their supremacy in manufactures. The industrial school (*Gewerbschule*) at Chemnitz, in Saxony, one of the best of its class, in 1857 had sixteen professors and teachers, and 237 pupils. Some of these schools have a very large corps of professors, and courses of study usually occupying six or seven years. Second. Technical schools, in which, in connection generally with elementary instruction in the common branches of study, the pupils are taught some practical art, trade, or employment; such are the lace workers' schools in Belgium and Ireland, the free schools of the arts of design, the agricultural farm schools, the schools for teaching household duties to girls, and the schools for the industrial instruction established in New York. In France, Belgium, many of the German states, and Ireland, such schools are numerous. A great impulse has been given to industrial instruction by the establishment of industrial associations in various countries, particularly in Germany, where they have become very numerous since 1848. There is a third class of schools established for the training of pauper and vagrant children in the habits of industry, and their instruction in rudimentary studies in connection with employment in some simple art or trade, by which they may subsequently obtain a partial support. These schools, to which the name industrial school is also applied, are wholly charitable; the children are usually wholly or partially clothed by the school, and one meal a day, or sometimes two, furnished them. The first idea of such a school seems to have originated with a poor mason in Rome, Giovanni Borgi (1736-1802), who collected the vagrant boys of that city in his own house, taught them to work, had them instructed in the rudiments of learning, and when they were old enough apprenticed them to artisans. On the continent of Europe industrial as well as secular instruction is given in the Sunday schools, while in the United States religious instruction only is given on that day, and hence the American ragged children's Sunday schools are not, even sophistically, to be identified with industrial univerities. According to returns made to the General Government, in relation to the progress of Industrial Education, in thirty-six States there are now thirty-nine colleges which have received the congressional land-grant of July 2, 1862. There are also branch institutions in Georgia and Missouri. The following is a list of the industrial institutions of the United States which had accepted the endowment in lands from the United States in 1875. The first column shows the location of the institution, and the second the name of the institution which has received the grant:

Location.	Name.
Auburn, Ala	Agricultural and Mechanical College of Alabama.
Fayetteville, Ark	Arkansas Industrial University.
Berkeley, Cal	University of California.
New Haven, Conn	Yale College—Sheffield Scientific School.
Newark, Del	Delaware College.
Eau Gallie, Fla	Florida State Agricultural College.
Athens, Ga	University of Georgia.
Dahlonega, Ga	
Urbana, Ill	Illinois Industrial University.
La Fayette, Ind	Purdue University--Indiana Agricultural College.
Ames, Iowa	Iowa State Agricultural College.
Manhattan, Kan	Kansas State Agricultural College.
Lexington, Ky	Kentucky University—Agricultural and Mechanical College.
New Orleans, La	Louisiana State Agricultural and Mechanical College.
Orono, Me	Maine State College of Agriculture and the Mechanic Arts.
College Station, Md	Maryland Agricultural College.
Boston, Mass	Massachusetts Institute of Technology.
Amberst, Mass	Massachusetts Agricultural College.
Lansing, Mich	Michigan State Agricultural College.
Minneapolis, Minn	University of Minnesota.
Oxford, Miss	University of Mississippi.
Rodnev, Miss	Alcorn University.
Columbia, Mo	University of Missouri.
Rolla, Mo	
Lincoln, Neb	University of Nebraska.
Nevada	(No industrial institution established.)
Hanover, N. H	Dartmouth College.
New Brunswick, N. J.	Rutgers College.
Ithaca, N.Y	Cornell University.
Chapel Hill, N. C	University of North Carolina.
Columbus, Ohio	Ohio Agricultural and Mechanical College.
Corvallis, Ore	Corvallis College.
Centre County, Pa	Pennsylvania State College.
Providence, R. I	Brown University.
Orangeburgh, S. C	Claflin University.
Knoxville, Tenn	East Tennessee University.
Bryan, Tex	Texas Agricultural and Mechanical College.
Burlington, Vt	University of Vermont and State Agricultural College.
Blacksburgh, Va	Virginia Agricultural and Mechanical College.
Hampton, Va	Hampton Normal and Agricultural Institute.
Morgantown, W. Va	West Virginia University.
Madison, Wis	University of Wisconsin.

The professors and assistants in these colleges during the year numbered 473, and the students, 4,211. In 1876, eleven States had not sold all the scrip or land granted them by Congress;

Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Nevada, New York, Oregon, and Wisconsin. They have sold during the year 51,405 acres, at an average price of $4.41 per acre, and 1,463,505 remain unsold. The largest average price obtained per acre by any State was $8.38, by Michigan, and the smallest, $2.20 by Iowa. In some of the colleges the number of students pursuing agricultural or mechanical studies is much smaller in proportion to the number in attendance than in others. This may be owing to several causes. In some cases the colleges have been recently established, and have not yet been brought into practical working order; in others the students were poorly prepared when they entered, in consequence of the low standard of education in the surrounding country, and in others, inducements were greater to enter upon other courses of study which seemed to promise more immediate profit; but these embarrassments are gradually becoming less, and when agriculture and the mechanic arts require higher qualifications for their practice and become more remunerative, they will, no doubt, entirely disappear. Some of the colleges have already attained a high standard of excellence, considering the time they have been in operation and the fact that they have largely to educate their own educators. A large number of students graduate at these colleges every year, and enter upon practical farming and the mechanic arts, or to become professors in industrial institutions of our own or other countries. The annual interest of all the institutions, except two or three, is given at $526,283, which, at six per cent. per annum, represents an investment of $8,771,383. The Commissioner of the General Land Office, in his annual report for 1869, states the aggregate claim upon the public domain accruing under the agricultural-college-scrip legislation at 9,510,000 acres, which, at the minimum price, $1.25 per acre, amounts to $11,987,500. But the prudence with which some institutions have husbanded their resources has raised the average much above this minimum. There yet remain 1,463,305 acres to be disposed of, which, at the highest average price obtained, will add about $6,500,000 to the fund. It will doubtless average much higher than this, and will probably raise the aggregate to $19,000,000 or $20,000,000.

INDUVIÆ. Organized remains; the withered leaves of monocotyledonous trees, etc.

INERMIS. Unarmed; without spines or prickles.

INERT VEGETABLE MATTER. Peat, tan, etc., which does not readily ferment; mixture with dung, lime, or ashes reduces it.

INERTIA. The indifference of matter to rest or motion.

INFLAMMATION. An unnatural increase of circulation, blood, and heat in any part. It originates in irritation, colds, contagion, and unhealthy conditions of the nervous system, and may attack any part. It begins with dryness, heat, pain, and tension, which is succeeded by increased vascularity, swelling, and secretion, and terminates naturally by resolution to the primary states, by the adhesion of parts or the formation of pus, ulceration, mortification, and death of the part. If the animal be vigorous, it is to be treated by bleeding, purging, blisters, and cooling applications. But the inflammations of weakly animals, especially when arising from contagion and ending in ulcerations and gangrene, is to be treated by stimulants and tonics, of which carbonate of ammonia (*sal volatile*) and bark are the best.

INFLAMMATION OF THE BOWELS. (See Enteritis.)

INFLAMMATION OF THE FOOT. (See Founder.)

INFLAMMATION OF THE LUNGS. (See Pleuro Pneumonia.)

INFLAMMATORY DISEASES. This is a class of diseases to which the horse, and also swine are peculiarly liable. The horse to inflammation of the brain and all the viscera, and the hog to inflammation of the lungs. In the horse the brain is often congested, resulting in inflammation showing itself in Phrenitis, mad or sleepy staggers. In the article Indigestion, staggers is noticed. In decided inflammation of the brain, from four to six quarts of blood should be drawn at once, and from the jugular vein, unless the pulse is feeble. In all cases the bowels should be relieved by six drachms of aloes and one drachm of calomel, given as a ball, to be repeated the next day if the first do not act. Keep the animal quiet and in a dark place. The head should be kept cool with ice, or cold water, and if fever supervene, give several times a day, as a ball, one drachm of powdered digitalis, and two drachms of saltpetre. If paralysis shows itself, three grains of strychnine, given twice a day, cautiously increased from time to time, until twelve grains at a dose is reached, will be indicated. Inflammation of the viscera, heart, lungs, bowels, etc., must be met without strong purging. The object being to allay the inflammation and subsequent fever. Injections to relieve the bowels, and hot fomentations, and injections of morphia under the skin, fifteen grains, by means of a hypodermic syringe. In every case of inflammation of the lungs, brain, bowels, etc., a veterinarian should be called if possible.

INFLATED. Distended like a full bladder, as the carpels of some plants.

INFLEXED. Bent inward.

INFLECTION. In optics, the same as diffraction.

INFLORESCENCE. The grouping of flowers on the stems of plants; the principal forms are the spike, raceme, corymb, umbel, panicle, thyrsus, catkin, capitulum.

INFLUENZA. Under the names Epizootic, Contagious Catarrhal-fever, Contagious Influenza, Pink-eye, etc., this disease has been known to veterinarians, and since the year 1872, generally to the horsemen of the United States and Canada. Its immediate cause is entirely unknown, but that it is produced by blood poisoning through germs floating in the air is now generally received as true. The first symptoms are general weakness, staggering gait, hanging head, trembling limbs, shivering, watery discharge from the nose, staring hair, and loss of appetite. The pulse is weak but quick, from fifty to sixty per minute, and from that up to eighty or ninety. The breathing is hurried, from forty to fifty inspirations a minute, and the temperature of the body over 100° even to 105°. The horse seems to be afraid to lie down, and so stands with propped legs, the bowels are bound up, and the urine scanty; the discharge from the nose becomes white, yellow or greenish, and death ensues from weakness and exhaustion, or from suffocation, paralysis, or from clots formed in the heart. Under the microscope the disease germs assume various forms. The figure shows some of them magnified 400 diameters. The treatment consists in good nursing, keeping the strength of the animal up by light, nutritious diet, and gruels, and in combating the symptoms as they appear under the many complications which this disease assumes. Dr. James Law, of Cornell University, in an elaborate monogram upon the disease, to the United States Government, gives the treatment to be followed, in various phases of the disease, even to the injection of pure blood into the veins of weakened animals. From it we excerpt that which will be of value to the farmer, in the treatment of the disease as it appears in malignant forms. All debilitating or depressing treatment must be sedulously avoided. Bleeding, purging, severe action on the kidneys, depressing sedatives and violent blistering, are alike to be deprecated. In the regular and uncomplicated form of the disease, nearly all will recover under good nursing and fresh air, and independently of all medicinal agents. Place the patient in a cool, dry, well-ventilated, and well-littered box; clothe him comfortably, so as to avoid all tendency to chill, bandage his legs loosely, and change the clothes, and curry or brush the skin twice or thrice a day; keep quiet and still, although usually a little exercise in hand, in the shelter and sunshine, will be rather beneficial than otherwise. Feed on bran mashes, boiled oats or barley, turnips, carrots, or other roots, in small quantities, and often, so as not to clog the appetite, and supply at frequent intervals a quart or two of water, nearly cold, or cold oatmeal, or linseed gruel. It is important to favor depuration of the blood by moderate but never excessive action of the kidneys or bowels. Costiveness will oftentimes be best met by abundant and frequent injections of water, blood warm, (three or four quarts at a time,) or by one-half pound of molasses, or three ounces of sulphate of soda added to the drink. If a laxative is absolutely necessary, it should rarely exceed one-third of the ordinary dose, on account of the dangerous susceptibility of the digestive organs. The author has seen a large Percheron die of superpurgation, after taking but three drachms of Cape aloes. During the recent visitation an instance came under his notice in which half a pint of linseed oil came nigh proving fatal. This susceptibility of the digestive organs, however, varies widely in different epizootics, and in some mild laxatives prove beneficial, yet their possible danger should be kept in mind. Mild febrifuge diuretics may be used with advantage. Spirits of nitrous ether, in half-ounce doses, may be given twice a day, or liquor of the acetate of ammonia, in ounce doses, four times a day in the water gruel drank. If the fever runs high, or effusions threaten to take place, these may be increased as far as the strength will allow, but always with the greatest caution and judgment. When the cough proves especially violent and painful, the addition of anodynes, such as belladonna and camphor, is advisable. A drachm of each may be added to the diuretics already advised. The cough may be further relieved, and the relaxation of the mucous membranes and the appearance of the discharge hastened, by causing the animal to inhale warm water vapor several times a day, for an hour at a time. This is most conveniently done by saturating chaff bran or other simple agent with boiling water, placing it in a nose-bag, which is then hung on the patient's nose by means of a strap crossing behind the ears. This proves especially beneficial, as the moderation of the fever is usually a concomitant of the appearance of the discharge. Burning a pinch of flowers of sulphur, more or less, according to the size and nature of the building, so as to impregnate the air to an extent just short of causing irritation and coughing, has a very soothing and beneficial effect on the mucous membrane. It is best done by laying a piece of paper bearing the sulphur on a shovel, and setting fire to it. It is superfluous, perhaps, to say that it must be done behind the patient, and not beneath his nose. The fumes of vinegar from a red-hot brick, of burning leather, and the like, are cruelly irritating, and occasionally induce fatal results. Counter-irritants are often useful from the first. If, however, inflammation and sore throat seem extreme, a poultice may be advantageously applied for a day previously, or the throat may be well fomented with warm water for an hour and then wrapped in a sheep skin with the wool turned inward. When, however, there appears little danger of even temporarily aggravating the local inflammation, the throat or chest, where the disease has been localized, it may be well rubbed with a thin pulp made of the best ground mustard and tepid water, and then covered up. This may be replaced by the soap liniment, made with six ounces of soap, three of camphor, and a pint, each, of proof-spirit, liquor ammonia, and linseed oil. This liniment may be applied repeatedly at short intervals and well rubbed in. If a more active blister is wanted an ointment may be used composed of a drachm and a half of powdered cantharides, a scruple of camphor, ten drops of spirits of wine, and an ounce of lard. The hair should be cut off and the ointment well rubbed in, in a direction contrary to that of the hair. After it has acted, the skin should be kept soft and pliant by rubbing it with fresh lard. Oil of turpentine, which has been largely used as a counter-irritant in a great number of cases, is only objectionable on the ground of its causing so much local irritation without blistering as to drive some excitable horses to distraction. In using any one of these

counter-irritants it is best to apply them over a limited space only, not exceeding the bounds of the inflammatory action, as we can thus secure the best results from the intimate nervous sympathy existing between the deeper-seated organ and the skin which covers the corresponding part of the surface, and at the same time avoid the depressing and debilitating effects of a blister. For this reason a careful examination, of the chest especially, should always be made before making such an application. As the mouth becomes cooler and more moist, and the pulse softer and less frequent, a more stimulating treatment is desirable. At first two drachms each of gentian, powdered cinchona, nitre and sal ammoniac, may be given night and morning, or if the debility is very great the last-named agent may be replaced by four drachms of carbonate of ammonia made into a bolus, with linseed meal, or dissolved in a half pint of water, and repeated three or four times a day. In cases marked by a daily remission, I have found a dose of thirty grains of sulphate of quinia to prove effectual in preventing the paroxysm, if given an hour or two before the period when it was in the habit of appearing. During convalescence gentian, cinchona, and other tonics, are desirable, with alcoholic, ammoniacal, or other stimulants, if there is much debility or prostration. The diet should be tempting and nutritious, supplied often, fresh and frequently varied, and care should be taken at all times to counteract any sudden suppression of the secretions of the bowels or kidneys, or even the nasal discharge In this connection may be mentioned the statement of Mr. Murray, of Detroit, that all the cases of dropsy that came under his notice occurred in animals which had taken for a few days condition powders, consisting largely of sulphate of iron, and had had the nasal discharge suddenly dried up. Improvement followed promptly on the withholding of the powders and soliciting the action of the kidneys and bowels. Should the prostration become extreme, stimulants must be resorted to even more frequently than is recommended above; five, or even six times a day. In some instances, however, the system seems to lose all power of reaction, and almost the only remaining hope lies in the transfusion of blood from the veins of a healthy animal to those of the sick. The blood may be obtained from a healthy horse, or more conveniently from oxen or sheep intended for slaughter. It may be transferred through an elastic tube without exposure to the air, or it may be drawn off into a vessel and thence transferred to the veins of the sick horse, unchanged or defibrinated, remembering, that the main dangers to be guarded against are the entrance of air into the circulation, the introduction of clots of fibrin, which by blocking the vessels, would produce local inflammation and abscess, and the too rapid transfusion which leads to vertigo and fatal fainting. If the abdominal organs are especially involved, the counter-irritant is to be applied over the region of the liver, bowels, or kidneys, as the case may demand. With yellow or brownish appearance of the mucous membranes and tenderness over the short ribs, this point should be selected for its application. With general tenderness of the abdomen, colicky pains, frequent straining, and the passage of a white, thick mucus forming a pellicle over the dung, or collected in masses, it should be applied generally to the surface of the belly. If there is tenderness and swelling of the loins, stiffness of the hind limbs, frequent straining, the passage of water in small quantities and highly colored, and above all if the urine contains microscopic fibrinous casts, it should be applied over the loins. In the last case it may be preceded by a bag of hot, scalded bran, or a fresh sheep-skin with the fleshy side turned in. The shivering, which usually attends the onset of such complications, may be counteracted by friction to the skin, clothing, a warm drink containing a stimulant—four drachms carbonate of ammonia—and injections of warm water or well-boiled gruel, given to the extent of three or four quarts at a time, and repeated every hour until shivering ceases. In cases affecting the liver or bowels, I have found excellent results from guarded laxatives. Two, three, or even four drachms of aloes in different cases, with a drachm of gentian, and thirty drops of hydrocyanic acid, or an ounce of laudanum, will usually promptly relieve the colic, secure an action of the bowels, and remove the deadly prostration which characterizes this type. It has manifestly the effect of relieving the inflamed surface by a free secretion from its turgid blood-vessels, of benefiting the portal system and liver by a direct local depletion, and of eliminating poisonous material, which was being pent up to the great injury of the system at large. Little more is wanted than the free use of demulcents, such as slippery elm, well-boiled linseed, and the like, great care to secure a continuous moderate action of the bowels, and a tonic treatment as in other cases of convalescence. Turpentine has been strongly recommended by some, and acts beneficially as a local and general stimulant. An ounce of the crude drug, or half an ounce of the oil, may be made into a ball with linseed meal, or beaten up with the yolks of two eggs, and given twice daily. The affection of the kidneys may demand gentle laxatives, (oleaginous,) anodynes, (laudanum,) emollient injections, counter-irritants, stimulants, and later gentle diuretics. The nervous symptoms will sometimes demand the application of cold wet cloths to the head, counter-irritants to the sides of the neck and limbs, the guarded use of laxatives and diuretics, with drachm doses of bromide of potassium, and if there is great depression, ammoniacal stimulants. The rheumatic complication is to be met like ordinary rheumatism. Liquor of the acetate of ammonia two ounces, and colchicum wine, one ounce, may be given twice a day, diluted in water; tonics, warm clothing, the frequent application of a hot smoothing iron over the affected part of the body, with the intervention of a thin cover, and even counter-irritants are among the agents especially demanded. When the heart is implicated in rheumatic cases, the same treatment is necessary, but the blisters are to be applied behind the left elbow. When there is reason to suspect the existence of clots in the heart, alkaline remedies are recommended, particularly the preparations of ammonia and iodide of potassium, attention being meanwhile given to support the system by tonics and stimulants, and to encourage the elimination of deleterious products from the blood. If dropsical manifestations appear, they must be treated according to their apparent causes; if disordered function of the heart or kidneys, these must be met by appropriate measures; and if, from weakness of the circulation, an anæmic or debilitated state of the blood and imperfect nutrition, gentle action of the eliminating organs, with stimulants, tonics, a nourishing diet, (embracing, in some cases, strong beef soup or tea,) or even transfusion of blood, will be necessary. *Purpura hæmorrhagica* is to be met by similar supporting and eliminating treatment, with the addition of oil of turpentine in half ounce doses, or pure carbolic acid in drachm doses, and cinchona in half ounce doses, repeated thrice a day. The skin over the engorgements should be rubbed frequently with a solution of carbolic acid, containing one part of the acid to every hundred of water, and a similar lotion should be applied frequently to the sores when these form. In short, the various complications and sequelæ of simple influenza are to be treated like similar lesions occurring independently of this affection, but with due regard to the great debility attending this disease. The great majority of cases will recover without any treatment; and indeed many require no medical treatment, but a certain number will demand the greatest care of the educated medical attendant. Upon prevention, Dr. Law adds: Many have attempted to ward off the disease by the use of tobacco, camphor, vinegar, tar, assafœtida, etc., and others more rationally, by bromo-chloralum, carbolic acid, permanganate of potash, sulphurous acid, and the hyposulphites, but in no case with permanent success. With a contagium like that at present under consideration, so easily diffused through the atmosphere, absolute prevention will always be difficult, though not necessarily impossible. With a disease, too, the tendency of which is almost invariably to a favorable termination, it is scarcely politic to shut up an animal for a month in a disinfected atmosphere, until the disease has subsided, with the probability before us that he would still contract the disease from the remnants of the poison when exposed at the end of this period. Thorough cleanliness and disinfectants are to be highly commended, not with the view of absolutely preventing the disease, but rather with intent to retard and moderate it. The comparatively non-volatile disinfectants, such as permanganate of potash, chloride of lime, bromo-chloralum, and carbolic acid, may be used for the solid structures of the stable, drains, manure, and the like, while sulphurous acid is above all to be commended for disinfection of the air. This agent, when used frequently and in small amount, so as to be non-irritating, has the double advantage of soothing and giving tone to the diseased mucous membrane, and of destroying organic germs, including perhaps the morbific elements in the respiratory organs.

INFUNDIBULIFORM. Shaped like a funnel.

INFUSION. A liquor obtained by macerating herbs, etc., in hot or cold water.

INFUSORIA. The minute animalcules of infusions and stagnant waters; some possess a mineral casing; and the remains of innumerable myriads are found in rocks, such as tripoli, hence termed infusorial, or infusory rocks or formations.

INGLUVIES. The crop of birds.

INGUINAL. Connected with the groin (*inguen.*)

INK. To make black ink of the best quality, take twelve parts of gall-nuts, five of green vitriol, and five of gum; the galls are to be well pounded and boiled, and the other ingredients afterward added; one gallon of water is used for every pound of galls. Oak bark, logwood, and other substances are often used in place of the galls; the quantity must be two or three times greater. The indelible ink, for marking linen, is a solution of nitrate of silver, (lunar caustic). It is used with a clean pen on a place previously soaked with a little salt; the marking is to be exposed to light to blacken. It is removable by chlorine and ammonia.

INJECTIONS, TO GIVE. Injections are a favorite mode of administering medicines to animals, particularly to assist the action of medicines given by the mouth. If these are to be retained and absorbed, the horse or ox should not have more than two pints, but when the object is to produce evacuation, two and even three quarts are used. The use of injections will often supersede the necessity of medicines at the mouth, and weak solutions of permanganate of potash, or weak sulphurous acid, are often useful for washing the vagina after parturition, as a means of mild disinfection. Injections are also valuable as a means of introducing sedatives into the lower bowels, and for removing pin or thread worms. As a rule the barrel syringe is used. It is, however, much better to pump the liquid in by means of a fountain syringe if one can be had. The same thing may be accomplished by placing the medicine in a vessel three or four feet above the animal, conducting the liquid into the rectum, by means of a rubber hose communicating with the reservoir. Any liquid medicine given by the mouth may be used as an injection; but for assisting the action of other medicines warm (tepid) soapsuds is generally used.

INNER BARK. The liber of botanists, bass.

INNOMINATUM BONE. The bone of the buttock; aitch, or adze bone.

INOCULATION. The introduction under the skin of animals of a particular poison, fluid, or virus, to produce a specific disease, as smallpox. Budding and the transfer of grass turfs are also called inoculation by farmers.

INORGANIC. Not organic or destructible by heat, as the ashes of plants, minerals, etc.

INOSCULATION. The union of the extremities of veins and arteries.

INSECT. (See Entomology.)

INSECTIVOROUS. Birds, animals, or reptiles that prey on insects.

INSERTION. In botany, the direction in which an organ, as the stamens, is attached to the part that sustains it.

INSESSORES. Birds which perch on trees. Perchers.

INSOLATION. Scorched by the sun.

INSPIRATION. In physiology, the act of inhaling air.

INSTEP OF THE HORSE. The part of the hind leg reaching from the ham to the pastern joint.

INSULATION. In electricity, surrounded by non-conducting substances, as glass, resin.

INTEGERRIMUS. With a perfect edge, or margin, in botany.

INTEGRANT PARTS. The smallest parts of a body, by the union of which the mass is produced.

INTEGUMENT. A membranous covering or expansion. It is used in botany for the covering of seeds.

INTERCELLULAR SPACES. In botany, the minute spaces existing between the sides of cells. Along these the movement of sap occurs in herbs and the lower plants. In some water plants they are large to assist natation.

INTERFERENCE OF LIGHT. The effects produced by causing two pencils of light to be reflected or transmitted at very minute intervals or distances from each other, whereby they interfere and produce colors If the light be homogeneous they produce bright and black bands.

INTERFERING. This is the cutting of one leg ankle generally by another foot. The mischief is occasioned by the foot on the ground being set too near the line of the passage of the other foot. The usual remedy is to throw the leg out of line by raising the inside of the shoe slightly. If properly performed, in the generality of cases, the animal will not cut, after a time, with an ordinary shoe, since it is more a habit than a disability. If all other means fail, the point of contact may be protected by a leather shield. The same rule will apply to speedy cut, and other habits of cutting the leg high up.

INTERNODE. The space between two knots, leaves, or leaf buds, in stems.

INTERVAL LANDS. Lands on the margins of rivers. Alluvial lands.

INTESTINAL FEVER IN SWINE. (See Hog Cholera.)

INTESTINALIA. Worms inhabiting the interior of the bodies of animals. Entozoa. Those of the intestines are destroyed by purges and large doses (two ounces) of oil of turpentine.

INTRADOS. The lower line or curve of an arch.

INTRORSE. Turned inward.

INTUSSUSCEPTION. The folding of one portion of the intestines into another.

INULIN. A variety of starch. It is colored yellow by iodine.

INUNDATION OF LANDS. Fields are sometimes covered with water in agriculture, especially meadows, and in the cultivation of rice. The water is let in by sluices, and allowed to remain for several days or weeks, and, in meadows, during the whole winter. It kills those weeds which are not aquatic, serves to manure the soil, and, in the case of meadows, advances the grass by some weeks, the water protecting it from frost. The lands should be well drained, or on a porous soil; otherwise the water, sinking, will stagnate, and become injurious; it should be perfectly let out by numerous drains. By this practice, meadows have been rendered fertile without other manure for ages. The sediment deposited is sometimes called warp, and the inundation warping. The inundation of land by freshets, always causes renewed fertility. Those bottom and intervale lands, subject to periodic overflow, are the most permanently fertile in the country, bringing crops year after year, and generation after generation, without manure. Unfortunately some of these, as the great bottom lands along the Mississippi and Missouri, can not easily be protected from extraordinary floods, and hence great damage, complete destruction to crops, and even loss of life to the inhabitants as well as to live stock, sometimes occurs. The great floods of the Mississippi are not soon forgotten, and that of 1881, extending, as it did, the whole length of the valley, from St. Paul to the Gulf of Mexico, intensified, as it was by the inundations along the length of the Missouri, (the first severe one since the settlement of the upper Missouri valley,) entailing vast loss of property in crops, live stock, and even human life, will long be remembered, and should cause energetic steps to be at once taken to prevent it in future—a difficult problem but one by no means insurmountable.

INVENTION IN AGRICULTURAL ART. Invention in the processes simplifying agricultural labor and art have scarcely kept pace with those applicable to manufactures. Nevertheless, within the last ten years, such notable improvement in the adaptation of machinery to agriculture has been made, that scarcely any farm labor need now be done by the direct application of manual labor. Even the pitching of hay by horse power is now fairly accomplished, thus taking off one of the most severe forms of labor with which the farmer has to deal. Wheel implements are now universally used in the place of the hoe in cultivating the kitchen garden, and in extensive market gardening the application of gang seeders and cultivators have been successfully used; one used by the writer, having been capable of cleaning twelve acres per day, with three men and three horses, covering eighty inches of surface at every passage over the field. The modern mower, tedder, hay rake, loader, and stacker, leaves little to be desired in hay making. The grain fields are plowed with gang plows, seeded by means of drilling machines, and cut, gaveled and bound by one operation of the modern harvester. Corn land in the West may be well prepared and cultivated at an outlay of less than the labor of a man and team working less than one and a half days per acre, leaving the field ready for the huskers. Roads are graded by machinery at the rate of a quarter of a mile per day, ditches are dug, and even tile laid by machinery. The threshing and cleaning of grain, and in fact all the principal labors of the farm are now so simplified, that what was once the most exacting drudgery is now not any more laborious than other industries. In dairying, invention seems to have been at fault in one respect. A perfect and practicable cow-milking machine has not yet been invented. A number have worked measurably well, but can not be relied on for constant use. Chemistry, however, has come nobly to the help of the dairyman, and in connection with modern apparatus for setting milk, making butter and cheese, has placed the dairyman now on an equality with other branches of husbandry.

INVERTEBRATE ANIMALS. Animals without an internal skeleton or back bone (vertebral column), such as crabs (*crustaceans*), insects (*articulata*), or shell fish (*molluscans*), etc.

INVOLUCEL, INVOLUCELLUM. A small or partial involucrum surrounding the secondary umbels, etc.

INVOLUCRUM. A collection of bracts at the union of several flower stems. A covering of the fructification of ferns and equisetums. In anatomy, a name for the membrane covering the heart (*pericardium*).

IODINE. A body, of a black color. It closely resembles chlorine in its chemical characters; is not found in inland plants, but only in sea weeds, and such as grow in salt marshes. It combines directly with metals, forming iodides.

With hydrogen, it forms hydriodic acid; with oxygen, it forms iodic acid. Iodine, as well as most of its compounds, is poisonous.

IOLITE. A dark blue mineral, massive, and crystallized in six or twelve sided prisms; found imbedded in primary rocks.

IPECACUANHA. *Cephœlis ipecacuanha.* A shrubby plant, of the natural family *Cinchoniaceæ*, the root of which is used as an emetic. It is a native of tropical America. In twenty-grain doses it is emetic; but in smaller quantities, expectorant.

IPOMÆA. A genus of plants resembling the convolvulus.

IRIDESCENT. Exhibiting bright colors by reflection.

IRIS. There are many species, some tender, requiring green house culture, and others hardy propagated either from seed or by division. They are chiefly bulbous roots. The well known orris root, *Iris Florentina,* belongs to this family and besides, the well known value of the root, is brilliant in its bloom, and noted for the graceful curve of its petals. The familiar varieties of Flower-de-Luçe of the gardens are irises. The name is from the Greek signifying the rainbow deified, anciently applied on account of the rich and various colors of its blossoms. In anatomy, the colored membrane of the eye which surrounds the pupil, and, by its contraction or dilation, regulates the amount of light entering.

IRISATED. Exhibiting the prismatic or rainbow colors.

IRON. A ductile metal, susceptible of taking a high polish. By exposure to damp air, it absorbs oxygen, becoming rust. Its ores are very numerous. Few soils are destitute of some admixture. The ashes of plants are also furnished with a small quantity. Cast iron contains impurities, which are removed, to a great extent, in wrought iron. The former is brittle, harder, and lasts longer when exposed than wrought iron, which is ductile, soft, malleable, and fibrous. Steel is a compound of carbon and iron, remarkable for its elasticity and hardness. Iron combines, also, with sulphur and halogen bodies. This is the black oxide, and exists in green vitriol and the proto-salts of iron, serving as a base. The peroxide is the common red or brown oxide; it is also a base, producing the persalts of iron. Iron is readily dissolved by acids, being first oxidized, and then uniting with the acid. The salts of the protoxide are, for the most part, instable, changing to peroxides when exposed to moist air. Iron is discovered in solution by an infusion of gall-nuts, which, sooner or later, produce a black color (ink). If the color arises immediately, the peroxide is present; if the mixture requires stirring and exposure to air, the protoxide is present. Many of the compounds of iron are of interest to the farmer. The protosulphate (copperas) is much used in dyeing, in making ink, and as an emetic. It is added to urine and fluid manures, to fix their ammonia, which it converts into a sulphate. It is also powerfully disinfecting, removing bad smells. This body is sometimes present in marshy and peaty soils, and makes them barren; they are recovered by liming. The pyrolignate of iron (persalt) is used in dyeing and the preservation of timber. The muriate has the same properties, and is also a medicine. Prussian Blue is a sesquiferrocyanide of iron.

IRON PYRITES. Native sulphuret of iron; it forms a mineral often crystallized, of a golden color. Its presence in soils produces barrenness, which is rectified by liming; it is the origin of most of the sulphur springs. Water flowing over the pyrites decomposes it in part, and becomes tainted with sulphuretted hydrogen.

IRON WOOD. (See Hornbeam.)

IRRADIATION. The brightness that surrounds luminous objects, and increases their apparent size.

IRRIGATION. In warm climates, where at certain seasons there is no rain, artificial watering must be adopted. Hence it became one of the first supplementary arts practiced in agriculture among the ancients, especially in Egypt. The appliances were crude, and the manual labor connected with it excessive; but in those early days the common people were slaves, their labor costing their masters merely the coarse food eaten, and the scanty clothing supplied. Modern intelligence has reduced irrigation to a science, wherever Europeans have penetrated, but in some Oriental countries nearly the same means are now employed as in ancient times. In irrigating the soil, the stagnation and evaporation of the water applied is to be guarded against. It would create as great an evil as drought. The circulation of the water is necessary. Hence, the more porous the soil, and especially the subsoil, the greater the vigor of the irrigated vegetation. Hence two principles have been established in irrigation. A sufficient supply of water during every period of the growth of the crop, and never to allow it to remain at rest on the land. In the cultivation of rice an exception is made. One of the objects of water here is to kill weeds. It is simply inundating the soil, and is called warping. Irrigation is the supplying of plants and the soil with water, either by showering, or by conducting the water over the land by means of artificial channels. In the United States the irrigation of water meadows has been practiced in some of the Eastern States. In the rice growing regions of the South, flooding is practiced, and in cranberry cultivation the same means must be available to secure the best results. In California, Utah, and Colorado, extensive systems of irrigation, involving the outlay of large capital, is common, and with the best results. In fact, in California, irrigation is considered essential in the reclamation of the swamp lands of the State, and that it would be of comparatively little use to reclaim from overflow the swamp-lands of the Sacramento or San Joaquin Valleys without providing at the same time an efficient system of canals and ditches for irrigating them during seasons of drought. The lowlands have an advantage in retaining their moisture to a later period in the season than the uplands; but experience shows that their productiveness is materially affected by drought, and that no reclamation is perfect which does not include the means of irrigation. The Commission appointed some years ago by the general government for the examination of certain lands and rivers in California with reference to irrigation, in their report say, the first point in a system of irrigation is to raise the surface of the water in the river to a level which will enable it to flow freely over the highest ground to be irrigated. This is usually done by a dam; but in the construction of dams, a great many mechanical, hydrostatic, and hydraulic principles must be applied under a great variety of circumstances. In the Old World, it is said, it is difficult to find two dams resembling each other. The size, alignment, and construction of the main canals constitute another branch of hydraulic engineering. The quantity of land to be irrigated, the nature of the soil, the minimum rain-fall, the kind of cultivation to be applied, and other considerations must be embraced in the programme of construction. The subordinate channels which are to convey the water down to the plow-furrows require the application of scientific principles. The following statement will show the methods which the commission considered practicable and suited to the peculiar features of the Great Valley. These methods are based on results of irrigation systems in the Old World. This account is taken from the works of San Joaquin and King's River Canal. The main canal has a slope of one foot per mile, the ground sloping at the rate of eight feet per mile. Water is not taken immediately from the main canals to the irrigated ground, but to the primary ditches, which follow the highest part of the ground and are about a mile apart. The section is partly in excavation, and partly in embankment. As a general rule water should not be taken from primary ditches, but through secondary ditches. Each secondary ditch irrigates the land between it and the next one below it, embracing about eighty acres. The land is subdivided, first, by plow-furrows, forty yards apart, parallel to the primary ditches. It is again divided by cross-furrows, called checks, fifty yards apart and parallel to the primary ditches. By closing the gate at the middle of the ditch, all its contents are discharged into the ten furrows above, through little gates at the head of each. The first check-furrow will arrest the flow and cause it to spread over the strip between it and the secondary ditch. When this is sufficiently irrigated, the check-furrow may be opened with the hoe, and the water will then overflow the second strip; and the process may be continued till the first forty acres are irrigated. Then close the small gates and open the gate in the secondary ditch, and in like manner irrigate the lower forty acres. As the ground slopes from the secondary ditches at the rate of eight feet per mile, the level of each check-furrow will be 2.7 inches below its predecessor. There will then be an inequality of depth of water at different points of a strip between the two furrows, but in porous soils there is a compensation in the percolation of the water in the check-furrows to the land just below them. In impervious soils, or in irrigation for alfalfa, or permanent pastures, the furrows and check-furrows must be more numerous. The surplus water is caught in catch-drains for irrigating land still further down the system. The irrigation of lands should not be undertaken except under due consideration. Irrigation is costly. It is not a current annual account simply, but an outlay to start with, that must be made as a permanent investment. The annual outlay is also considerable, amounting often to five dollars per acre. When hand labor is scarce and high this must be taken into account. Subterranean irrigation by means of drain pipes has been practiced in California. The plan has long been known in England, but in that moist climate is not recognized as of value. Warping, allowing the water to back over land, is used when there is tide water, and quickly produces results. In irrigation, sand and porous land receives the greatest benefit from irrigation; clay soils are least benefited, since they percolate water slowly, and one of the effects of irrigation is constantly to compact and harden the soil. Hence, cultivation should always follow irrigation between waterings, as soon as the soil becomes dry enough. Indeed, this is one of the best known means of conserving the water of irrigation by preventing undue evaporation, and in irrigation, the greater the descent and the quicker the flooding, the greater the benefit. It is also essential, that means be provided to secure the escape of superabundant water quickly, once the soil is saturated, since, as before stated, once water has done its work, stagnation is injurious. The history of irrigation and its advantages have been summed up as follows: The art of producing large crops by means of artificial supplies of water, has been practiced from remote ages in the warm countries of the world. It was used by the aborigines of America, by the Incas, the inhabitants of Mexico, extensively practiced by the Egyptians, the Romans, and at the present day in France and Germany. The Hindoos make no attempt at cultivation without artificial irrigation. The rivers of Italy are made subservient to agricultural wants wherever it is practicable. Arthur Young gives an account of an hour's run of water through a gutter, near Turin, which produced, in 1778, 1,500 livres. The rent of irrigated lands in Italy is much larger than upon land not watered. Moses, in speaking to the Israelites in the wilderness, said: The land whither thou goest in to possess it, is not as the land of Egypt, whence ye came out, where thou sowedst thy seed, and wateredst with thy foot, as a garden of herbs. Here the lawgiver alludes to the machines that were used in Egypt, which they worked with their feet, for raising water. Virgil tells how to bring down the waters of a rivulet upon the sown corn, and when suffering from heat, to convey the vivifying liquid from the crown of the declivity, in channels, to the roots of the plants. Columella, Pliny, Cato, Varro, etc., all dwell upon the importance of irrigation. It is found profitable in England to irrigate plantations of willows and other semi-aquatic trees upon dry soils. The efficiency of irrigation is dependent upon many considerations; one of the principal is the nature of the subsoil. When it is a tenacious clay, the preparation consists in suitable underdraining, that would be useless where the subsoil is sand or open gravel. Some waters are injurious. Certain salts of iron are known to be unfavorable to vegetation. Waters issuing from factories impregnated with animal and vegetable substances, such as the waters of distilleries, breweries, slaughter-houses, etc., are highly fertilizing; others issuing from chemical establishments, calico printing factories, are injurious. Salt water in small quantities may be found useful upon certain plants, such as the grasses, asparagus, etc., while they are positively injurious to such plants as rice. The salt marshes of France are known to produce a superior quality of mutton, which commands a high price, and is known in the French market under the name of pres salé. Waters impregnated with carbonate and sulphate of lime are very fertilizing. In certain parts of Germany, a weak solution of sulphuric acid has been employed for irrigating grass lands with great advantage. Those which hold in suspension mud and other detritus, are highly useful, particularly on sandy soils; the fine mud settles in the pores, and gives consistency, but any soil would be benefited by water holding mud in suspension, and that, of course, in proportion to the amount of organic and saline matter in the mud. Sir Humphrey Davy thought that the protection of grasses from frost during the winter season was of great importance, for a meadow irrigated in winter is preserved from sudden alternations, and from the effect of the roots being thrown out of the ground by alternate freezings and thawings. The water immediately in contact with the roots of the grass is rarely below 40° Fahr. In the month of March, in a meadow near Hungerford, the air was, at seven o'clock, a. m., at 29°. The water was frozen above the grass, and the temperature of the soil below the water in which the roots were growing was 43°. While the temperature is thus prevented from falling during the winter, it is kept cool during the summer. Irrigation supposes water in motion; if it be allowed to stand and stagnate, its effects would destroy the objects sought to be accomplished. Instead of fine grasses we would have a growth of carices, junci, and other coarse plants of no value. Sir John Sinclair says that the advantages of meadow irrigation are chiefly as follows: With the exception of warping, it is by far the easiest, cheapest, and most certain mode of improving poor land, particularly if it is of a dry and gravelly nature. Land once improved by irrigation, is put into a state of perpetual fertility, without any occasion for manure or trouble of weeding or any other material expense. It becomes so productive as to yield the largest bulk of hay, besides abundance of the very best support for ewes and lambs in the spring, and for cows and other cattle in the autumn of every year. In favorable situations, it produces very early grass in the spring, when it is doubly valuable. Not only is the land thus rendered fertile without having any occasion for manure, but it produces large amounts of food for animals, which is converted into manure, to be used on other lands, thus augmenting, in a compound proportion, that great source of fertility. The subject of irrigation is one of immense importance, in a dry, arid climate, such as characterizes portions of the western plains particularly. It is paramount, and may be employed throughout the continent with advantages greater than any other agricultural application. It is an important art of itself, and one that requires special acquirements for its adaptation. The direct action of the fertilizing constituents of water are not the only influences which that substance exerts upon our fields and growing crops. Its simple percolation through a soil has an important influence, by displacing gases and thus creating circulation of air and bringing a fresh supply of ameliorating agents. It is not necessary in this article that we go into details of the various systems of doing work in the articles treated. These must be sought in works written especially therefor, giving in detail the minutiæ. There are, however, many things to be considered before entering upon the work. First, the configuration of the land to know if it is adapted to irrigation; second, the water supply, to be sure that there is enough for every contingency. Then the nature of the soil, the character of the climate, and the nature of the subsoil must be taken into account. For instance, the greater the capacity of the soil for absorbing water, the longer it will retain it, so that a soil containing but a small amount of sand or gravel will not need irrigation nearly so often as one composed largely of sand; and yet the best results in irrigation, are reached, when water is abundant, in porous soils and subsoils, and for reasons heretofore stated. To give some idea of the water required per acre, it may be stated that a stream of water one inch wide and one inch deep flowing four miles an hour will cover an acre one inch deep in twenty-four hours. Hence, this would only suffice for seven acres to furnish an amount equal to the average annual rain fall which is fifty-two inches a year. In the irrigation of gardens recourse is often had to the common watering cart. This may do as a makeshift in times of drought, to keep special crops along until rain falls; no man would be foolish enough to depend upon this means in an arid climate. The only means here presented, where the water of natural streams can not be carried over the ground is by means of steam or wind power, and a system of underground pipes may thus be supplied, from a tank elevated twelve or fourteen feet, that will irrigate whatever the water supply will afford. Thus, with a tank holding 400 barrels, we have had a full water supply for 1,100 hot bed sash, besides affording all the water required at the house, barns, and wash-houses, no inconsiderable amount in a large market garden. A round tank, twelve feet deep and fifteen feet across will hold 15,000 gallons, and a square one sixteen feet across, and ten feet deep will contain nearly 20,000 gallons. Thus, such a tank if the water supply is sufficient to replenish it once a day, will furnish an inch a day over an acre of land. In times of extreme drought this supply will irrigate from five to seven acres of land. Thus the land may be irrigated by surface pipes discharging over the beds, in jets or it may be carried in open channels but at a waste of water.

ISOMORPHISM, ISOMORPHOUS. Having the same crystalline form; this is associated with the same number of atoms, but of unlike elements, and also with similar properties. Alum consists of sulphuric acid, alumina, and potash; but either of these bodies may be replaced by certain other isomorphous bodies; the sulphuric acid by the selenic, chromic, or manganic acids; the last two of these produce a difference of color in the crystal, but little else. The alumina may be replaced by peroxide of iron, sesquioxide of manganese, or sesquioxide of chromium; and the potash, by soda or hydrated ammonia. Thus, the alum may have none of its primary constituents, but isomorphous atoms of the same number. Isomorphism, or the study of these changes is of importance in agriculture, for it is found that the same substitution takes place in organic bodies. This is not, however, a matter of indifference; for the presence of soda in grapes, instead of potash, deteriorates their flavor; lime in the place of potash, in tobacco, injures its excellence; and lime or potash in place of soda, in onions and asparagus, is injurious to their mildness. The limit of isomorphous substitution is a chemical inquiry. (See Isomorphous Groups)

ISOMORPHOUS GROUPS. Potash, soda, hydrated ammonia, hydrate of lime. Of this group soda only replaces potash in cerealia; but lime, ammonia (or organic alkalies), can replace potash or soda in plants that do not require soluble silicates, as tobacco, potatoes, etc. Sulphuric acid is replaced by the telluric, selenic, chromic, and manganic acids. Phosphoric acid is isomorphous with the arsenic acid, but seldom found in soils. Iron, as the peroxide is isomorphous with alumina, oxide of chrome, and sesquioxide of manganese. These substitutions, although of no apparent moment, are continually occurring in plants.

ISOPYRE. A silicious mineral resembling obsidian, found in granite, basalt, and primary rocks.

ISOSCELES. A name given to an angle two of whose sides are equal.

ISOTHERMAL. Having the same average temperature. Geographical lines drawn over the surface of countries, and passing through places having the same average heat, are termed isothermal lines; they are very irregular, in consequence of the occurrence of mountains and surfaces of water, which modify the temperature. The terms Isotheral and Isochimenal are used; the first, to designate a line showing the places having the same summer heat, and the last, those with the same mean winter temperature. (See articles Heat and Meteorology.)

ISSUES, TO PRODUCE. A rowel or seton is used to produce an issue as a counter-irritant. A rowel is a wound made through the skin and integmuents, which are kept open by a pledget of tow, lint or other substance smeared with an irritant dressing. They can not be recommended. A seton is a strip of leather passed through a fold of the skin, and answers every purpose. These again can hardly be recommended, unless in very exceptional cases. (See Seton.)

ITALIAN RYE GRASS. *Lolium perenne.* (See Grasses.)

ITCH. Mange, scab, and itch, often prevalent in sheep and dogs, is produced by a minute insect (*acarus*) burrowing under the skin, and is highly contagious, since it may be left wherever the animal rubs itself to relieve itself of its misery. In hogs, mange is produced by the presence of an insect (*Sarcoptes suis*) which is transmissible to man. Scab in sheep is produced by a dermatocoptes, or itch insect, of which the horse, cattle and sheep each has its peculiar species. (See Scab, and Lice.)

IULUS. The generic name of the gally worm; insects with numerous feet, (*myriapoda*).

IVORY. The compact bony structure of the tusks of elephants; it contains sixty-six per cent. bone earth, and twenty-four gelatine. Ivory has long been a valuable article of export from Asia and Africa, but now its use is largely superseded.

IVORY BLACK. Bone black.

IVY. The term ivy is applied to a variety of climbing plants. The English ivy, *Hedera*, is probably the only genus to which the name is properly employed. There are two species, and a number of varieties. The Irish ivy, *H. comariensis*, like the English ivy, is a fast growing climber, but can not be said to be suited to our dry climate, even when it will survive the winter The Virginia creeper, *Ampelopsis quinquefolia*, is called American ivy. The poison oak, *Rhus toxicodendron*, is generally known as poison ivy. It is often mistaken for ampelopsis, the Virginia creeper. The poison ivy has its leaves in threes, the Virginia creeper in fives. It is also more robust. The climbing bittersweet, *Celastrus scandens*, is also called ivy. The so-called German ivy, is *Senecio scandens*, deservedly popular as an ornamental plant, on account of its rapid growth and freedom from insects. The so-called Coliseum ivy, is *Sinaria cymbalaria*, a species of snap dragon. Among the real ivies that are ornamental may be mentioned *Hedera digitata* or hand-shaped ivy, from its palmate leaves, and the Golden ivy, whose young leaves are golden yellow.

J

JACK. A general name given to engines for raising heavy weights.

JACOB'S STAFF. The cross staff used by surveyors in measuring heights and distances.

JALAP. The root of the *Ipomœa jalapa*, a convolvulaceous, Mexican plant, has a perennial root, or tuber. It is a powerful purge, the dose being ten to twenty grains for a man.

JAMAICA PEPPER. *Myrtus pimenta.* Allspice, the produce of an evergreen tree of tropical America. The berries are warm and aromatic.

JAMBS. The sides, or post of any aperture, or door which bears the cross piece on which the weight of the wall rests.

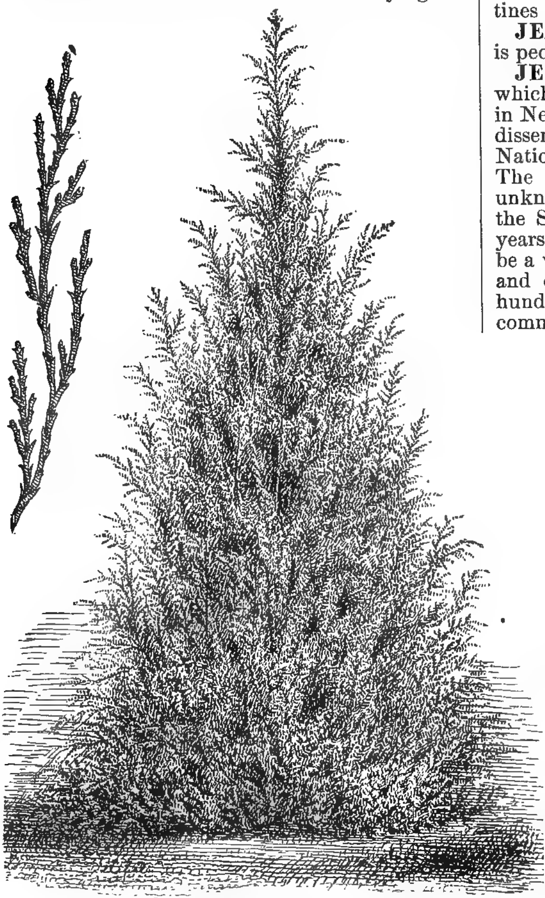
JAMESTOWN WEED. *Datura stramonium.* A poisonous weed. (See Stramonium.)

JASMINE. *Jasminum.* A family of climbing plants, in great esteem for their elegant foliage and fragrant flowers, blooming in the latter part of winter in the green-house or conservatory. Among the desirable varieties are the Catalonian jasmine, the odorous yellow-flowered jasmine, the white-flowered multiflorum, and nudiflorum with yellow flowers. There are over thirty species, including hardy, green-house, and hot-house climbers.

JASPER. An ornamental and colored silicious mineral.

JATROPA. A genus of euphorbiaceous, tropical plants, of which the *J. manihot* yields a root from which cassava is extracted; *J. curcas* has purging seeds resembling castor oil seeds.

JAUNDICE. Congestion and inflammation of the liver, called Hepatitis, results in what is called the Yellows or Jaundice. The eyes assume a more or less yellow tinge; the bowels are constipated; the animal is feverish, and there is a general debilitated and feverish appearance. The animal must first be brought into condition by gentle exercise and plain, nutritious, laxative food. Grass is best. If absolutely necessary to arouse the liver with mercurials, thirty grains of calomel, one drachm powdered aloes, two drachms soap, and four drachms powdered rhubarb, made into a ball with syrup, and given once or twice a day until an operation is had, may be used. This may be followed by a ball every day of one ounce of Peruvian bark and one drachm powdered nux vomica, mixed with linseed meal and syrup. Generally, however, saline mixtures are good. Take one pound each of Epsom salts, glauber salts and common salt; add one ounce essence of ginger, and mix in a gallon of warm water, and give a pint a day until the animal (horse or ox) is gently but fairly purged. Calomel should not be given to cattle.



JUNIPERUS VENUSTA.

JAY or BLUE JAY. Moose bird. The Jay is one of our most common and noxious birds, if for no other reason than its habit of destroying the young of other small birds while in the nest. The Canada Jay or Moose bird has been known to destroy the young from the nests of four pair of snow birds, *Junco hyemalis*, (sixteen in all) in a single half day. The Canada Jay, *Perisoreus Canadensis*, inhabits the northern portions of New England and Canada. The Blue Jay, *corvus cristatus*, is too well known to need description. It has no more good qualities than its Canada relation to recommend it, and the same bad habit of eating eggs and young of small birds. Of the two birds belonging to the family *corvidæ*, the crow deserves the protection of man far more than the Blue Jay. Prince Maximilian's Jay is a native of the Rocky Mountains and West, and is said to live principally on frogs, lizards and other reptiles. The Mexican and Beechy's Jay inhabits California and Texas. In the West and Northwest are also found the Ultramarine Jay and Steller's Jay, and in the South the Florida Jay. It is an open question as to whether the Jay is or is not beneficial to the farmer. In the summer he feeds upon pretty much every animal food he can find. In winter on grain. It is a noisy, quarrelsome bird and we incline to the opinion that it should be destroyed.

JEJUNUM. The portion of the small intestines next the duodenum.

JELLY. Gelatine with water; vegetable jelly is pectine.

JERSEY RED SWINE. Of this breed, which has acquired very considerable celebrity in New Jersey, but which has not been largely disseminated, the committee thereon, of the National Swine Breeders' Association, says: The positive origin of this family of swine is unknown. They have been bred in portions of the State of New Jersey for upwards of fifty years, and with many farmers are considered to be a valuable variety. They are of large size, and capable of making a heavy growth, five hundred and six hundred pounds weight being common. They are extensively bred in the middle and southern portions of New Jersey. In neighborhoods they were bred quite uniform, being of a dark red color, while in other sections they are more sandy and often patched with white. They are probably descended from the old importations of Berkshires, as there is no record of the Tamworth—the red hogs of England—ever having been brought into this country, nor is it likely, as the Tamworth were not considered a valuable breed, and were confined to a limited breeding. The Reds resemble the old Berkshires in many respects, but are now much coarser than improved swine of this breed. A good specimen of a Jersey Red should be red in color, with a snout of moderate length, large lop ears, small head in proportion to the size and length of the body. They should be long in the body, standing high and rangy on their legs Bone coarse, hairy tail and brush, and hair coarse, inclining to bristles on the back. They are valuable on account of their size and strong constitutions, and capacity for growth. They are said to be not subject to mange, and undoubtedly are a most valuable hog for those sections where swine are expected to get their own living in the range, except at fattening time. Yet when swine are kept in a more artificial manner the finer breeds are more highly prized.

JERUSALEM ARTICHOKE. (See Artichoke.)

JET. A bituminous coal of fine texture, and taking a high polish.

JETERUS. The yellows of plants.

JOGGLED JOINTS. Joints of masonry or wood, which are made by indenting the faces and fitting them together.

JOGGLE PIECE. A truss post, whose shoulders and sockets receive the lower ends of the struts.

JOHN'S WORT. Plants of the genus *Hypericum*, especially *H. perforatum*, a common weed in meadows. Much prejudice exists against it, and being a perennial-rooted plant, it is not easy of extirpation. A kind of itch, and even inflammation of the stomach, are said to be produced by it in sheep, but salt is said to be a preventive, and the itch is treated with sulphur ointment.

JOISTS. The timbers to which the flooring is nailed.

JUBA. The mane, or crest of hair which runs along the back-bone of animals.

JUDAS-TREE. An ornamental genus, (*Cercis*,) of trees, of which the *C. Canadensis*, or red bud, is the only indigenous species.

JUGAL BONE. The cheek bone.

JUGULAR VEINS. The veins running on the sides of the neck, which bring the blood from the head. The external jugular is that from which blood is taken in the horse.

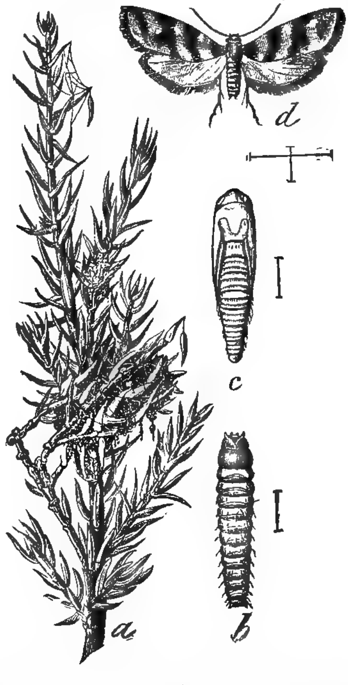
JUGULUM. The fore part of the neck in animals.

JUJUBE. *Zizyphus vulgaris.* The fruit of this shrub or small tree is red, with a coriaceous skin, and of the size of a large olive; it is a native of Italy and Spain. *Z. Jububa* is the true Jujube tree. A syrup made from the dried fruit and mixed with gum forms jujube paste.

JUNGERMANNIACEÆ. A natural family of acrogens, resembling mosses, and growing on the bark of trees, and in moist, shady places; the *Hepaticœ*, or true liverworts.

JUNIPER. *Juniperus.* This immense genus of evergreens comprises varieties from creepers and trailers to the largest trees of the forest, and are found in every portion of the earth, from the Torrid zone to the Arctic circle. Some species are valued for their lumber, others for the valuable resins, and others again for the fruit used in flavoring liquors, and in medicine. Among the true junipers are the common juniper, *J. communis*, a low, trailing shrub, the fruit of which is used for flavoring gin, and the oil is used in medicine. The Irish juniper is one of the most beautiful varieties of the common juniper. Erect in habit, dense and compact in growth, it may be used where formal growth is desired. The Swedish juniper is more hardy than the previous variety. It is light yellowish-green in its foliage, upright in growth, and, seldom seen more than ten to eighteen feet high, though trees fifty feet in height are said to be found in the forest of Fontainbleau, France. The weeping juniper, *J. rigida*, is another beautiful species, a native of the mountains of China and Japan. It is not hardy in the West, but where it will stand it is fine grafted into the common red cedar of the country. The red cedar, *Juniperus Virginiana*, is found in the United States from the Gulf of Mexico to the northern boundary on the great lakes. Its height is seldom more than forty to fifty feet, and with age becomes very striking. It is most valuable in its timber, being valued for its lasting qualities and the odor of the wood. One of the more ornamental forms of the Red cedar, *Juniperus venusta*, as illustrated on page 534, is one of the many exquisite forms this genus of plants assumes. It is a rapid grower, hardy, erect in habit, of beautiful silvery foliage, and one of the most ornamental of the upright varieties.

JUNIPER MOTH. In some sections of the country this insect (*Dapsilia rutilana*) a late importation from Europe, has appeared, but has had but a limited distribution. It is feared that, like many other imported insects, it may find a congenial home. While it is probable that it can never be exterminated, attention in carefully eradicating any noxious insects in the nursery stock before packing for shipment, would prevent their spreading to a great degree. The insect is single brooded, that is, produces but one generation in a season, hybernates at different stages of the larval development, and the chrysalides are found throughout the spring months. The worms appear in autumn, and should be destroyed, either by picking or by spraying the foliage thoroughly with a solution of Paris Green or London Purple. The cut illustrates the Juniper Moth and larva: *a* shows manner of work of larva; *b*, larva, dorsal view; *c*, chrysalis, dorsal view; *d*, moth, with expanded wings; the hair lines at the side show the natural size of the larva, chrysalis, and moth. The Entomologist of the Department of Agriculture, Washington, says the worm from birth webs the leaflets together, and lives within a more or less perfect silken tube, the tube being more complete around the hybernating individuals. The sprigs and branches affected present a more or less seared and brown appearance, so that a tree affected may be seen for a considerable distance. The Irish and Swedish junipers are said to be the varieties most infested, but it is quite probable that these varieties failing, they will then attack our indigenous varieties.



JUNIPERUS. The genus yielding the juniper berries. It contains also the *J. Sabina* (savine), *J. Virginiana* (red cedar) and many others.

JUTE. Jute is the fiber of two species of East India plants, *corchorus capsularis*, and *C. olitorius*, the latter sometimes called Jew's mallow. The first named is considered the most valuable. They are annuals, and grow to a height of from four to twelve feet. The jute of commerce is the fiber of the plant, which somewhat resembles hemp, but is much softer and finer. The butts of jute, for about nine inches, are used for paper making, and coarse fabrics; the finer and long stapled remainder is exported, while the short staple is manufactured into gunny cloth, of which gunny bags are made. Some idea of this great and growing industry may be formed from the fact that the export of jute from India reaches nearly 3,000,000 bales yearly, besides giving employment to an immense multitude in that country, men, women and children. The cultivation of jute has for years attracted attention in the South, and it is to be hoped that the cultivation and preparation of the fiber may in the end prove successful, since, if so, it will add another important crop to those of the South, and enable the country to become independent in respect to a commodity for which vast sums are annually expended by us in foreign countries. In relation to the cultivation of jute, the climate of Louisiana, Texas, and Florida has been found congenial to the plant, the chief difficulty in the successful following of the industry being the difficulty and cost of preparing the fiber, machinery not yet having been able to accomplish this successfully. A Boston merchant, Mr. N. G. Fuller, living in India, gives the following account of the cultivation in India: The quantity of jute fiber and seed produced to an acre depends greatly on the richness of the land. It is planted in Serajgunge, Naranigunge (Dacca) and other northeastern districts, where about four-fifths of the total crop is raised; the product is from two thousand to three thousand pounds of jute on an average; in some cases, however, as much as four thousand pounds are produced. The yield of seed is about one thousand to one thousand two hundred pounds per acre. In places, say about fifty miles around Calcutta, the production of which is called dessee, or country jute, the yield is smaller, being only about six hundred to one thousand pounds of fiber, and more seed, say one thousand five hundred to one thousand six hundred pounds per acre; but on rich, damp lands the product is almost as much as in the northeastern provinces. The dessee description was used only for local consumption until about five years ago, when shipments of it to England began, and both the shipments and production of it are increasing every year. Jute is sown broadcast, and about twenty-two to twenty-eight pounds of seed is required to an acre. In the northeastern provinces it is planted in February and March, and is cut about the end of June and beginning of July. The dessee is sown in July and August and cut in August and September. On rich land it grows and ripens quicker. In the northeastern districts, when grown on rich soil, the diameter of the stalk at the bottom is from three-fourths of an inch to one and a quarter inches, and the length from seven to ten feet, and sometimes, but rarely, longer and thicker. The country jute is from four to seven feet long and one-half to three-fourths of an inch in diameter. The plants are cut about three inches above the ground, excepting dowrah, which is uprooted. The butts are cut at the time of baling the jute for export to Calcutta. When the stalks are cut they have a green bark, which, after going through certain processes, become fiber; the planters can not tell at the time of cutting the stalks whether any or how far from the bottom will be hard The stalks are cut about a month before the seed ripens, and the poorer plants are generally let go to seed. Jute made of the plants producing seed is hard and barky; the unripe seed, cut with the stalks, is of no use. It grows best on rich, moist ground, but not on low ground. Castor-oil cake is the best for it, and next to that cow-manure, but the country planters, as the ground is naturally rich, use no manure whatever. An acre of cotton costs much more than an acre of jute. Jute and cotton do not interfere with each other in the least. Cotton grows in the northwestern provinces, central and southern India, while jute is raised in Bengal. The little cotton that Bengal produces, and the little jute that the cotton districts produce, are of poor quality, and only used for local consumption. For the last few years jute has been encroaching on the linseed-crop, as the same ground is suitable for both. The best manner of cultivating this plant, in the South, is described as follows: To obtain good fiber-crops the land must be elevated, rich, moist, and well drained, as in India; to raise seed, low lands may be used, provided that favorable weather allows sowing and enables the growing plants to keep above the points of overflow. However, when the growth is fully started, water is not to be feared, so long as the tips remain above the surface of submersion. In the first case, jute is sown broadcast; in the second, in drills five feet apart. That interval is to facilitate the branching, and, at the same time, the destruction by plowing of the tall weeds which generally occupy low lands. In both methods the soil must be as well prepared as for ramie; plowed as deep as possible in January or February, then left exposed to atmospherical influences until the planting period. That period commences with April and terminates with June, in monthly succession. To prepare for sowing a second plowing is required, and as fine a harrowing as can be effected. The circular pulverizer, applied before the harrow, shortens the labor. Then the sowing for fiber-crop is performed with a broadcast sower. The quantity of seed required for each acre is from twelve to fifteen pounds. That is amply sufficient, and if the Hindoos put more in their land, there must be some accountable reason for that excess. Either the condition of their seed or of their land is inferior to that of America, or they are singularly prone to go to waste. We have repeatedly observed that, when the growth is thicker than what is allowed by the aforesaid quantum of seed, some natural destructive agent enters into the stand and thins the space to the limit demanded by the plant. This fact was verified in several spots of a jute plantation in Louisiana. Therefore no advantage at all can be derived from prodigality in sowing. The equal distribution obtained by the mechanical sower may account also for the economical difference existing between us and the Hindoo planters, who, having no machinery whatever, do all their work by hand. The ground being well tilled and the seed properly sown, on wet days if possible, the jute is left alone like wheat. No other care than that of drainage is necessary until maturity. The cost of that first operation can not exceed $4 per acre, if the material is adequate and the management judicious. That expense, of course, does not include the value of the seed, because, after the first outlay, planters will provide themselves with it from the low lands, or from the weak spots of the plantation. In the bottoms, when we plant in drills for seed, a subsequent plowing or two will be necessary in the intervals to neutralize the encroachments of grass. In Louisiana that labor is a necessity principally for the purpose of combating the tall weed called wild indigo, which occupies the low grounds. That tall weed, which is also fibrous, is the only vegetable that keeps pace in growth with jute; all other plants are distanced and smothered by the shade of the corchorus. In the field planted broadcast no parasite can resist the vigorous and absorbing influence of jute. Even the hardy and noxious gramineal plant, commonly called coco in Louisiana, is destroyed after two seasons of broadcast cultivation. Another peculiar advantage of jute planting is the antagonistic influence it exerts over insects, especially the lepidoptera tribe which generates the caterpillar. It having been stated in some reports of the Department of Agriculture that cotton-fields surrounded by jute-plantations were respected by the devouring worms, the director of the Ramie-Planting Association made special experiments to test the reported fact. Three different fields, planted with various sorts of cotton, were belted by jute. None of them were visited by the caterpillar, while the cotton of adjacent plantations was partly destroyed by the insect. That protection is attributed to the above-mentioned influence hostile to insects. It was observed that flies and butterflies kept away from jute-fields, especially at the blossoming period. The peculiar odor of the flower and the bitter exudation of the leaves seem to be strongly repulsive to them, if not poisonous. So important a fact deserves to be demonstrated once more on a larger scale. It would cost but little to plant belts of jute around the regular cotton-plantations which have been heretofore invaded by these injurious insects. The best period for cutting good crops of jute is during the stage that precedes the blossoming, or, at least, the seeding. The fiber is then fine, white, and strong. The monthly sowing graduates the maturing of the successive crops, which facilitates labor. April planting can be harvested in July, May planting in August, and June planting in September. Any late growth can be harvested in October, and even after, if no frost interferes. The plant stands green until frost dries it up; but even then it can furnish a good material for paper. The cutting operation is done with a mower or a reaper. The albumen of the plant makes it easier to cut than dry wheat. The reaper gathering the stems, bundles are made and carried as fast as possible to the mill where the textile is rapidly separated as described in our notice on ramie. Then comes the rotting operation. As fast as the fiber is turned out by the decorticating machine it is plunged into large vats filled with pure water and left exposed to the heat of the atmosphere. Kept under at least one foot of water, the filament is disintegrated by the dissolution of the gums or resins which united it in a sort of ribbon. That process of fermentation or rotting takes about a week in summer. With care and attention to the proper degree of rotting the fiber comes out almost white, lustrous, and fine like flax. The disintegration is known to be complete when the fiber assumes a pasty character. Then the rotted hanks are withdrawn, carefully washed in clear water, and hung up to dry in the shade. Care must be taken that the filament be well covered with water during the fermenting period, because atmospherical agencies tend to communicate to it a brownish color. After a few days of good weather it is ready to be shaken and twisted for baling like other textiles. That new process of rotting the separated filament instead of whole stalks combines different profitable results—the advantages of economy in labor, in value, and also in the integrity of product. Planters in the South should persevere in experimenting with this crop. If it can be proved that the plant is adapted to the soil and climate, American ingenuity will soon invent machinery for preparing the fabric cheaply. Jute is the fourth in point of export, of the commodities of India, only cotton, opium, and rice exceeding it in importance. The statistics of the development of the jute culture in India are very suggestive. In 1862, India exported 10,000,000 pounds of fiber and rope, and 300,000,000 yards of gunny cloth. In 1863, Great Britain employed more than 30,000 spindles in spinning 80,000,000 pounds of Indian jute. Some of the Indian factories are immense. There is an establishment at Barnagpoor, near Calcutta, which employs more than 4,500 workmen and annually manufactures more than 30,000,000 pounds of jute. In 1872, the total exportation of Indian jute was 700,000,000 pounds, of which Great Britain received upward of 395,000,000 pounds. In the same year more than 900,000 acres were devoted to the cultivation of jute in India; and in the thirteen provinces in which jute is principally raised, out of a population of 15,725,000, more than 1,350,000 were wholly or partially engaged in this occupation. These figures conclusively show the vast magnitude and importance of this industry to India. Why should not American talent and enterprise make its success certain here. According to the Department of Agriculture reports, for 1876, jute is mixed with cotton, linen, and silk. It is a material part of twilled stair carpeting and low-priced broadcloth. In combination with other textiles, it imitates the gloss of Irish linen, the luster of French silk, the beauty of Turkish rugs, and the splendor of Axminster, Kidderminster, Brussels, and Venetian carpets. Single or mixed, it enters into the manufacture of a thousand articles of commerce. In 1872, there were in Dundee about one hundred jute mills, employing upward of 20,000 workmen, and manufacturing more than 180,000,000 pounds of jute annually. In the same year, nearly 50,000,000 gunny bags—most of which were made in Dundee—were exported from Great Britain. Of the 300,000,000 pounds of jute that were manufactured in the United Kingdom in 1876, 200,000,000 pounds were woven in the mills of Dundee. The annual value of the flax, hemp, and jute manufactured in Dundee is now $15,000,000. Experiments in the culture of jute have been successfully tried in South Carolina, Florida, Georgia, Louisiana, and Texas. These trials conclusively established the fact that, wherever in the Southern States there is a hot, damp climate, and a moist soil of sandy clay or alluvial mold, jute can be profitably raised. The plant matures in this country in about the same time that it does in India. The April plantings were cut in July, and the June plantings were cut in September. Some of the stalks reached the height of fifteen feet, and in some instances the fiber was, according to the judgment of experts, superior in strength to that of India. The yield was in several cases at the rate of 3,500 pounds to the acre, yet this is probably an exceptional yield.

K

KAINIT. (See Fertilizers.)

KALE. A name for some varieties of cabbage or borecole.

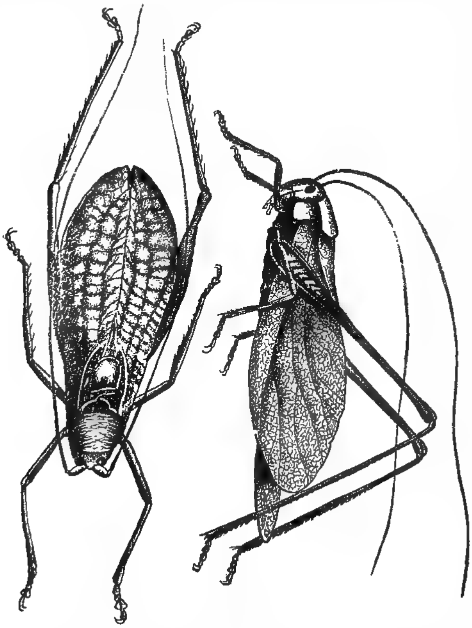
KALI. A contraction for alkali, potash; also, the ashes of *salsola kali* or barilla.

KALIUM. Potassium.

KALMIA. A genus of handsome flowering shrubs called American laurels. The leaves and flowers are poisonous, especially to lambs; those poisoned should be dosed with milk and castor oil.

KAOLIN. Porcelain clay, the fine, white, disintegrated feldspar of some primitive countries.

KATYDID. Under the heading Catydid, was given something in relation to that class of insects, except the locusts proper, which go under the general name Grasshopper. The Katydids belong to the order Orthoptera, which includes the earwigs, grasshoppers, true locusts, crickets, etc. Dr. Riley, in his sixth Missouri Report, says: We have in this country four Katydids that are tolerably common. They all dwell among trees and shrubs, and might far more appropriately be called tree-vaulters than grasshoppers. They are all of a green color, with very long, slender legs and antennæ, and the females are all furnished with curved or saber-shaped ovipositors, formed of two pairs of flattened sheaths which inclose two narrower pieces. The base of the front tibiæ or shanks is somewhat dilated, with an oval cavity each side, closed by a membranaceous covering. In the Oblong-winged species the first and middle shanks have such cavities, but in the other three species it is found only on the front shanks. Our most common species is the Angular-winged Katydid The eggs of this species are more or less flattened, usually of a slate color, sometimes inclining to brown, and are deposited in two rows overlapping each other, and on the twigs of trees. The Narrow-winged Katydid is distinguished from the others by the length and narrowness of its wing-covers and by the male having a cylindrical style curving from below upwards. The female has the ovipositor much curved, and deposits her eggs in the leaves of trees. The Broad-winged Katydid has the wing-covers longer than the wings, and is distinguished from all others by the greater breadth and convexity of these wing-covers, which entirely enclose the abdomen. The eggs are deposited, says Dr. Riley, by means of the sharp ovipositors into crevices and soft substances, and probably in a state of nature, into the crevices of loose bark, or into the soft stems of woody plants. The Oblong-winged Katydid is not abundant in the West, and not found at all, we believe, in the latitude of and south of St. Louis. It is said to be at once distinguished by the perfectly oval form of the wing-covers, the long hind thighs, and by having the base of the middle, as well as of the front tibiæ, swollen and furnished with a membranaceous cavity each side. The female has an ovipositor, intermediate in size, between those of the Broad and Narrow-winged species, or almost as long as the abdomen, and it is more strongly toothed for one-half its length than in any of the others. The notes of the male are described by Harris as though grating, comparatively feeble.



KATYDIDS.

KEEL. *Carina.* The two lower petals of papilionaceous flowers are termed keel.

KELP. A term used both for sea weeds and their ashes. The ashes used for the manufacture of soap and glass, is now superseded in a great measure, by manufactured carbonate of soda.

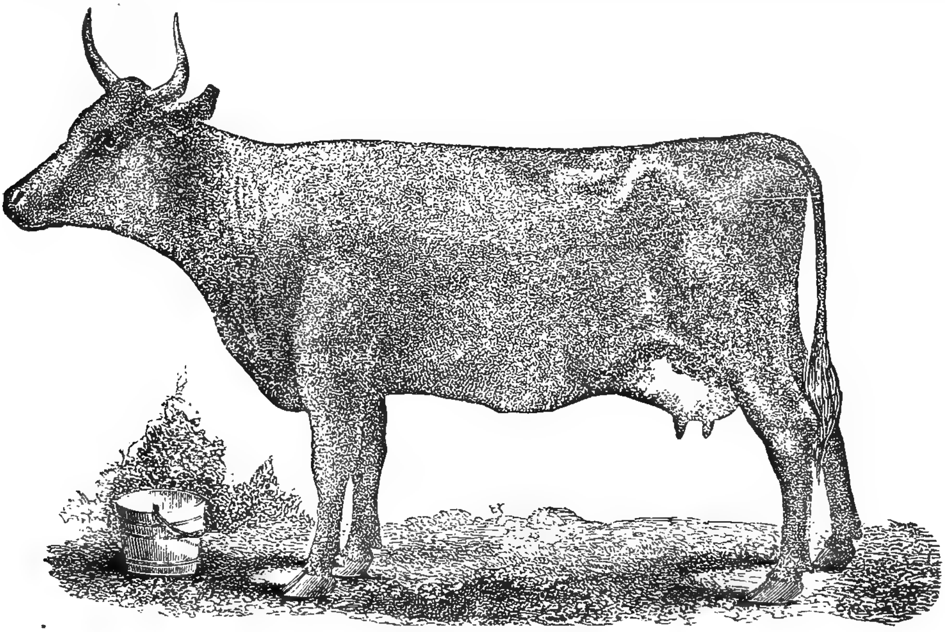
KENNEL. A hole inhabited by a fox or other animal. A shelter for dogs. A kennel is also used to designate a collection or pack of hounds.

KENTUCKY COFFEE TREE. *Gymnocladus.* This unique tree is found in the western part of the State of New York, and as far north as Montreal, in Canada. But it is seen in the greatest perfection in the fertile bottoms of Kentucky and Tennessee. Sixty feet is the usual height of the coffee tree in those soils; and, judging from specimens growing in various situations, it will scarcely fall short of that altitude, in well cultivated situations, anywhere in the Middle States. When in full foliage, this is a very beautiful tree. The whole leaf, doubly compound, and composed of a great number of bluish-green leaflets, is generally three feet long, and of two-thirds that width on thrifty trees; and the whole foliage hangs in a well rounded mass, that would look almost two heavy were it not lightened in effect by the loose, tufted appearance of each individual leaf. The flowers, which are white, are borne in loose spikes, in the beginning of summer, and are succeeded by ample brown pods, flat, and somewhat curved, which contain six or seven large grey seeds, imbedded in a sweet, pulpy substance. As the genus is diœcious, it is necessary that both sexes of this tree should be growing near each other, in order to produce seed. Downing says, the Kentucky coffee tree is well entitled to a place in every collection. In summer its charming foliage and agreeable flowers render it a highly beautiful lawn tree; and in winter, it is certainly one of the most novel trees, in appearance, in our whole native sylva. Like the Ailanthus, it is entirely destitute of small spray, but it also adds to this the additional singularity of thick, blunt, terminal branches, without any perceptible buds. Altogether it more resembles a dry, dead, and withered combination of sticks, than a living and thrifty tree. Although this would be highly monotonous and displeasing, were it the common appearance of our deciduous trees in winter; yet, as it is not so, but a rare and very unique exception to the usual beautiful diversity of spray and ramification, it is highly interesting to place such a tree as the present in the neighborhood of other full-sprayed species, where the curiosity which it excites will add greatly to its value as an interesting object at that period of the year. The seeds vegetate freely, and the tree is usually propagated in that manner. It prefers a rich, strong soil, like most trees of the Western States.

KERMES. Insects of the genus *Coccus*, or bark lice, collected from numerous plants, as the oak, etc., and formerly much used for dyeing a red color, but to a great extent superseded by cochineal.

KERMES MINERAL. The hydrosulphuret of antimony.

KERRY CATTLE. The Kerry cow, a most valuable milking strain indigenous to Ireland, but not, we believe, imported to the United States, except occasionally by amateurs as a curiosity, are eminently adapted for taking care of themselves on the hills with but little care from their owners. Hardy as they are, they can scarcely compete with our more valuable milking breeds, when feed is so cheap as it is all over the United States. In some sections of the more mountainous regions they might, indeed, find a limited range, but here the Swiss cow would probably surpass them. Youatt calls them truly the poor man's cow; living everywhere hardy, yielding for her size abundance of milk of a good quality, and fattening rapidly when required; but they are rather apt to be coarse in the head and deficient in the hind quarter, with a certain cloddiness of the shoulder They are short-legged, with good hides covered with thick, long hair; their horns are fine, short, and turned upwards; their colors are black, brown, or brindled. They are exceedingly hardy and active, almost disposed to wildness; and live on the mountains and moorlands of their native country without shelter or care. The quality of their milk is very good. In an experiment made between the Ayrshires and grade Kerrys—the



KERRY COW.

cross being with the long-horned Irish, and not calculated to improve the milking of the former—the milk of the Scotch breed required nine and nine-tenths quarts to make a pound of butter, whilst eight and one-fifth quarts of that of the Irish cows yielded a pound of butter; making a yield of one-sixth more butter in favor of the Kerrys. Mr. Bogan, who conducted the experiment, states that the color of both the milk and butter of the latter was the richer of the two. It must be taken into consideration, though, that the Ayrshires were just imported from Scotland, and had not time to become acclimated. A further experiment, made by the same parties, on the crown estate at King Williamstown, between Galloways, Ayrshires, and Kerrys, resulted as follows: The Galloways averaged six and a quarter quarts per day, requiring nine and one half quarts to produce a pound of butter; the Ayrshires gave nine quarts of milk per day, requiring ten and one-fifth quarts to produce a pound of butter; the Kerrys gave seven and a quarter quarts per day, requiring eight and seven-eighths quarts to produce a pound of butter. The Galloways were but three years old with their first calf; the Kerrys were four years old, and the Ayrshires six years old In both these trials the Kerrys proved themselves good dairy cows. The cut shows a cow of this breed as it is known in Ireland.

KETCHUP. Catsup.

KEUPER. The upper portion of the new red sandstone formation.

KEY. In building, a piece of wood let into another in the contrary direction of the grain.

KEYSTONE. The central stone of an arch.

KID. A young goat. (See Goat.)

KIDNEY BEAN. (See Bean.)

KIDNEYS. The reins. The organs in which urine is secreted, from whence it flows along tubes (ureters) into the bladder. They are situated in the loins and attached to the spine.

KIDNEY-SHAPED. Reniform, of an oval figure, with one side indented, so as to resemble a sheep's kidney.

KIDNEY VETCH. *Anthyllis.* An ornamental flowering plant.

KIDNEY WORM. There are various parasites infesting the kidneys of the hog, and the fat which surrounds them. The lard worm, (*stephananrus dentatus*) seldom causes serious trouble. The kidneys are sometimes affected by a larger and somewhat similar worm (*Eustrongylus gigas*) found in the pelvis or hollow curved portion in which the secretion of urine takes place. These occasion a weakness, or partial paralysis of the hind limbs, and an inclination to sit or lie down. Pouring turpentine on the loin of the back is a favorite remedy, and, as a stimulant, it sometimes does good. The difficulty is in determining the existence of the worms. The kidneys are also infested sometimes with hydatids or bladder worms, far more serious than the latter. If it were possible to know surely of their existence, moderate and continued doses of turpentine would be indicated. Unfortunately, even veterinary surgeons are not always sure from the symptoms, as shown.

KILLING ANIMALS. It is customary to keep oxen two days, and smaller animals one day, without food, but this is neither humane nor proper. The ox is killed by a blow on the forehead, and his throat immediately cut. The Jews, who eat no meat with blood in it, do not fell the animal, but, having tied it, divide the throat down to the bone. Animals killed by accidents are eaten with propriety, but such as die from disease are unwholesome, and sometimes poisonous. A method of killing animals by pithing, or dividing the spinal marrow high in the neck by a sharp knife, is practiced in southern Europe; the animal falls at once, but the flesh is said not to be free from blood.

KILLINITE. A greenish lamellar mineral, consisting of silica, alumina, and iron, with six per cent. potash.

KILN. A furnace. The figure depends on the object in view.

KILN ASHES. The ashes of the wood, straw, etc., used in burning.

KILN-DRYING. Drying hops, malt, grain, etc., in a chamber, or over a wire-work heated to 120° Fahrenheit, and upward by a kiln or stove below.

KILOGRAMME. A French weight, equal to two lbs., three oz. five pwts., avoirdupois.

KING BIRD. *Tyrannus Carolinensis*, known also by the name of the Tyrant Fly-catcher, and, Bee Martin, is a common summer bird all over the North, arriving generally just before corn planting time, or when insects begin to be plenty. Its nest is placed in the fork of a tree, generally in and near the orchard, seldom more than twenty feet from the ground. It has the reputation of catching bees. There is no real evidence, however, that it does catch living bees. Its food is beetles, grasshoppers, and insects in general. In defense of the king bird, Mr. Townsend Glover says: The stomach of one examined in May contained May beetles, but no bees. Another shot by a farmer, who suspected it of taking his bees, as he had seen it make repeated dives among them from a willow overhanging his hives, contained no less than fifteen *anomala varians*, one *carabus*, and not the vesttige of a bee. These insects were so packed together and mixed up in the stomach, that an inexperienced person would have taken them for a mass of bees; and it was only after careful and close examination that they were all indentified. This bird may, however, feed upon bees at some particular seasons; and if farmers would only carefully examine the stomachs of such as are killed, or send them for that purpose to some competent naturalist, the question would soon be settled as to whether it ought to be shot as a marauder upon bee-keepers, or protected as a benefactor of farmers.

KING-POST. The central post of a trussed framing for supporting the tie beam.

KINIC ACID. The acid with which quina is associated.

KINO. A dark-brown astringent extract containing much tannin.

KIRSCHWASSER. A liquor obtained by fermenting cherries, with which the stones are pounded, and distilling the fermenting liquor.

KNEE. In architecture, an artificially or naturally bent timber. Knees are most largely made use of in the building of vessels.

KNEEPAN. A small, flat bone (*patella*) situated before the knee-joint to protect it.

KNOLL. A hillock, or small hill.

KNOPPERN. Gall-like excrescences of oaks, used for dyeing and tanning.

KNOT GRASS. A weed-like plant (*Polygonum aviculare*); also a *Holcus*, which produces bulbs on its roots.

KNOT-WEED. *Polygonum.* There are many varieties of polygonum, including buckwheat, wild (false) buckwheat, knot-grass, smart weed, water pepper, etc., and all worthless to the farmer, except the cultivated buckwheat (*Polygonum fagopyrum*).

KOHL-RABI. *Brassica caulo-Rapa.* A vegetable partaking of the nature of the turnip and cabbage, and hence sometimes called turnip cabbage. The leaves resemble the Swede turnip and it is peculiar in the bulb-like swelling above ground, which is the edible part. It is in great repute among our German population, and growing in favor among all classes, especially since the attacks of the cabbage caterpillar, has rendered that vegetable a precarious crop. The vegetable is fit for use when half grown. If allowed to attain its full growth it becomes hard and stringy. It is cooked by being sliced and boiled like the turnip, and resembles both the cabbage and turnip in flavor. The seeds are sown for the earliest crop in a cold frame, and thence transplanted in rich soil, in rows eighteen inches apart by twelve to fifteen inches in the row. When raised for feeding stock, the seed should be sown in May, in rows two feet apart, the plants to stand twelve inches in the row. For family use in winter the seed is sown in June and the plants set out when large enough. They are kept by packing in dry sand. The cultivation is precisely like that of cabbage. The Early White Vienna may be sown for family use, and for stock, the large white or the large purple, which sometimes grows to a weight of eight or ten pounds.

KRAMERIC ACID. It is obtained from the root of the *Krameria triandra* or rhatany.

KYANITE. A silicate of alumina, sometimes colored by iron and other bodies; it occurs in doubly oblique prisms; is white, gray, or blue. It is common in primitive formations, and sometimes forms a fine blue stone resembling sapphire. and used by jewelers.

KYANIZING. A process named from its inventor, Mr. Kyan, for preserving timber and other vegetable substances from decay by the use of antiseptic materials. Corrosive sublimate was the material which Mr. Kyan employed for the purpose, but chemistry has shown that other substances can be used with equal advantage, and much less expense; arsenic, sulphate of iron, sulphate of copper, and some other substances have been used with more or less advantage by the French chemists, who have taken the lead in this art. Chloride of zinc was successfully employed by Burnet, a surgeon in the British navy, several years ago, for kyanizing rope yarns, and this was the substance used at Maysville, Kentucky, for kyanizing cordage made of unrotted hemp. It was prepared by dissolving zinc in muriatic acid, and this diluted with water in a large tub to such an extent as to give but a slight alum-like taste to the chloride when placed upon the tongue. The yarns were immersed in the solution for about twelve hours, drawn out with a heavy reel over the tub to drip for an hour or two, then stretched out to dry. This made the rope almost indestructible from ordinary exposure to the weather. The kyanizing of material is not now much practiced other processes having superseded it. It was at one time supposed that it would be valuable on the farm in the preservation of posts, but the cost of preparation and injecting the material precluded its adoption. In fact all chemical processes are too costly for the farm.

L

LABELLUM. The flower petal of a labiate or orchideous flower.

LABELS. In all experiments with plants, it is especially necessary that they have labels attached to them, by which the correct name of the plant may be determined, and the record pertaining to the experiment kept easy of access. Many labels have been invented both of wood and metal. When it is necessary that the label bear the name distinctly, for a long time, labels of zinc running to a long point, and upon which the name may be marked in oil paint, are undoubtedly the best. For ordinary use, we have found the common wooden labels, brushed over with thin white lead paint and then marked with an indelible pencil, to answer every purpose. These are now made of all sizes, both for wiring and thrusting into the ground. When but few are required, they are easily made at home, out of soft, clear pine. For marking nursery rows, where there are many names, marking by Roman numerals, and recording the name with accompanying numeral in a book, should be practiced. The same is true of any plants, the name of which is to be preserved, either in ordinary farming operations or in horticulture. Thus, if several varieties of grain are to be tested, they should be correctly marked by having numbers carefully cut in. Then the record should be kept in a book containing data, that may occur in connection with the grain, or plant, from time to time.

LABIATÆ. An extensive family of plants, characterized by a two-lipped, monopetalous corolla, an irregular number of stamens, and four-lobed ovary. They are mostly herbs or small shrubs, with highly aromatic flowers and leaves, as the mint, lavender, sage, etc. None of them are poisonous.

LABIUM. A lip, the divisions of some monopetalous flowers. In entomology, the movable organ which is at the front of the head, or face, covering the mouth, and representing the upper lip.

LABORATORY. The workshop of the chemist; chemical manufactories are often improperly so called.

LABRADORITE. An iridescent, opaline variety of feldspar.

LABRUM. The labium, or upper lip of the insect.

LABURNUM. *Cytisus laburnum.* The varieties generally cultivated are the common broad-leaved; the narrow-leaved, long-spiked, the short-spiked; the variagated, and the intermediate or dwarf laburnum. The first two come fairly true from seed, the others are propagated from cuttings eight to twelve inches long, kept over winter and planted in the spring like currants. *Laburnum vulgare.* The common sort makes a nice shrubby tree, with fragrant flowers, but in the West requires protection in winter, until it is thoroughly well rooted, or until it has obtained some size.

LAC. The dry resinous juice of several trees of Southern India. The trees are wounded by the *Coccus ficus*, a bark louse, parts of which being entangled in the juice, produce a red color like cochineal.

LACERATED. A botanical term, used to designate a leaf which appears to have been torn.

LACERTIDÆ. The family of lizards.

LACHRYMAL GLAND. A small conglomerate gland placed in the upper portion of the outer angle of the eye; it supplies the eye with moisture to lubricate the surface; an excessive flow produces tears. The lachrymal duct is a small channel from the inner corner of the eye to the inside of the nose.

LACINIATE. Fringe-like; petals, leaves, etc., cut into numerous thin shreds.

LACQUER. A varnish used to cover brass and other metals, made by dissolving shellac in alcohol, and coloring with gamboge, saffron, and other bodies.

LACTARY. A dairy.

LACTATION. Giving milk, or suckling.

LACTEALS. Minute vessels running from the interior of the small intestines along the mesentery to the thoracic duct; they convey the chyle or nutritious portions of digested food. They form the lacteal glands of the mesentery.

LACTIC ACID. The acid of sour milk, and also found in digested food, and sour, starchy substances, saur kraut, etc. It is a thick, colorless, sour liquid, soluble in water and alcohol; and coagulates milk. It readily combines with bases forming lactates.

LACTINE. Sugar of milk.

LACTOMETER. An instrument for measuring the purity of milk by specific gravity, or for ascertaining the proportion which the cream bears to the milk of any particular cow.

LACTUCARIUM. The dry juice of the wild lettuce. (*Lactuca viposa.*)

LATUCIC ACID. It exists in the lactucarium.

LACUNA. A small pit. The mouth of the excretory ducts.

LACUNOSE. Having little pits or shallow indentations.

LACUSTRINE. Belonging to a lake, as lacustrine deposits.

LADY BIRDS. *Coccinellidæ.* These are among the most beneficial of the insect tribes to the farmer and the horticulturist, from the fact that they prey on other insects in all stages of their growth from the larva to the perfect beetle. They were named from Coccus, the insect which produces the cochineal of commerce, from the prevailing bright red color of the species. Dr. Le Baron says that upwards of twenty North American species have been described and distributed in a number of sub-genera, founded for the most part upon obscure or unimportant characters. There is a greenish, black spotted insect that should not be confounded with the lady birds, since it is a vegetable feeder, and a near relation to the three-striped cucumber beetle, and is known as the twelve-spotted diabrotica, or spotted squash beetle. All the coccinella, or lady birds, excepting, it is said, *Epilachna borealis*, one of the largest species, are beneficial, by destroying plant lice, (bark lice,) scale insects, including the orange scale insect, and various eggs and larvæ, especially those of the Colorado potato beetle, which, in the egg state, is preyed upon by a number of species of lady birds. They deposit their eggs in the midst of the aphides, and, when hatched, the young larvæ immediately commence feeding voraciously upon them, and continue to destroy them until they change to the pupa state; then they remain motionless, fastened to a leaf or branch, until they again change to the perfect insect—in this stage to feed on other insects and propagate their species. *Chilocorus bivulnerus*, a small black lady bird, with two red spots on its wing cover, is very useful in destroying bark lice, which are so injurious to fruit trees. I have observed them early in the spring attacking the pine tree scale, ripping open the cases and devouring a few of the eggs, leaving the rest to fall to the earth when the trees are agitated by the wind, in this way destroying many of this injurious coccus. *Exochomus guexi*, a small red lady bird with two black spots is of similar habits. It is of great utility, by destroying the orange scale insect, which has proved so very destructive to the orange tree in Florida. If any farmer wishes to satisfy himself as to the utility of the lady bird, he can easily do so. By minutely examining his rose bushes in the summer, when covered with lice, he will find an elongated bluish black insect, somewhat resembling an alligator in shape, with more or less orange or yellow spots on the back and sides. This is the larva of a red or black-spotted lady bird, and if placed under a tumbler with a fresh twig of the plant covered with plant lice, after a few days it will cease eating, fasten itself to a leaf, shed its skin, and assume the pupa state; and in a few days more change again into the perfect insect. As a means of illustrating some of the more common species of these beneficial insects, we give a series of cuts—beetles, larva and eggs—with explanations from one of Dr. C. V. Riley's Missouri Reports, which says: In the egg state the Colorado potato beetle is preyed upon by no less than four distinct species of lady birds. Foremost among them is the Spotted lady bird (*Hippodamia maculata*, DeGeer) which is one of our most common species and is of a pink color, marked with large black spots as in Figure 1. Next comes the Nine-spotted lady bird (*Coccinella 9-notata*, Herbst) which is of a brick-red color and marked with nine small black spots as in Fig. 2. Next, the Thirteen-spotted lady bird (*Hippodamia 13-punctata*, Linn.) which is also of a brick-red color but marked with thirteen black spots as in Fig. 3. (To these we have added the black, two-spotted lady bird, *Chilocorus bivulnerus*, Leach, Fig. 4. This is black, with a red dot on each wing cover and is useful in destroying the lice of the apple, plum and other trees. Edt.) And last but not least, the little species fig-

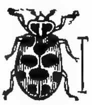


Fig. 1.

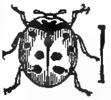


Fig. 2.

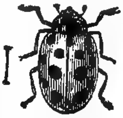


Fig. 3.

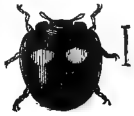


Fig. 4.

ured at 5 which may be known as the Convergent lady bird (*Hippodamia convergens*, Guer), and which is of an orange-red color marked with black and white as in the figure. This last species alone has been of immense benefit in checking the ravages of potato beetles. Its larva is represented of the natural size at Fig. 5 *a*, its colors being blue, orange and black; when full grown it hangs by the tail to the under side of a stock or leaf and transforms into a pupa represented at Figure 5, *b*. In this state it is of the exact color of the Colorado beetle larva and is doubtless quite often mistaken for that larva and ruthlessly destroyed. It may readily be distinguished however by its quiescence, and let every potato grower learn well to recognize it and spare its life! The larvæ of all these lady birds are more bloodthirsty in their habits than the perfect beetles, and the larva of the little Convergent lady bird is so essentially cannibal that whenever other food fails, it will turn to and devour the helpless pupæ of its own kind. All these larvæ bear a strong general resemblance, and with the aid of Fig. 5, *a* and Fig. 6, a good idea may be obtained of them. They run with considerable speed, and may be found in great numbers upon almost any kinds of herbage. The larvæ of certain species that prey upon the Hop Plant-louse in the East are well known to the hop-pickers as black niggers or serpents, and are carefully preserved by them as some of their most efficient friends. The eggs of lady birds greatly resemble those of the Colorado potato beetle, and are scarcely distinguishable except by their smaller size and by a much smaller number being usually collected together in a single group. As these eggs are often laid in the same situation as those of the potato-feeding insect, care must be taken by persons who undertake to destroy the latter, not to confound those of their best friends with those of their bitterest enemies.

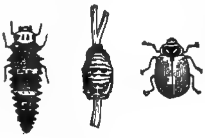


Fig. 5.

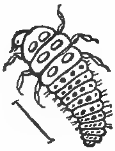


Fig. 6.

LADY-BUG. (See Lady birds.)

LADY'S MANTLE. Plants of the genus *Alchenuilla;* they are slightly astringent, but wholesome.

LADY'S SLIPPER. Flowers of the genus *Cypripedium*, of great beauty.

LADY'S TRESSES. Small orchideous plants of the genus *Spiranthes*, of no importance.

LÆVIS. Smooth.

LAGENÆFORM. Bottle-shaped.

LAGOON. A shallow lake, into which the sea flows.

LAGOPUS. The genus containing the grouse and similar birds feathered down to the toes.

LAMBDOIDAL SUTURE. The line of junction between the bone at the back of the head (occipital) and the side bone (parietal).

LAMB SKINS. Their value depends on the fineness, brightness, and color of the wool, black being most esteemed. The skin is extensively employed in making gloves.

LAMB'S LETTUCE. Corn salad.

LAMB'S QUARTER. (See Goose-foot.)

LAMELLÆ. The gills of mushrooms.

LAMELLICORNS. A division of pentamerous beetles, in which the short antennæ are inserted into a deep fossa at the side of the head; the body is ovoid and heavy; the anterior part of the head is commonly dilated, and projects; the mentum is large, covering the labrum or incorporated with it, and bearing the pupi. They are very numerous, and feed on excrements, rotten wood, and roots.

LAMINA. The flat surface of a leaf.

LAMINÆ. A tribe of longicorn beetles, distinguished by a vertical head, filiform palpi, antennæ bristly and simple, thorax nearly equal throughout; some species are apterous.

LAMINATED. Rolled or beaten to thin leaves or foil.

LAMINITIS. (See Founder.)

LAMPAS. The horse is subject to various local inflammations in and around the mouth, which prevents the proper chewing of the food, causing working of the jaws, ejection of the food, and often drooling of saliva from the mouth. Persons who do not apprehend the real cause apply to the nearest horse doctor (?) who, in his ignorance, burns the lampas out. Lampas is an active inflammation of the fleshy bars of the roof of the mouth, not unusual in young horses while shedding their teeth. Sometimes they swell so much as to project beyond the nippers, and are so tender that hard food is refused. Scarifying the bars with a sharp lancet, so they will bleed slightly, is the proper remedy. If this does not suffice, touch the inflamed parts with a stick of lunar caustic, or swab them with a strong solution of the same every day until they disappear, or the inflammation is reduced. The glands of the lower jaw sometimes encroach on the cavity of the mouth, through enlargement. The glands should be painted with iodine until the swelling disappears. This form of swelling is called Vives. Paps is a name given to swellings caused by obstructions of the salivary glands. Touching with a pencil of nitrate of silver once a day, until it disappears, is the remedy. In cutting teeth, the gums of young horses are swollen, as in the case of infants. Cutting down onto the teeth with a sharp knife will give relief. Old horses are often supposed to have lampas, when the trouble is either decayed teeth, or from the increasing spaces between becoming filled with closely impacted food, so much sometimes that inflammation and even excoriation will ensue, causing foul breath. In fact, if the horse have a foul breath, the first thing to be looked for is decayed teeth, or else food lodged between. If decayed teeth are found extract them, if impacted food be found remove it and wash the parts with a solution of chloride of lime, in the proportion of one ounce of chloride of lime to a pint of water.

LAMPBLACK. Fine charcoal obtained by imperfectly burning resins, etc.

LAMPYRINÆ. A tribe of soft-skinned, serricorn beetles, characterized by palpi with enlarged terminations, a soft, straight, slightly depressed body, by the thorax projecting over the head, which it partially or wholly covers.

LANATE. Covered with wool, or having the appearance of wool.

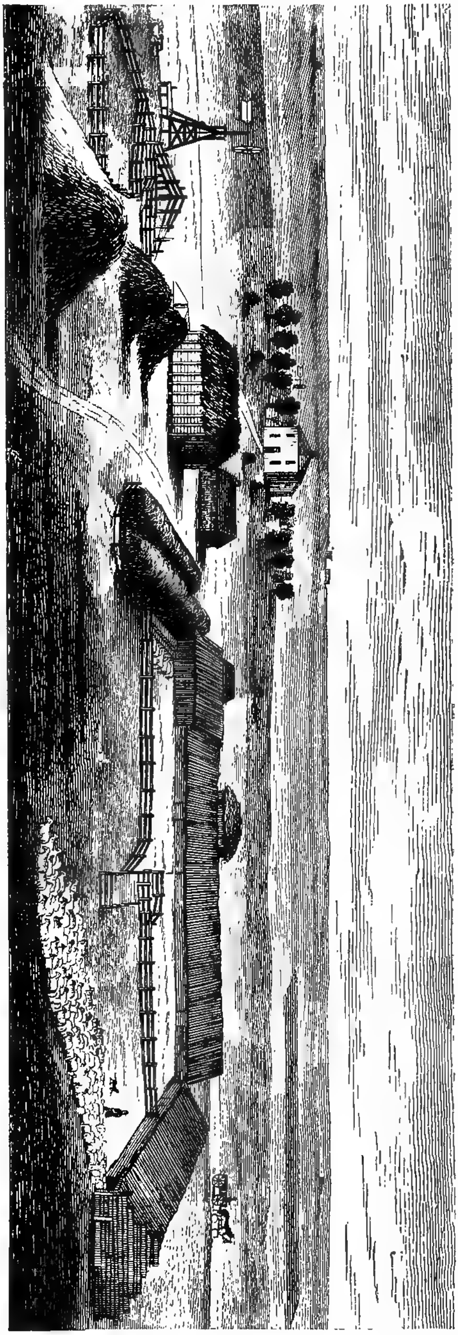
LANCASHIRE SWINE. This is an English breed and it is divided into three sub-families. The Short-faced Lancashire, the Middle Breed

Lancashire, and the Large Lancashire. They are all pure white, and their characteristics, were described as follows, at a convention of Swine breeders in the West: Until the fall of 1870 but little was known concerning this breed of hogs in the United States, but in England they have been known for over one hundred years. In 1767, at the First Manchester Agricultural Show, Manchester being in Lancashire, a hog of this breed was shown, taking the first prize in the class of White Swine. It is the representation of a hog of immense size, with tremendous limbs, very coarse, and by no means an animal that would be approved of by the judges of the present day. Short-Faced Lancashire White Breed.—This breed of swine may be known by the following characteristics: The shortness of the face from the eyes to the end of the snout; prick ears; small bones; a good coat of white hair; cubic in form, with broad back and broad hams, well let down. The skin, as well as the hair, is white, although an occasional one may be found having a few dark-blue spots on the skin, but never dark or black hairs. Large Lancashire White Breed Swine.—This variety of swine have large bones, are of great height and length, and are the largest breed of swine known. They are a true breed, which is proved by the greatest winners and most famous hogs being got by those who have won most prizes. Thus, Samson, Ranger, Victor, Great Western, Great Eastern, etc., etc., hogs that won the First Royal All England Prizes, are the sires and dams of the present winners, and the size and quality descend from generation to generation—the quality being improved by judicious selection. Lancashire Middle Breed White Swine.—This breed is one which partakes of the quality of the small breed and the size of the large breed. Middle bred hogs are got by crossing large bred sows with small bred boars, but all attempts to attain the same results by reversing this operation, and putting large bred boars to small bred sows have proved failures. The largest of the middle bred sows are used to improve the large breed. Their characteristics are as follows: The small bred hog must have small bones; a short face; silky hair; fine, small, upright ears; a comparatively square form; must have good square hams, the most valuable part of the hog; must carry the meat near the ground; flat on the back; straight and cubic in form. Large Breeds.—Must be of large size; great length; flat back, with large square hams when fattened; must carry their width of back along over the hams; must have deep and tolerably straight sides, large feet and leg bones; hair short; may have a long face, but it had better be short, as they fatten better; may have a large, drooping ear, but, other qualities and size being equal, an upright, smaller ear preferred. They usually have a long, thick, strong tail; must be of great weight when fattened, and above all must be descended from a hog having the foregoing qualities, and, if a breeder, must produce them. They are short of hair, but still are hearty. A middle bred hog must have a short face, and all other good qualities of the small breed, except that they may be longer in proportion to their width; must have thicker legs and longer bones to carry the greater size; should be well haired, fattening to full form often causes the hair to temporarily fall off, which must be allowed for. As good a short rule as can be adopted to judge them by is as follows: The best middle bred hog should have the most possible of all the qualities of the small breed, with the length, and, in a measure, the larger bones of the large breed.

LANCEOLATE. Lance-shaped, oblong, and gradually tapering to the ends.

LAND. In agriculture, the bed, between two water furrows.

LANDED ESTATES AND FARMS. As a nation increases in wealth the acquirement of large landed estates seems to become a passion among the wealthy. In Great Britain, the accumulation of land by the wealthy has been carried to such an extent that the entire land of the country is held by less than 50,000 individuals in a population of over 30,000,000. The same rule holds good, though not to the same extent, in other European countries except in France, where the land is generally held in small areas. In the United States, within the last ten years, the same passion has taken root among a certain class of wealthy Americans, and bodies of land running from one thousand to hundreds of thousands of acres, are now held by individuals. Yet, from the fact, that in this country, we have no law of primogeniture, the estates are eventually subdivided and disintegrated. In England there are 32,342,000 acres of land. This vast area of land fifteen years ago, was owned by less than 44,000 proprietors. In Scotland there are 19,738,930 acres of land. It is owned by 4,000 proprietors. Within the last fifteen years these accumulations have steadily gone forward, and the accumulations have become greater and greater in individual hands. In France, the waste land in 1826 was one-twelfth of the whole surface, 10,000,000 acres; and since that time improvements have steadily been carried forward. In 1850 there were but 5,000,000 acres of waste land, and now there is scarcely an acre but has its money value, either in the crops it produces, in timber and brush wood, or in other valuable products. In many countries the pastoral lands form the chief wealth of the country; such are the steppes of Asia, the grazing regions of South Africa, Australia and South America, where herds may live the year round. Corresponding to these are the plains of the United States, extending from the Mexican boundary on the south, to the British possessions on the north, and from the twenty-first meridian of longitude west of Washington to the Pacific ocean, comprising an area of over 1,000,000,000 acres, which is covered with rich grasses, a considerable portion of it now occupied with fertile farms; the mountain ranges rich in timber, and with inexhaustible mines of both the precious and baser metals beneath the surface. In Colorado, Wyoming and mountainous Utah, the first cattle were shipped east from these mountain and valley ranges, and now vast herds are there raised, feeding winter and summer on the bunch, and other nutritious grasses that retain their substance even when dry. This country is bisected into nearly equal portions by the lofty and snowy range of Sierra Madre, or Mother of Mountains, of the old Spanish explorers. This mountain range, in its windings, measures fully fifteen hundred miles in length, and from its snow-covered tops a thousand streams take their rise and plentifully water its mountain slopes. It is here that the Rio Grande, the Red, the Arkansas, the Plattes, the Yellowstone, and the Missouri on the east, and the Columbia, the Sacramento, the Humboldt, the Green, and the Colorado on the west, with their many tributaries, take their sources in the everlasting snows. The soil of the country is produced by the disintegration of the limestone, sandstone and granite ridges of this mountain range, and it is therefore, dry, gravelly, and porous, except on the border of the streams. Along the streams the soil is a dark mold, formed from the decomposition of the vegetation growing on the mountains. The grasses of the wide plains and valleys and the lower mountain sides are the bunch, buffalo, grama, mesquite, and in some valleys the blue-joint, red-top, and wild rye grass. The grasses grow and flourish up to the timber and snow line—to an altitude of 10,000 feet. In addition to the grasses, there is a great variety of sweet, tender, and aromatic herbage, upon which sheep and goats delight to browse. Of the artemisia there are twelve to fifteen varieties, of which the wild sage furnishes five or six. There are four or five varieties of sheep-sorrel; and of the wild pea-vine there is an extensive family. There are also many kinds of the wild dock and the balm. The climate of this region is much like that of Asia. The rain-fall is light, being about eight inches annually in the country west of the Missouri river and east of the Sierra Nevada Mountains; while the snow fall, at the altitude of 7,500 feet, is only two feet. The fall of snow at any one time is small, and never lies on the ground to afford sleighing or to cover the grasses. The rainy season is in May and June, and after these months the only rain that falls is from electrical showers. While the rain is falling in May and June, vegetation grows luxuriantly; but, when the rains cease, the grasses gradually dry on the ground, so that by the time the frosts come, in September, they have become perfectly cured uncut hay. The post surgeon at Fort Kearney, says of the country surrounding that post: The average temperature for the year 1868 was 52° Fahrenheit. Snow does not remain any length of time. The report from North Platte station, Union Pacific Railroad, states that the climate is healthful, and the extremes of temperature, on account of the dry and rarefied atmosphere, are well borne. The rain and snow fall are small. From Fort Sedgewick, Dr. Monroe, United States Army, reports: The mean temperature for 1869 was 50° Fahrenheit, rain-fall 8.9 inches, snow-fall 10.82 inches. The atmosphere is usually dry. The prevailing winds are from the west. From Fort D. A. Russell, near Cheyenne, at the base of the Rocky mountains, at an altitude of 6,100 feet, Dr. C. H. Alden, United States Army, reports: The mean temperature for the past two years, 1868 and 1869, has been 46.53° Fahrenheit; average rain-fall for the past two years, 6.25 inches. From Fort Laramie, Wyoming Territory, Dr. Schell, United States army, writes: The mean annual temperature is 50.6°. The climate is healthy, autumn and winter mild, summer dry and sultry, spring usually rainy. Dr. W. E. Waters reports from Fort Bridger, in the extreme western portion of Wyoming: The climate is temperate and salubrious the greater part of the year; the weather during the fall months is mild and delightful, excepting a few storms of short duration. During the months of May and June there is a greater rain-fall than in all the other months. The rain-fall for the last year amounted to 7.97 inches. Dr. F. L. Town, of Fort Shaw, Montana Territory, in latitude 47° 30′ north, writes: The climate of the Territory is exceedingly dry all the year round. The aggregate fall of rain and snow (melted) for the year 1868 was 10.14 inches.



A WESTERN RANCH.

Snow rarely lies on the ground long after a storm. The mean temperature for 1869 was 47.35° Fahrenheit. This shows conclusively that the climate is uniformly dry, that the rain and snow-fall is small, as in the interior of other continents, where winter grazing has been generally common through all historic periods. The total area of land in the United States, as reported by the Land Commissioners, was estimated at 2,943,257 square miles, or 1,883,744,000 acres; or, if we include the Indian Territory, 3,010,277 square miles, equal to 1,926,636,800 acres. The following table will show, by States and Territories, the acres of cultivated and uncultivated farms in 1850 and 1860:

States and Territories.	Acres of improved land in farms.		Acres of unimproved land in farms.	
	1850.	1860.	1850.	1860.
Maine.	2,039,596	2,677,216	2,515,797	3,023,539
New Hampshire.	2,251,488	2,367,039	1,140,926	1,377,591
Vermont	2,601,409	2,758,443	1,524,413	1,402,396
Massachusetts	2,133,436	2,155,512	1,222,576	1,183,212
Rhode Island	356,487	329.884	197,451	189,814
Connecticut	1,768,178	1,830,808	615,701	673,457
New York	12,408,964	14,376,397	6,710,120	6,616,553
New Jersey	1,767,991	1,944,445	984,955	1,039,086
Pennsylvania	8,628,619	10,463,306	6,294,728	6,548,847
Delaware	580,862	637,065	375,282	367,230
Maryland	2,797,905	3,002,269	1,836,445	1,833,306
Dist. Columbia	16,267	16,267	11,187	16,789
Virginia	10,360,135	11,435,954	15,792,176	19,578,946
North Carolina.	5,453,975	6,517,284	15,543,008	17,245,685
South Carolina.	4,072,651	4,572,060	12,145,049	11,623,860
Georgia	6,378,479	8,062,758	16,442,900	18,587,732
Florida	349,049	676,464	1,246,240	2,273,008
Alabama	4,435,614	6,462,987	7,702,067	12,687,913
Mississippi	3,444,358	5.150.008	7,046,061	11,703,556
Louisiana	1,590,025	2,734,901	3,399,018	6,765,879
Texas	643,976	2,649,207	10,852,363	20,486,990
Arkansas	781,530	1,933,036	1,816,684	7,609,938
Tennessee	5,175,173	6,897,974	13,808,849	13,457,960
Kentucky	5,968,270	7,644,217	10,981,478	11,519,059
Ohio	9,851,493	12,665,587	8,146,000	8,075,551
Michigan	1,929,110	3,419,861	2,454,780	3,511,581
Indiana	5,046,543	8,161,717	7,746,879	8,154,059
Illinois	5,039,545	13,251,473	6,997,867	7,993,557
Wisconsin	1,045,499	3,746,036	1,931,159	4,153,134
Minnesota	5,035	554,397	23,846	2,222,734
Iowa	824,682	3,780,253	1,911,382	5,649,136
Missouri	2,938,425	6,246,871	6,794,245	13,737,939
Kansas	....	372,835	....	1,284,626
California	32,454	2,430,882	3,861,531	6,533,858
Oregon	132,857	895,375	299,951	5,316,817
Washington	....	....	....	300,897
Utah	16,333	16,333	30,516	58,898
New Mexico	166,201	166,201	124,370	1,177,055
Nebraska	....	....	....	501,723
Dakota	....	....	....	24,333

The older States have varied but little since. According to the report of the Commissioner of the General Land Office for 1878, the total area of the public domain was 1,814,772,648 acres, of which 724,311,447 acres had been surveyed, leaving 1,090,461,171 acres unsurveyed. Some of the unsurveyed lands are covered by inchoate titles that will inure to railway corporations and pre-emption settlers upon the completion of survey, but the great mass of these unsurveyed lands are, as yet, entirely uncovered by any private claims, and are consequently open to settlement. Of the above area of unsurveyed lands, 369,529,600 acres are in Alaska, of which a former Commissioner of the General Land Office, Mr. Joseph S. Wilson, estimated that about 20,000 square miles or 12,800,000 acres are fit for some kind of agricultural settlement; this is about half the area of Ohio. A large portion of the unsettled land west of the Mississippi river consists of broken mountain country and of arid alkali soil unfit for cultivation by any process now known. The Indian Territory, embracing 44,154,240 acres, is reserved for the occupancy of Indian tribes, and hence it is not open to white settlement. Making all deductions, it is safe to estimate that of the unsurveyed lands there remain 500 million acres suitable for profitable culture and uncovered by private title of any kind. The annexed table will show the area in acres, the acres surveyed, and the acres appropriated, in 1874, of those States and Territories containing public lands:

States and Territories.	Area in acres.	Acres surveyed.	Acres appropriated.
California	120,947,840	38,805,776	20,877,602
Dakota Territory	96,596,128	13,863,913	5,835,604
Montana Territory	92,016,640	6,784,481	5,179,821
New Mexico Territ'y	77,568,640	5,486,185	6,864,082
Arizona Territory	72,906,240	3,135,753	4,050,350
Nevada	71,737,600	8,198,194	4,669,383
Colorado	66,880,000	15,683,086	4,303,329
Wyoming Territory.	62,645,068	4,748,841	3,480,281
Oregon	60,975,360	15,255,617	9,515.744
Idaho Territory	55,228,160	4,014,953	3,102,407
Utah Territory	54,065,042	5,984,792	5,315.086
Minnesota	53,459,840	35,897,912	19,516,340
Kansas	52,043,520	45,770,685	10,544,439
Nebraska	48,636,800	32,372,410	8 869,943
Washington Territ'y	44,796,160	10,190,046	3,556,967
Indian Territory	44,154,240	22,832,725	....
Missouri	41,284,000	41,284,000	40,549,368
Florida	37,931.520	29,845,870	20,643,611
Michigan	36,128,640	36,128,640	32,468,110
Illinois	35,462,400	35,462,400	35,462,400
Iowa	35,228,800	35,228,800	34,036,220
Wisconsin	34,511,360	34,511,360	26,118,729
Alabama	34,462,080	34,462,080	28,522,448
Arkansas	33,406,720	33,406,720	22,463,872
Mississippi	30,179,840	30,179,840	25,531,387
Louisiana	26,461,440	23,909.258	20,033,897
Ohio	25,576,960	25,576,960	25,576,930

Of the surveyed lands it is somewhat difficult to form anything like a satisfactory estimate. The public surveys have been completed in the States north of the Ohio river, in Alabama, Mississippi, and in all the States just west of the Mississippi river, except Minnesota. In Alabama there were 91,000 acres of United States land yet unoccupied and subject to entry in Crenshaw county, 85,000 in Monroe, 100,000 in Franklin, 46,000 in Conecuh, and smaller tracts in others. In Mississippi, Scott county reports 42,000 acres; Lauderdale, 40,000; and Winston, 30,000. In Florida, where 7,827,724 acres are still unsurveyed, Clay county reports 140,000 acres; Santa Rosa, 87,000; the southern counties embracing the Everglades, have been to a small extent appropriated by private parties, though large areas have been donated to the State as swamp lands. Lousiana has 1,229,396 acres yet unsurveyed. Our correspondent reports 130,000 acres in Bienville, 29,000 in Claiborne, and smaller tracts in other parishes. In Arkansas vast tracts of government land, all surveyed, are open to settlers; about half of Garland county, 309,000 acres in Van Buren, 100,000 in Pike, and large bodies in other counties. These Southern States probably still contain from fifteen to twenty million acres of United States land open to settlers under the land laws, by purchase, pre-emption, and homestead titles. North of the Ohio river the government title has been extinguished to all lands in Ohio, Indiana, and Illinois, except a few isolated small tracts of refuse land. In northern Michigan several counties still report vast bodies; Chippewa, 500,000 acres; Delta, 100,000; Alcona, 30,000, etc. Very large tracts are found in northern Wisconsin; Oconto and Lincoln counties are supposed to have upwards of a million acres; in the southern counties also large bodies are found unoccupied. In the absence of definite statistics it may be safe to estimate the amount of government land in these States uncovered by private titles at from five to seven million acres. West of the Mississippi river, Minnesota, Nebraska, and Colorado still embrace 67,884,579 acres of unsurveyed land, Iowa, Missouri, and Kansas having completed their surveys. The total amount of surveyed land in these six States is 230,104,921 acres. Of this area a very large amount has been donated to States and railway corporations, and a very large area taken by private claimants. It is not unreasonable, however, to estimate that about 100,000,000 acres, or one-third the area of these States, remains at the disposal of the general government. In the Territories of Dakota, Wyoming, New Mexico, Utah, Idaho, and Montana, embracing an area of 438,119.680 acres, about six-sevenths, or 373,748,118 acres, remain unsurveyed, but of this area a considerable amount will inure to railway corporations as soon as the surveys are completed. Probably 250,000,000 acres of land suited to agricultural settement yet remain at the disposal of the government. On the Pacific slope three States, California, Oregon, and Nevada, and two Territories, Arizona and Washington, covering in all 351,408,000 acres, about five-sevenths, or 250,290,564 acres, remain unsurveyed. Individual or corporate title has attached to an area about equal to the surveyed lands, but of the remainder a large proportion is covered with mountain ranges, or with an arid climate, rendering it unfit for any kind of farming except, perhaps, sheep farming. In regard to lands at the disposal of the different States, the information is less general or specific. None of our correspondents found any such lands available for private settlement in the New England or Middle States. Craig county, Virginia, reports 2,000 acres. State lands undisposed of are also reported in several counties of North Carolina, viz, Pamlico, Hyde, Graham, Bladen, Caldwell, Alleghany, Camden, Henderson, Tyrrel, Wilkes, and Montgomery. Similar reports from Beaufort, Colleton and Clarendon, in South Carolina. Camden, Georgia, reports 60,000 acres. All the Gulf States report considerable bodies of State land disposable in different counties. Texas on her accession to the Union stipulated for the possession of her own public lands, and has consequently an immense domain open to settlement. The other Gulf States were all erected out of the public domain, and have been endowed by the general government with various land grants under the educational, swamp land, and other laws. Of the Southern inland States, only Arkansas is a public land State, and hence has had numerous grants from the general government, of which a considerable portion remains unsold. In Tennessee, where the unoccupied lands has been ceded to the Union by North Carolina, the lands were found so covered by contradictory private claims that the general government ceded them to the State of Tennessee. From the returns we conclude that the mass of these lands have passed into private ownership, as only two counties, Fentress and Meigs, note any remnant within their borders. West Virginia and Kentucky report no lands of this character. In Ohio no State land is reported; in Indiana our correspondent, in Jasper county, reports 40,000 acres. In northern Michigan

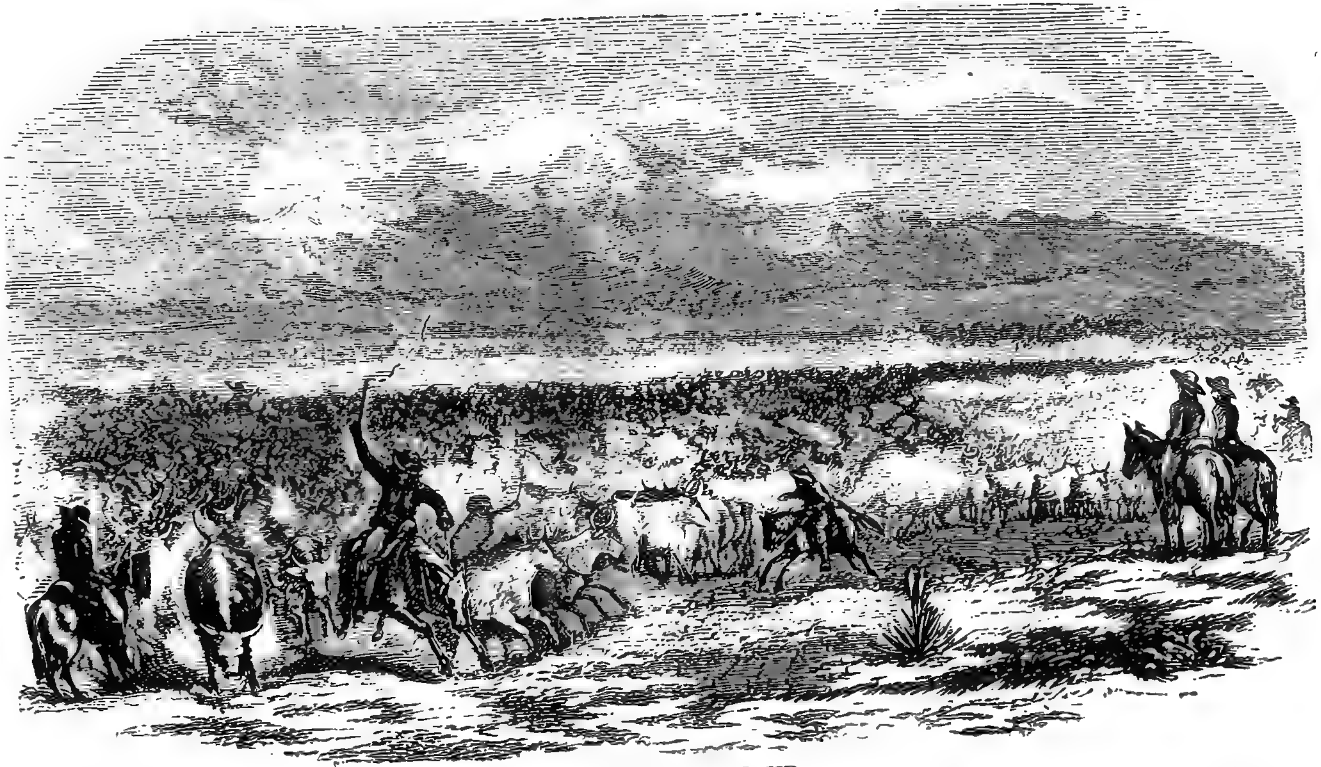
HARVESTING IN THE FAR NORTHWEST.

large bodies of State lands are yet undisposed of. Wisconsin has largely disposed of her lands, yet several counties report from 10,000 to 20,000 acres. Minnesota has a large amount of State land undisposed of; only half the county of Crow Wing has passed into private ownership. Iowa has mostly disposed of her State lands. Considerable tracts are scattered through Missouri; but Kansas, Nebraska, and Colorado present very large areas. The Territories have received but small endowments as yet, and consequently have but little to offer. On the Pacific coast numerous tracts of State land await disposal. Of lands granted for rail and wagon road construction the total area is 198,165,794 acres, of which 59,308,581 were granted to fourteen States, viz, Illinois, Mississippi, Alabama, Florida, Louisiana, Arkansas, Missouri, Iowa, Michigan, Wisconsin, Minnesota, Kansas, California, and Oregon, in behalf of railways chartered by them. To the corporations commonly known as the Pacific roads were granted about 135,000,000 acres. The locality of many of the later donations can not be determined till the public surveys along their lines shall have been completed. The endowments vary in amount. The earlier roads, such as the Illinois Central, were allowed the odd numbered sections within six miles on either side of the road, and selections of odd numbered sections between that limit and fifteen miles to replace sections within six miles to which prior rights had attached. In some of the later grants the limits of the original and reserve tracts were increased to twenty and thirty miles respectively. Some of these grants have lapsed through failure of the grantees to comply with the conditions required by law. Of the above aggregate, 3,857;213 acres were granted to three States, viz, Wisconsin, Michigan, and Oregon, for military and wagon roads. Of unoccupied lands belonging to individuals, vast areas are reported in all sections of the Union. In the mountain and forest regions of the older States, for instance, we are informed that from half to three-fourths of whole counties are held, without occupation or cultivation of any kind, by private parties. Much of this represents valuable mineral lands, and other woodlands largely on mountain slopes. Such lands are to a small extent available for agriculture. There is no doubt that in a great many instances men have more real estate than they can profitably manage, and that many eligible farm tracts are available to purchasers from this source. Yet it is human nature to hold on to what is acquired as long as possible, and it must be confessed that the management of the great wheat growing farms in the Northwest and the great cattle and sheep ranches on the plains, have been most admirable, so far as a good interest on the capital invested is concerned. As the country grows older, these investments will continue to pay less and less, until at length it will become imperatively necessary that these immense estates be subdivided into small estates. As showing the animus exhibited in acquiring these large estates, we have shown, by illustrations, a stock ranch on the plains, an actual harvest scene in the Northwest, a plantation scene in Texas, and also a round-up of cattle on the plains. The prices of farm lands, both cleared and timbered, were made subject of inquiry in several investigations. The following table shows the results of those inquiries for 1880. The first column gives the States mentioned, except Rhode Island, from which there is no report; the second column the average value per acre of cleared land in 1880; the third column the average value per acre of timbered land, and the last column the average increase in value of both classes in one year:

States.	Average value cleared lands.	Average value timbered lands.	Average increase both classes.
			Per cent.
Maine	$12 87	$12 66	10
New Hampshire	15 00	32 00	10
Vermont	15 28	17 73	6
Massachusetts	85 00	43 25	8
Rhode Island	....	....	....
Connecticut	29 00	24 50	7
New York	58 48	40 88	4.7
New Jersey	82 42	56 82	5.2
Pennsylvania	45 75	29 70	7
Delaware	19 00	15 00	7.5
Maryland	24 65	35 50	6.3
Virginia	9 42	7 48	1.4
North Carolina	9 77	5 53	6
South Carolina	8 64	6 24	9
Georgia	6 93	5 45	10
Florida	9 48	3 03	28
Alabama	6 53	4 08	9
Mississippi	7 88	3 78	9
Louisiana	14 36	3 53	9
Texas	8 98	4 00	4.8
Arkansas	11 78	3 48	7.3
Tennessee	13 00	7 28	8.7
West Virginia	21 05	9 39	8
Kentucky	18 86	12 82	8.2
Ohio	47 53	41 87	8.5
Michigan	34 39	20 27	8
Indiana	30 46	26 90	8.7
Illinois	33 03	23 68	11
Wisconsin	26 07	10 55	7
Minnesota	14 45	12 25	[illegible]
Iowa	27 36	39 36	7.5
Missouri	14 52	8 25	12.5
Kansas	11 82	19 12	10.3
Nebraska	8 93	25 85	15.3
California	27 16	8 55	3.2
Oregon	21 71	4 50	2.6

It will be observed that every State shows an increased average value. A few counties report no change and still fewer a decline. The average for the whole country is eight per cent. increase. New England reports an increase of eight per cent. Timber lands here show a tendency to advance in relative value, showing a growing scarcity of this kind of lands. In New Hampshire and Vermont the average value of timbered lands exceeds that of cleared lands, while in Maine there is comparatively little difference. In Alabama, Mississippi and Louisiana wood lands are comparatively lower. The proportion of urban to rural property and population is so much greater, that the value of land depends more upon its market crops. In the Middle States the average value of both classes of land has advanced five per cent. The total area here is more than double that of New England. The advance in prices is mostly caused by the extension of mining and manufacturing and is felt more strongly near the centers of those branches of industry. Timber land also commands a higher price. In the oil regions quite an area supposed to be rich in petroleum is held by speculators for higher prices. The South Atlantic States have advanced their land values six per cent. Many counties report a very considerable appreciation from various causes. The increase in tobacco culture, the abundance and high price of the last cotton crop, manufacturing and mining enterprises, etc., are mentioned as among the causes of this improvement. The Gulf States estimate a rise of eight per cent. The Florida figures, twenty-eight per cent., are believed to be excessive, but the small area of farm land compared with other States in this section, renders this excess of little importance in the general estimate. On the other hand, the estimate of Texas, 4.8 per cent., is evidently too low. In Florida, vast areas of timber land are just coming into market, and the special value of the land depends not upon its adaptability for agriculture as for the timber to be cut off it. In all these States are large amounts of public lands available for settlement and purchase from the government. In the western counties the exodus of African laborers has caused some reaction and caused some lands to be thrown upon the market. The yellow fever also had its reactive influence. In several counties, a rapid denudation of timber lands is noted. The Southern inland States claim an improvement of nine per cent. In Arkansas the rapid increase of population and settlement will account for this improvement. In Tennessee and West Virginia there has been a considerable increase in the mining population and in mining enterprise. The removal of colored laborers to Kansas has caused an influx of white labor. In these and in other Southern States it is noted that the freedmen are becoming land-owners to an extent hitherto unexpected. North of the Ohio the enhancement in the value of lands was about nine per cent. An increased demand for real estate has sprung up under the operation of several causes. Mineral and manufacturing enterprise are advancing in different parts of this region, the latter at giant strides; but the advance in prices of farm lands in this region is evidently due to the immense crops of 1879. Several correspondents complain that timber land is becoming scarce, yet in all these States cleared land bears a higher average price. West of the Mississippi river farm lands increased ten per cent. in value. In the prairie States—Iowa, Kansas, and Nebraska—timber land bears a higher price than cleared land, and in these States a very considerable effort has been made to plant lands in timber. The rapid increase in population, together with the extension of manufacturing enterprise in these States, will account for the increase in farm values. The Pacific States show but three per cent. increase. In relation to the public domain of the United States, and the yearly surveys, in spite of the prodigal manner in which they have been given away in aid of public and private enterprises, there still remains a large body, surveyed and unsurveyed, to be disposed of. This is exclusive of Alaska, which is not supposed to contain much land suitable for cultivation. The public lands surveyed during the year 1880 amounted to 15,699,253 acres, making, with previous surveys, a total of 752,557,195 acres in all surveyed, and leaving an estimated area of 1,062,231,727 yet to be surveyed. The annual survey is about double the number annually disposed of. How much really arable lands remain for the settler to take up can not, of course, be determined from the land office reports, nor do the best authorities agree as to the proportion of good land to the whole domain. In respect to the amount of area susceptible of cultivation in the different countries of Europe nature has been very diverse. Inaccessible and arid mountains, and lands subject to overflow of the sea, constitute the greater portion of lands classed as not arable. The

A TEXAS FARM.



A CATTLE ROUND-UP.

percentage of lands not arable is greatest in Norway, being seventy-two per cent. of the whole; next comes Sweden, then Portugal, while Bavaria and Würtemberg have the least proportion not susceptible of cultivation, being less than two per cent. Great Britain has twenty-eight per cent. not susceptible of cultivation, Ireland thirteen per cent., and France only nine per cent. The amount of land devoted to cereal crops and to fallow and pasture also differs greatly, according to the habits and traditions of the inhabitants. Belgium has the largest proportion of land in cultivation, having fifty-nine per cent.; France has fifty-three per cent., and Great Britain thirty-nine. In the United States no effort has been made to find the area susceptible of cultivation. It is, however, one of the most favored of any country on earth, considering its vast area. In the prairie country, for instance, there is almost none of the land but what may be cultivated, and the mountain area of the whole country is comparatively small.

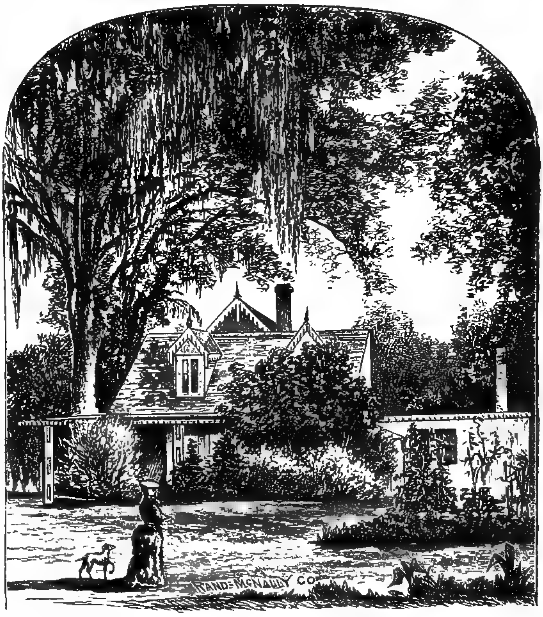
LANDSCAPE GARDENING. Landscape gardening is one of the departments of Horticulture, by which the effect of a natural scenery is heightened by art, or by which a monotonous area is rendered beautiful, by means of walks, drives, lakes, bridges, rock-work, and the planting of trees, shrubs, and flowers. In fact, in its broad sense, it is high art, in which but few professionals ever arrive at high eminence. So far as the present work is concerned, it will not be necessary to go into the minutia of details. To point out some means by which the farmer may beautify his home, and give illustrations of nature's, and of artificial work, will be sufficient. Many farmers seem to be imbued with the idea, that time and money spent in beautifying the grounds about the home is time and money thrown away, and yet there is no means that may be employed that will give so much present satisfaction, or that will more enhance the value of a property if it is to be sold. In this they are not altogether to blame. They have been taught to believe that it could only be accomplished at a large outlay of money, and through the labor of a professional gardener. Nothing, however, could be more fallacious. It is not merely artificial surroundings that they are to create, but to take advantage of the natural beauties of a home and heighten these by bringing the grass into a close and smooth sward, to lay out and build walks and drives, and so arrange the planting of the whole that it may be partially shaded with handsome trees, and to shut out offensive objects by closer planting. In fact the whole farm is to be considered. If there is an unsightly knoll near crown it with deciduous and evergreen trees. If there is a depression, some parts of which are marshy, form a lake, and from it a small stream to carry away the outflow, taking advantage of any facility that may offer to drain the balance. Plant the edges of the pond with weeping or other willows, and thus three important objects are subserved, drainage, water, and shade. In nine cases out of ten the drained land will pay the cost of the whole. If there is a meandering water course running through a valley, clear the banks, leaving clumps of elms, maples, and lindens at the bends here and there. Cover the banks with a firm sward of grass, and here again three objects are attained: superior pasturage, available water, and shade. In time the groups of timber will grow into trees, when they may be thinned and the surplus sold. There should be woodland on every farm, and if one can take advantage of land otherwise of little value for the planting, two objects again are attained: a provision of timber for the future, and a landscape effect that will be pleasant to the eye. In all this do not seek the picturesque, it is only here and there a place that can be heightened by picturesque planting, and these situations, picturesque in themselves, as for instance where there is a waterfall or rugged scenery. Sylvan beauty is what is wanted on the farm, and in no country in the world is the ground work more carefully laid by nature than in the West, where we have undulating prairie. There are but few farms where a permanent thread of water may not be supplied by artificial drainage intelligently conducted, and what is more beautiful than the soft haze lying about distant bits of woodland in the spring. The cool, inviting shade in summer, and the gorgeous splendor of the autumn when the maples are blazing with their many tints, while the other trees tone down their beauty with their more sober hues. It is the home grounds, however, that require the nicest attention. Here there should be plenty of room. A five acre lot is none too much for the farmer's home, for none can better afford it than he, and here it is grass and trees that beautify. Plenty of grass and only trees enough to shade it here and there. This may be partitioned off with light wire fences, to afford pasturage to sheep, calves and colts, or the grass may be mown so it need not be lost. If the ground be somewhat broken plant the knolls with clumps of trees just so as to

SOUTHERN FOREST SCENE.

break the view but not to shut out the vista beyond. Do not have too many roads and walks, these cost money, for they should be well made, and at least have the appearance of being made for use. Above all, never make the mistake of setting a pretentious mansion down on the prairie, with nothing about it but rough fences and rank herbage. The owner of a fine house without anything about it to tone down its glaring exterior, has made one of the most comfortless mistakes possible. A cottage, however humble, shaded by trees and with its vine-clad porch, with a winding path, gladdened with a few flowers, leading to it, is far more beautiful as it is far more homelike. Other things being equal, the farm with its pretty cottage and comfortable barns, protected by wind-breaks, and enlivened here and there with clumps of trees, will bring far more money, than the other with its barn-like mansion and its bleak surroundings. How this will look may be seen in the cut of a Southern Homestead on page 553. Mr. McWorter, one of the most observing and practically scientific horticulturists in the West has given the following ideas on making a homestead. They will well repay perusal. He says: Not to dwell at length on the various mistakes most commonly made in homestead arrangements, it may be briefly stated people are generally too stingy of the little bit of ground around the house; they allow no ground for shady lawns or homestead scenery; they fence themselves up in a little narrow door-yard, and then to save steps in doing chores they get the barn and its numerous appendages closely and conspicuously located, if not exactly in front of the house, at least so as to break the view to the road in a side direction. In short, the arrangements for the comfort, convenience and pleasure of cattle, hogs, chickens and children, are too closely mixed and commingled together. Even people who are anxious to have everything very nice, conceive of no way only the old, stiff, rectangular square rule plans for every thing—every thing is brought to straight lines and square corners—fences all straight, gate exactly in front, a straight walk to the front door, shade trees arranged in exact military order. Such grounds present no pleasing variety—nothing but the tiresome sameness of straight lines and rectangular forms. It is difficult to give any very definite rules for homestead arrangements, because scarcely any two situations are exactly alike. But, to bring the matter to your minds, we will suppose you are about to prepare for yourself a country home. You are inspired with the beauties of nature—you have listened to the music of the pines; and nature's picturesque scenery and flowing outlines have nearly expelled the old rectangular, iron square plans all out of your mind. You first choose your building site. You do not choose the most level portion of your farm; because for your building sites, groves, orchards, and general homestead scenery, you prefer grounds somewhat rolling; and for farming purposes you prefer the level lands. You choose a site for your house on a rising swell of ground, some ten or twelve rods from the road. You want room in front of your house for some breadth of grassy lawn, and some pleasing diversity of landscape scenery. You next decide on a spot for your barn, back of your house, and not too near, because you want room back of your house for garden and fruit-yard; for you know it is in bad taste to have a fenced-up kitchen garden next to the road. Having chosen the place for your barn and feed-lots off back of the house, you want a lane from these to the public highway; but you do not want this lane to infringe on the grounds of your house-yard, and you give this lane a graceful curve around your buildings. You border this lane with large trees—it gives a rich expression to your homestead and furnishes grateful shade. You plant trees of large growth back of your house, that will rise above the house and partially screen the barn and its appendages from view. You do not commit the blunder of planting all your evergreens exactly in front of the house; because you know, though they might look well enough there at first, they will, in time, grow to broad proportions, and even darken the light of your windows, and nearly hide your house from view. You group the evergreens mostly off in side directions, to the right and left; only allowing a few of symmetrical form and smaller growth on the grounds in front. You plant perhaps a few trees of large growth at the extreme outer border of your grounds, along the road. You avoid getting your front grounds too much filled up with low shrubbery; for you prefer that your front views shall consist mostly, of a clean, grassy lawn, with only

NORTHERN FOREST SCENE.

a few scattering trees to afford a pleasing play of sunshine and shadow. In short, you desire to have your largest trees back of your house, and breaking round in irregular groups toward the road, with only scattering trees in front. When your trees have grown up, your house, when viewed from the road, will appear to stand back in a kind of bay, partially encircled with a rich background of sylvan scenery, and having a breadth of green lawn in front. It is a very common error to plant too many trees in front, and not enough back of the house, and off at the wings. If a natural grove of young timber should be on the ground you have selected for your homestead, you will consider this very fortunate. The most charming situations are such as are already adorned with a growth of young timber. You will make such improvements on what nature has supplied at your hands as good taste and landscape effect will suggest. If you can preserve a natural grove of some extent, contiguous to your building ground, you will consider yourself especially favored. Nothing could add more to the sylvan attractions of a homestead. A country that is divested of its natural groves is bereft of its richest garlands of beauty. In planting trees and laying out grounds you will imitate nature's rounded turns and flowing outlines, so as to make groups of evergreens and masses of shade trees present a scenery of wild diversity. The aspect of your situation, or make of ground, will suggest natural curves or rounded turns to the outside boundary of your grounds. You will determine on the place for your entrance gate—not exactly in front of the house, but off in a side direction, so as to afford a richer view of the architectural forms of the house, and also to afford more changing views in the scenery of your grounds. Perhaps a gate for foot men will enter your grounds, in a side direction, from the one side, and the carriage gate off at the other. Your carriage-drive may either pass by a graceful curve in front of your house, and thence around your house; and off back to the barn, or (what is better) it may curve up near the house, and then wind its way toward the barn. Your walks, also, should take such easy turns or windings as the make of your ground or groups of trees will suggest. There should always be some seeming necessity for any or all turns in your walks. It is often proper to plant groups of trees to occasion a necessity for such turns in a walk or carriage-drive. Fences are obstructions in landscape scenery, and should only be built where absolutely necessary. Where a fence is indispensable, as along the public highway, it should be such as will obstruct the view as little as possible. If swine are excluded from the public highways, (as they should be in every civilized community,) fences may be constructed in good taste, that will be very little obstruction to landscape views. Out door-yard fences should be no higher than necessary—if a picket fence, let it be of square pickets, and as wide apart as security will permit. Do not paint your fences white. It is from a want of due reflection that people so often commit the error of painting their boundary fences white. A glaring white picket fence should never be placed in front of a beautiful landscape. The ostentatious white fence stands there in self-display, and attracts all attention from the landscape scenery beyond the fence. Let the fence be painted in some color that will harmonize with the bark of the surrounding trees, such as a sober drab, or the softer shades of brown. For objects of ornament, that stand back in some shady portion of the grounds, such as a pretty summer house, for a small building, partially screened by trees, or if a low cottage, white is not inappropriate for the dwelling itself; but for buildings of any considerable architectural proportions, other shades of color are preferred. Having thus rapidly presented some general principles in the arrangement of homestead scenery, we will briefly add a few suggestions on the management of grounds. In commencing the work of preparing a homestead on wholly naked ground, it is advisable to first plow and harrow the entire grounds. Your whole plan is next laid out and staked off. Your trees are planted by experienced workmen. Knowing the importance of giving your trees a vigorous growth on the start, you decide to cultivate the whole ground for a few years. You perhaps appropriate the more open portions to some low, hoed crops. A good, steady single horse and careful driver may be employed in the work of cultivation. After two or three years of this treatment, your trees get a luxuriant start and begin to present a pleasing aspect; and you finally prepare your grounds for seeding. This, in favorable seasons, should be done in August, so that if the August seeding is not a success, another sowing or seeding can be made very early in the spring. It is not very important what kind of grass seed is used, provided some blue grass seed is mixed with it—the blue grass will ultimately occupy the ground. In preparing grounds for seeding,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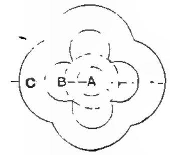
A SOUTHERN HOMESTEAD.

NORTHERN HOMESTEAD.

no labor should be spared in getting the surface perfectly even. After your grounds are seeded, it may be necessary to nurse the growth of some of your favorite trees by mulching, or by surrounding them with circular flower beds. You will not neglect the frequent and timely use of the lawn mower. What can be more charming than an expanse of closely mown lawn, enlivened by the lights and shadows of sylvan scenery? Your walks, also, must be kept free from weeds. A few of your evergreens most contiguous to the house may be kept trimmed in neat symmetrical forms; but those in more remote portions of your grounds should be allowed to assume a free growth and natural proportions. As illustrating natural scenery the cuts will show, first, a Southern forest scene, second, a northern forest scene. As illustrating great natural beauty, when water forms the principal feature, the illustration showing islands in the Mississippi will suffice. From the fact that it would occupy too much space to go into the details of landscape work from a working standpoint, and from the added fact, that no two places should be treated alike, we leave these suggestions as they are; but as a means of educating the eye to purely artificial work, so that when nature's effects have been heightened by art, and to natural picturesqueness, and also to sylvan landscapes, we have interspersed through this article landscapes which explain themselves. A few words as to the trees for planting will not be out of place. The barns and other farm buildings should be well protected, especially in prairie regions. Strong winds require strong trees, and cold winters warm shelter. Oaks, maples and elms, among deciduous trees and the Norway Spruce, white pine and firs, among evergreens, will be proper. Cottonwood, and other soft wooded trees may be allowed for a time while other trees are growing; but for permanent planting, they give a cheapening—not to say pennywise—appearance, and where they are allowed to tangle with and overgrow better trees, a slovenly, not to say shiftless, appearance, while the other class express strength, sturdiness, independence and retirement. The common mistake made in new places is too thick planting, and especially in negligence in thinning. There is, however, no objection to rather thick planting of young trees but be sure you thin before there is even an appearance of crowding. Among the most beautiful of deciduous trees is the hard maple on suitable soil. On well drained prairie soil, although rather slow at first, it will clothe itself in the most luxurious foliage, and grow more and more beautiful year by year. The red or swamp maple, on moister soil, is handsome in summer and magnificent in autumn. A weeping willow is always beautiful in a valley or near water, and next to it the black willow. The golden willow is also beautiful in early spring, looking like a light green cloud in the distance. The elm is always beautiful and assumes so many graceful and pendent forms when planted singly that it should not be neglected. The Linden (basswood) is among the most beautiful of trees in summer where it has plenty of room to spread. It is on the whole a cleanly tree, handsome in its bloom at midsummer, and its broad leaves are somewhat tropical in appearance. Among shrubs for ornament the planter must be guided by circumstances. Small flowering shrubs may be interspersed about the lawn and herbaceous perennials may form center pieces for beds of flowers, or be placed nearer the house. In all cases when the planter may be in doubt, if practical descriptive text books be not at hand, the nearest intelligent nurseryman should be consulted. Nevertheless, the intelligence of the female portion of the household may here be generally relied on to guide correctly, in the arrangements and care of beds. So also their taste will be generally correct as to the proper planting of trees, shrubs, curves of walks and drives. In regard to the planting of trees and shrubs avoid straight lines. A good plan in the setting of trees and groups, is to provide a tall stake that may be easily seen from a considerable distance, and the requisite number of smaller stakes. Let the assistant be sent upon the ground to be planted to hold the stake, while the director stations himself from the point of view, as the porch of the house, etc.; direct the stakes to be set, so no two of them will come in line, at least not near together. Once they are fixed from the principal point of view, proceed to another principal point, and if there is a glaring defect, as seen from thence, have it rectified by moving the offending stake to another position that will not interfere with the view from the first point. Thus you may get your planting so it will easily harmonize as a whole, and it will have been accomplished at a minimum outlay of time. In preparing your grounds, you have the satisfaction of having not only accomplished a work not generally supposed possible for farmers, but of having illustrated that it is not difficult. That it only requires a little thought and the display of original ingenuity. Neither of these are really difficult to him who should be as observant of what is going on about him in nature and art as the farmer. Because one labors with his hands it is no sign that he may not be an artist. In fact the inspiration of art seldom comes unsought or without thought. In conclusion we also present several forms of beds carefully prepared by Mr. H. DeVry, Assistant Superintendent of Lincoln Park, Chicago, from the more simple to those somewhat intricate with a list of plants proper for planting therein. The taste of the female portion of the family, however, may be relied on to make these beautiful with other flowers, annual, biennial, and perennial. The idea being to so blend color, form and size that the whole shall make a harmonious picture.

I



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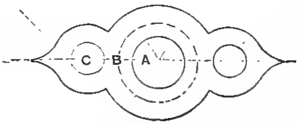
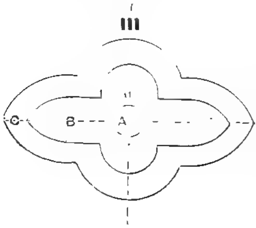


I.—A. Ageratum, dwarf, blue. B. Geranium, Wonderfu', scarlet. C. Coleus, Buttercup. The border, Alternanthera amœna.

II.—A. Coleus, la Nigra. B. White or pink Geraniums. C. Coleus, South Park Gem. The border, Achyranthus Lindenii.

III



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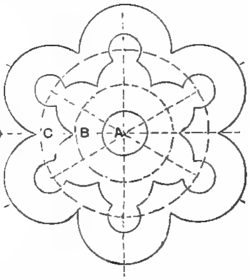
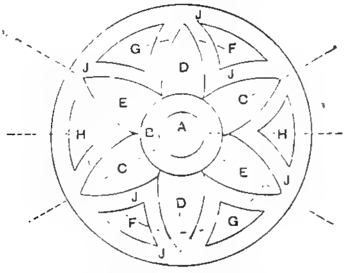


III.—A. Coleus, Crown Jewel. B. Geranium, Mme. Thibout. C. Blue and white Verbenas, mixed. The border, Alternanthera amœna.

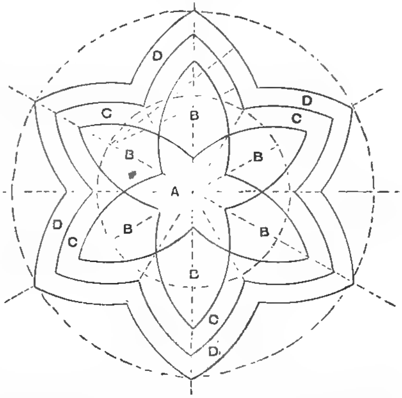
IV.—A. Scarlet Geraninm B. Coleus, Mrs. Kirkpatrick. C. Achyranthus Vershaffeltii. The border, Cineraria Maritima.

V



V.—A. Ageratum, blue. B. Geranium, Wonderful, scarlet. C. D. E. Coleus, Vershaffeltii. F. Geranium, Mountain of Snow. G. Geranium, Earl Roslin. H. Blue Verbenas. J. Coleus, Park Gem. The border, Achyranthus Lindenii.

VI

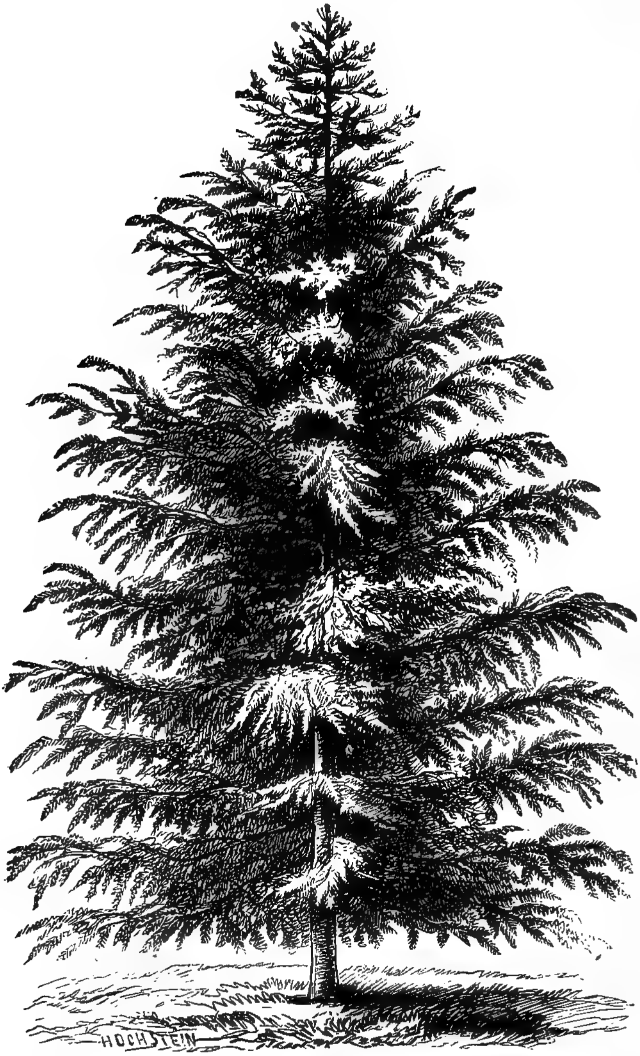


VI.—A. Coleus, Mary Stuart or C. Rubra. B. Coleus, Park Gem. C. Coleus, Versicolor. D. Coleus, Puck. The border, Gnaphalium lanatum.

Under the articles Forestry, Gardening, Horticulture and Lawn, will be found other valuable information relative to the subject of Landscape Gardening

LANIARIES. *Dentes laniarii.* Conical teeth at the sides of the jaws, next the incisors.

LARCH. *Larix.* A class of trees having the general characteristics of the Coniferæ, except in the loss of the evergreen character, the family being strictly deciduous. When raised from seed the young plants hold their leaves for two, sometimes three years, and thereafter become deciduous, dropping their leaves and remaining bare during the winter. The larches, however, are treated precisely like evergreens, are subject to the same rules in transplanting, and in the effects to be produced upon the landscape. The species are few. The American Black Larch and the European Larch will serve as the types of the species. The European Larch for all purposes of ornament and excellence is the variety now generally planted. The wood is firm, very lasting, of tolerably quick growth, and has the peculiar quality of resisting fire. The tree is handsome in its drooping foliage and one of the most picturesque of trees in age, being especially adapted to planting on promontories, rocky places, gorges, etc. The best situation for the larch is sound land where the roots will not be drowned in winter nor suffer with drought in summer. The whole family are natives of cold climates and mountainous districts of Europe, Asia, and America. When planted in proper situations, the larch is a fast growing tree, but if transplanted should be done early in the spring, since the buds are apt to start with the first few warm days. The best way to handle larch is to transplant in the fall after the leaves have dropped, and protect the first winter with mulch and staking. Besides the European and American Larch, the Dahurian Larch may be mentioned, growing well up into the colder regions of Siberia. It seems nearly allied, according to the description of it by European writers, with the European Larch. In the colder regions of Siberia, it is a mere shrub, but further south becomes a large tree, with irregular, twisted, drooping branches. The Sikkim Larch, a native of Bhotan, Sikkim, and Nepal, an inelegant, sprawling branched tree, says Dr. Hooker, with the branches standing out awkwardly, and often drooping suddenly. In the autumn, the foliage is said to change to a bright red, forming a fine contrast to other trees. In the Altai mountains, of Siberia, is found the Altaian Larch, similar to the common larch, but with smaller cones, a strong growing tree, luxuriant, with large leaves and pendulous habits. The Western Larch (*Larix occidentalis*) found on the western slopes of the Rocky mountains, and thence toward Oregon. That the larch is a valuable tree for planting upon the soils we have described there is no doubt. That it is altogether unsuited to that class of prairie soils that are light and fluffy and subject to be wet in the winter and spring, is quite as evident. The evidence in regard to the success of planting on the western plains is conflicting, but the weight of testimony so far would seem to be that it is a valuable tree for planting.



EUROPEAN LARCH.

LARD. The leaf, intestinal and other fat of swine when tried into oil. It is one of the most important products next to the meat, and forms a very considerable portion of the carcase. The average ranging about thirty-four pounds per hog, when the average weight is 217 pounds varying according to fatness. In 1874-75, the average weight of all the hogs slaughtered in the West and Northwest, was 209.77 pounds; the average weight of lard per hog was 35.02 pounds. This was an exceptional year, the hogs being very fat. In 1876, the United States exported 168,405,839 pounds of lard of the value of $22,429,485 ; an average value of 13.3 cents per pound.

LARGE-FOOTED HAWK.—(See Buzzard.)

LARK. The Meadow lark, or American starling is the best known of our larks. Its song is of exceeding sweetness, the few plaintive notes it utters being welcome to all as one of the earliest harbingers of spring. It is one of the most beneficial of birds to the farmers, living exclusively on insects and seeds in the cultivated fields and meadows. It is one of our most common birds West, is found in the southern New England States, and thence South and West. Nuttall says, in mild winters it remains through the year, but generally leaves for the South late in the fall, and returns about the second or third week in March. It commences building about the second week in May, sometimes earlier ; the locality is generally in a meadow or low field. The nest is usually built in a tussock of grass; it is pretty compact, made of dry, wiry grass, to which a hidden and almost winding path is made, and generally so well concealed that the nest is only to be found when the bird is flushed. Their food consists of the larvæ of various insects, as well as worms, beetles and grass seeds, to assist the digestion of which they swallow a considerable portion of gravel. It does not appear that this species ever adds berries or fruits of any kind to his fare, like the starling, but usually remains the whole summer in moist meadows, and in winter retires to the open grassy woods, having no inclination to rob the orchard or garden ; and, except in winter, is of a shy, timid, and retiring disposition. But one brood is reared in the season. In the North it is a bird of passage, arriving among the first of the spring visitors.

LARKSPUR. *Delphinium.* Very ornamental, hardy, flowering plants, both annual and perennial, and single and double, combining the richest possible variety of brilliant and effective colors, with great duration and profusion of bloom, The dwarf growing varieties are very effective in long lines and groups ; the candelabra-flowered forms a beautiful pyramid, shaped like a many-branched candlestick. For large beds on lawns, or masses and mixed flower borders, also for cut flowers, the taller growing varieties are the most desirable. The perennial larkspur should be more cultivated in the rural gardens than it is; all are remarkable for great beauty, diversity of shades of color, and decorative qualities. They also differ greatly in their habit of growth ; some produce magnificent spikes of flowers, while others are dwarf, and completely covered with bloom. The principle color is blue, shading from the softest celestial to the darkest purple blue, while all are more or less shaded or marked with some other color. With the exception of *D. cardiopetalum*, all are hardy perennials.

LARVA. The caterpillar or maggot state of insect life; the young of some amphibious animals are also called larvæ.

LARVIPARA. Producing larvæ by the undermining of water, or by an earthquake.

LARYNGOTOMY. The operation of making an opening into the larynx; this is sometimes necessary in cases of choking or severe inflammation, where the opening of the larynx, along which air passes, is closed.

LARYNX. The upper part of the windpipe, formed of cartilage, and lying at the root of the tongue.

LATENT HEAT. Heat supposed to be present in all bodies, and on which their form depends; it can not be felt, but, by a change in the form, is given out, and becomes sensible or free heat. Vapors and gasses contain most, next fluids, and last solids; so that, by the abstraction of heat, vapors are condensed, fluids freeze, and, by the reverse, solids become fluid or gaseous.

LATERITIOUS. A deposit of a reddish color from urine, etc.

LATEX. The milky or elaborated juices of plants: it circulates in a peculiar arrangement of tubes called the *laticiferous* vessels, which anastomose over the plant.

LATHYRUS. A genus of handsome climbing, leguminous plants, much cultivated for ornament.

LATICIFEROUS VESSELS. Milk vessels; they carry the *latex.*

LAUDANUM. Opium dissolved in alcohol, tincture of opium.

LAUREL. Shrubs, or small trees, of the genus *Laurus;* several are evergreen; they yield aromatic resins and oils.

LAURINE. A fatty, acrid substance, found in the berries of the common laurel, *Laurus communis.*

LAVA. The porous molten mineral matter which has flowed from volcanoes.

LAVENDER. A plant of the order *Labiatæ. Lavendula vera,* is the variety from which the lavender oil is made; which is distilled from the flowers. It is a small shrub from the south of Europe, but not hardy in the North and West. *L. spica* yields oil of spike. This is darker in color, not so agreeable in its perfume. It is an ingredient in some liniments, and is used in mixing colors for painting on porcelain, and in the preparation of certain varnishes.

LAVER. *Porphyra laciniata.vulgaris.* A seaweed eaten as a delicacy when boiled; green laver (*Ulva latissima*) sometimes is substituted.

LAW. Laws relating to agriculture, such as bird, dog, fence, forests, manures, roads, stock, weights and measures, etc., should be generally understood by farmers. It would save much costly litigation and neighborhood quarrels. We, therefore, give some of the most important laws in relation to the subjects of interest to the farm. The following digest of the bird laws of the United States was prepared by Hon. J. R. Dodge, one of the most correct statisticians in the United States: In Maine the penalty is one dollar for taking larks, robins, partridges, woodpeckers, or sparrows, between March 1st and July 1st; and ten dollars to the owner of lands, with the liquidation of all damage suffered for any trespass committed, between March 1st and September 1st, in hunting or killing the above birds. The law in New Hampshire prescribes a fine of one dollar for killing, taking, or having in possession, at any season of the year, any robin, thrush, lark, bluebird, oriole, sparrow, swallow, martin, woodpecker, bob-o'-link, yellowbird, linnet, fly-catcher, or warbler, or rail, yellowleg, or sandpiper, between March 1st and August 1st. The fine is three dollars for each snipe, woodcock, or plover, between March 1st and August 1st; or for each partridge, or grouse, or quail, between March 1st and September 1st. One dollar additional is assessed for each bird, if taken in defiance of a published notice by the owner of the land—one-half for the use of the complainant, and the other half to the town or city. The action of the law may be suspended for one year, at any time, by vote of a town or city, so far as relates to such town or city. In Vermont the fine is one dollar in each case for taking, wounding, or killing, or for the destruction of the nest or eggs of the robin, bluebird, yellowbird, cherry, or cedar bird, catbird, kingbird, sparrow, lark, bob-o'link, thrush, chickadee, pewee, wren, warbler, woodpecker, martin, swallow, night-hawk, whippoorwill, groundbird, linnet, plover, phœbe, bunting, humming bird, tattler, and creeper. The penalties for the violation of the Massachusetts bird and game laws are as follows: Two dollars each for killing, at any time, robins, thrushes, linnets, sparrows, bluebirds, bob-o-links, yellowbirds, woodpeckers, or warblers; the same for killing birds on salt marshes, the owner excepted; five dollars for killing partridges or quail, between March 1st and September 1st; woodcock, between March 1st and July 4th; five dollars for trapping or snaring any birds at any time, save partridges; twenty dollars for killing grouse or heath hen at any time, and ten dollars to the owner of the grounds and a search warrant authorized for any one suspected of the offense; and twenty dollars for hunting deer with hounds or dogs in Plymouth or Barnstable counties. There is a fine of one dollar for killing between sunset and one hour before sunrising any plover, curlew, dough-bird, or chicken bird. Any city or town may vote to suspend, within its limits, any of the provisions of this law. The Rhode Island law-makers have prescribed a penalty of two dollars in each case for killing, destroying, selling, buying, or having in possession any lark, robin, wood duck, gray duck, or black duck, between February 1st and September 1st, or quail, partridge, or woodcock between January 1st and September 20th;

snipe, between May 1st and September 20th; grass plover, between February 1st and August 1st; grouse, or heath hen, between January 1st and November 1st, and swallow, or box martin, between May 1st and October 1st; twenty dollars in each case for killing woodcock between January 1st and July 1st. In addition, five dollars may be imposed, to be paid to the owner of the land, for the first offense, and ten dollars for the second offense, besides a liability to damage for trespass. Action must be brought within three months. In Connecticut a law was made in 1850, after much opposition, which has since been modified and rendered more effective. Insectivorous and song birds have greatly increased since, especially near towns and villages, and on the shore of Long Island Sound. A fine of three dollars is imposed for killing, selling, or possessing, or destroying a nest of eggs of woodcocks between the first day of February and the first day of July; pheasants, partridges, or ruffed grouse, between the first day of February and the first day of September; quails of any species, between the first of February and the first of October; wood duck, widgeon, black, gray, broad-bill, canvas-back, or teal duck. The fine is one dollar for killing, or trapping, a nightingale, bluebird, Baltimore oriole, finch, thrush, lark, sparrow, catbird, wren, martin, swallow, or woodpecker, at any time, or a robin, or bob-o'-link, between the first of February and the first of September. The taking of brook or lake trout between September 1st and January 1st is fined one dollar. It is also forbidden under a penalty of ten dollars, to take pheasants, partridges, or quails, on the land of any other person. The laws of New York, both local and general, relative to birds and other game, are numerous, and frequently modified or suspended. By the recent law, insectivorous and other birds are protected between February 1st and October. The fine is placed at five dollars for each woodcock, between January 1st and July 4th; ruffed grouse, between January 1st and September 1st; quail, between January 1st and October 20th; wood, black, gray, and teal duck, between February 1st and August 1st, (excepting upon the shores of Long Island). It is forbidden to catch quail or ruffed grouse with a snare at any time; and it is unlawful to take prairie fowl within ten years, under penalty of ten dollars for each one killed or taken. Five dollars each is the penalty for taking trout between September 1st and March 1st. A penalty is incurred of one hundred dollars and damages for putting lime or drugs in any lake, pond, or stream, by which fish may be injured. Owners of dams, if two feet or more in height, on the tributaries of Lake Ontario, Champlain, or the river St. Lawrence, are required to provide a sluice at an inclination of not more than thirty degrees, suitably constructed and protected, as a passage-way for fish. Deer are prohibited game from February 15th to August 1st, in all counties, except Clinton, Franklin, St. Lawrence, Jefferson, Lewis, Herkimer, Hamilton, Essex, Warren, Fulton, and Saratoga, (where the prohibition is taken off only in October,) and in Kings, Queens, and Suffolk, where November is the only month for their pursuit. The fine in the last-mentioned counties is twenty-five dollars each. For fishing, except with hook or line, in certain interior lakes, the fine is twenty-five dollars. A similar penalty attaches to trespass in fishing, after public notice has been given. It is forbidden in Pennsylvania, under penalty of two dollars, to trap, kill, or shoot any blue-bird, swallow, martin, or other insectivorous bird, at any season of the year, and the same penalty attaches to the destruction of eggs or nest of any of the birds mentioned in law. A fine of five dollars is laid for killing rail or reed birds betweed June 1st and September 1st; pheasant, between February 1st and August 1st; woodcock, between February 1st and July 4th; partridge, or rabbit, between February 1st and October 1st, and a similar penalty is incurred by buying these birds out of season to sell out of the State. Laws have tended to restrain men and boys to some extent, yet, it is to be regretted that there is room for great improvement, so far as insectivorous birds are concerned. The game laws of New Jersey impose a fine of five dollars each for killing any partridge, water fowl, grouse, quail, or rabbit, between January 1st and November 1st, or woodcock between January 1st and July 5th; to be recovered with cost of suit, and in default of payment imprisonment for sixty days may be adjudged. A penalty of fifteen dollars is laid for placing decoys for geese, ducks or brant, at a distance of more than three rods from ice, marsh, meadow bank, or sand bar, or for hunting them with a light at night; and it is made unlawful to kill geese, ducks, or brant between April 15th and October 15th, in or about the waters of Barnegat bay, or Manasquon river. The fine is five dollars each for killing geese, ducks or brant, between April 1st and December 1st, at Cape May. A trespass, after having been once forbidden to enter lands, renders one liable to a fine of three dollars. The Secretary of State believes these laws effective, though not very vigorously enforced. By the laws of Delaware it is unlawful for non-residents to catch or kill any wild goose, duck, or other wild fowl, under a penalty of not less than fifty and not more than one hundred dollars. Citizens do not rest under this prohibition. A warrant may be issued by a justice of the peace, upon affidavit that any person has violated this law, and the offender arrested, tried, and, upon conviction, fined not less than fifty nor more than one hundred dollars, and imprisoned until fine and costs are paid. By giving bonds in the sum of two hundred dollars, the arrested party can elect to be tried before the court of general sessions. Any boat, gun, or decoy, used in violation of this law, may be seized and confiscated, and the penalty for resisting an officer is fixed at one hundred dollars. The law does not prohibit persons from killing game on their own premises, but it is unlawful for others to kill a partridge, pheasant, robin, or rabbit, between February 1st and October 15th, (in Newcastle county, between January 1st and October 15th;) woodcock, between February 1st and July 1st. The penalty is one dollar for each bird killed. A person not a citizen of the State, gunning upon land not his own, without permission of the owner, is liable to a fine of five dollars for each bird or other game. Some persons permit gunning upon their property; others exclude all hunters. The penalty of hunting or killing deer is two dollars. No general law for the preservation of game or birds has been enacted in Maryland. Laws of a local character have been made with a limited and partial jurisdiction. In Ohio the penalty is from two to ten dollars for killing, or attempting to injure or kill, at any season of the year, any sparrow, robin, bluebird, martin, thrush, mocking-bird, swallow, meadow lark, pewee, wren, cuckoo, indigo bird, nuthatch, creeper, flicker, warbler or finch, oriole, redbird, or catbird. The same penalty in each case is incurred by disturbing the nest of any of these birds; also for killing dove, wild rabbit, or hare, yellow-hammer or flicker, between February 1st and September 15th. From five and to fifteen dollars may be imposed for killing or hunting wild turkey, quail, ruffed grouse, prairie chicken, or wild deer between April 15th and September 1st; woodcock between February 1st and July 4th, and wood duck, teal, or other wild duck between May 1st and September 15th. Exposing for sale or having in possession, incurs the same penalties, and the costs of prosecution are in all cases to be paid by the offender. The Secretary of State says the law is effective through most portions of the State; that there are numerous prosecutions, and judges usually affix the extreme penalty. The penalty for killing small birds in Michigan is fixed at five dollars each, and for wild turkey, partridge, or ruffed grouse between February 1st and September 1st; for woodcock between March 1st and July 1st; prairie chicken or wild duck, goose, or swan between February 1st and August 15th; for quail from January 1st to October 1st. It is made unlawful to destroy nests or eggs. The fines go to the school library fund. Indians and inhabitants of the upper peninsula are exempt from the effect of these provisions. Illinois has no general bird law. In a portion of the counties it is made unlawful to hunt or kill deer, turkey, grouse, prairie hen, or quail, between January 15 and August 15th. A fine of five dollars is imposed in the State of Wisconsin for killing grouse or prairie chicken between December 1st and August 12th, or partridge, ruffed grouse, or quail between December 1st and the first Tuesday of September. An exception is made for the benefit of the Indians not civilized. Half the penalty goes to the prosecutor and half to the county. It is unlawful to kill or take woodcock in Iowa between the 1st of January and 1st of July; prairie hen or chicken between 1st of January and 1st of August, or quail, ruffed grouse, pheasant, or wild turkey, or deer, between the first day of January and 1st of September. In Minnesota the penalty is five dollars each for killing at any time a nightingale, whippoorwill, nighthawk, bluebird, finch, thrush, lark, linnet, sparrow, wren, martin, swallow, bob-o'-link, robin, turtle dove, catbird, or other birds; five dollars for each woodcock, from January 1st to July 4th; partridge or ruffed grouse between January 1st and September 1st; ten dollars for trespass in sporting; twenty-five dollars for killing each deer, elk, or fawn, or having the skin of one in possession between January 1st and August 1st. A fine of five dollars is also imposed for each speckled trout taken, except in Lake Superior, Mississippi, Minnesota, St. Croix and Root rivers. In California there is no law for the preservation of the insectivorous or song-birds Game is so abundant that not even the boys are disposed to kill them. The destruction of hawks, coyotes and other wild animals has caused a marked increase of small birds. In some sections quails have increased so as to prove destructive to farm crops. Wild geese, in some places, do great injury by feeding upon the young grain after it is sprouted. A game law exists which makes it unlawful to kill any quail partridge, grouse or ducks, between March 15th and September 15th, except in San Bernardino and Los Angeles counties. It is also unlawful to kill elk, deer, or antelopes from January 1st to July 1st. A fine of twenty-five dollars is imposed for having in possession or exposing for sale such game. Fines may be laid to the amount of five hundred dollars in a single case. A very stringent bird law exists in the District of Columbia. In 1863 the levy court of the county of Washington passed an ordinance for the protection of insectivorous birds, prohibiting the shooting or taking of such birds under a penalty of five dollars for each bird so killed, possession being held as *prima facie* evidence of killing. The law confiscates the gun of any person carrying or using such weapon on Sundays. Pheasants, partridges, woodcock, snipe, rail or reed birds and blackbirds, may be killed at certain seasons. Only hawks, crows and owls are unprotected. All other birds not here mentioned are protected at all seasons, except the last fifteen days of the year. The rigid enforcement of this strict law has peopled the woods and groves anew in the vicinity of Washington. In giving the laws relating to agriculture we have been obliged to generalize. If the farmer wishes to know specifically as to the latest law on any given subject he must consult his lawyer. We aim simply to give the original laws, those having been amended from time to time. The compiler of these laws says in relation to them. The laws of the several States indicate a transition period between pioneer life, with its inevitable dog companionship, and a state of permanent settlement and superior civilization. The silly prejudice that allows dogs to trespass upon a neighbor's grounds and destroy his sheep, while enacting laws to restrain sheep from wandering from their owner's pasture, is rapidly giving way to a common sense that would make restraint equal and just. In most of the States are certain provisions of a just law upon the subject, but a lack of completeness, or want of penalty attached to neglect in enforcement, render them partly inoperative, or wholly inefficient. In Pennsylvania there is, practically, only a threat held over the heads of the dogs, for which they seem to care very little; in Maine, each separate township has the option to ratify or nullify the general law—a non-committalism that is far worse than no law; in Ohio, dogs are instructed that it is unlawful for them to run at large at night, but their owners are held to no proper responsibility for their effective restraint; and in most other States some radical defect exists. Massachusetts has the best law. It taxes dogs from two to five dollars each; owners are made responsible, under heavy penalty, for their registry and taxation; assessors must make accurate lists, and evasions of the listing are heavily fined; refusal or neglect of officers to execute the law incurs a penalty of one hundred dollars; and untaxed dogs are killed without mercy, and district attorneys are required to prosecute officers who neglect to destroy them. Such a law, or one more guarded and efficient still, should be on the statute book of every State. In Maine a law taxing persons owning or harboring dogs one dollar for each dog was enacted in 1862 with a saving clause as follows· Provided, that towns or cities shall so vote. By its provisions dogs inflicting damage subject their owners to fines of double the amount of the damage done, to be recovered by an action of trespass. Any person may lawfully kill a dog that assaults himself or other person while walking or riding peaceably, or is found worrying, wounding, or killing any domestic animal. Any person finding a dog strolling out of the enclosure of his owner may, within forty-eight hours, make oath before a magistrate that he suspects such dog to be dangerous or mischievous, and notify the owner by giving him a copy of the oath; and if the dog shall be found again at large, he may be lawfully killed; and if he shall thereafter wound a person or kill a domestic animal, the owner shall be liable to treble damages and costs. In 1862 the legislature of New Hampshire levied a tax of one dollar on male and two dollars on female dogs. Prior to this the common law was the only protection enjoyed by owners of flocks. In 1863 a law was enacted forfeiting double the amount of damage done by dogs, recoverable from the owner by an action of debt; or a complaint may be made to the selectmen of towns, who are required, upon proof made within thirty days, to draw an order upon the treasury, which is registered and made payable, in whole or in part, from the fund accruing from the dog tax, on the second Tuesday of March annually. The following is the law of 1862 for Vermont:

Sec. 1. The listers in the several towns of this State shall in each year set all dogs in their respective towns in the grand lists to the owner or keeper of the same at the sum of one dollar each; and no person shall be entitled to have the amount so assessed deducted from their lists in consequence of any debts owing.

Sec. 2. Every owner or keeper of a dog shall, when called upon by the listers for their lists, notify them of the dogs by him owned or kept; and every owner or keeper of a dog who shall neglect or refuse to notify the listers as aforesaid, shall forfeit and pay to the town in which he resides the sum of two dollars, to be recovered in an action on the case in the name of the treasurer of such town, before any court competent to try the same, with full costs.

Sec. 3. It is hereby made the duty of the owner or keeper of a dog, whether set in the lists or not, to cause a collar, with the name of the owner or keeper plainly written thereon, to be worn on the neck of each dog by him owned or kept; and it shall be lawful for any person to kill any dog running at large off the premises of the owner or keeper not having on such collar; and the owner or keeper of such dog shall recover no damage for such killing.

By another law, owners of dogs that have worried or wounded sheep are made liable for double damages and double costs; and they can sustain no action for damages against persons who have killed dogs assaulting them off the premises of their owners, or chasing or worrying sheep. In Massachusetts, where sheep husbandry of a high order is on the increase, stringent and effective laws have been passed. The following is a synopsis of the last law:

An Act concerning dogs and for the protection of sheep and other domestic animals:

Sec. 1. Every owner or keeper of a dog shall annually, on or before the thirtieth day of April, cause it to be registered, numbered, described, and licensed for one year from the first day of the ensuing May, in the office of the clerk of the city or town wherein he resides, and shall cause it to wear around its neck a collar distinctly marked with its owner's name, and the registered number, and shall pay for such license two dollars for a male dog and five dollars for a female dog.

Sections second, third, and fourth provide for licensing and the payment of money into the treasuries:

Sec. 5. Whoever keeps a dog contrary to the provisions of this act shall forfeit fifteen dollars, to be recovered by complaint, and the money shall be paid to the treasurer of the county in which the dog is kept, etc.

Sec. 6. The assessors of the cities and towns shall annually take a list of all dogs owned or kept in their respective cities and towns on the first day of May, with the owners' or keepers' names, and return the same to the city or town clerk on or before the tenth day of July. Any owner or keeper of a dog who shall refuse to give just and true answers to the assessors relative to the ownership thereof shall be punished by a fine of not less than ten dollars.

Sec. 7. Mayors of cities and the chairman of the selectmen of the towns shall annually, within ten days from the first day of July, issue a warrant to one or more police officers or constables, directing them to proceed forthwith either to kill or cause to be killed all dogs within their respective cities or towns not licensed and collared according to the provisions of this act; and any person may, and every police officer and constable shall, kill, or cause to be killed, all such dogs, whenever and wherever found. Such officers, other than those employed under regular pay, shall receive one dollar for each dog so destroyed from the treasurers of their respective counties, etc.

Sec. 8. The mayors of cities and the chairman of the selectmen of towns shall, after issuing their warrant to police officers or constables, as specified in the preceding section, forthwith certify the fact under oath to the district attorneys of their respective districts, whose duty it shall be to prosecute all such officers as fail to comply with this requirement.

Sec. 9. Whoever suffers loss by the worrying, maiming, or killing of his sheep, lambs, or other domestic animals by dogs, may inform the mayor of the city, or the chairman of the selectmen of the town wherein the damage was done, who shall appoint two disinterested persons, who, with the mayor or chairman of the selectmen, shall proceed to the premises where the damage was done, and determine whether the damage was inflicted by dogs, and if so, appraise said damage. The amount of said damage shall be certified by the board of appraisers, and, except in the county of Suffolk, be transmitted to the county commissioners, who shall during the month of December examine all such bills, and, when any doubt exists, may summon the appraisers, and make such examination as they may think proper and shall issue an order upon the treasurer of the county in which the damage was done for all or any part thereof, as justice and equity may require. The treasurer shall annually, on the first day of January, pay all such orders in full, if the gross amount received by him under the provisions of this act, and not previously paid out, is sufficient therefor; otherwise, he shall divide such amount *pro rata* among such orders in full discharge thereof. The board of appraisers shall receive from the county, or in the county of Suffolk from the city or town treasurer, out of the moneys received under the provisions of this act, the sum of one dollar each for every examination made by them as prescribed in this section.

Sec. 10. Any town, city, or county officer refusing or neglecting to perform the duties herein imposed upon him, shall be punished by a fine not exceeding one hundred dollars, to be paid, except in the county of Suffolk, into the county treasury.

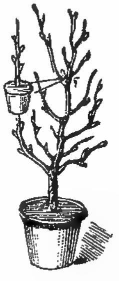
Sec. 11. The treasurer of any county may, in an action of tort against the owner or keeper of any dog concerned in doing damage to sheep, lambs, or other domestic animals in said county, which damage has been ordered to be paid by the county commissioners, recover the full amount thereof to the use of said county. If the amount so recovered exceeds the amount, so received by the owner of the sheep or other animals, under the provisions of section nine, the excess shall be paid by the county treasurer to such owner. All fines and penalties provided in this act may be recovered on complaint before any police court or trial justice in the county where the offence is committed. Moneys received by the treasurer of any county, city, or town, under the provisions of this act, and not expended in accordance with its provisions, may be applied to the payment of any county, city, or town expenses.

In Rhode Island, by the law of 1860, a dog might be killed with impunity if found without a collar bearing his owner's initials, or worrying or wounding sheep or other stock out of the enclosure of his owner. Any person might make oath to any case of injury, or to the special ill-fame of any particular whelp, and if the allegation was sustained, the dog must be confined, or the life of the animal was forfeited. An additional law has just been passed, which requires dogs to be collared, registered, numbered, described, and licensed, with the payment of $1.15 for each male and $5.15 for each female dog, before the last day of April, and one dollar additional for each dog after that date, and previous to the first of June. It provides for the appointment of suitable persons to make a list of the owners or keepers of dogs, to be returned to the clerk previous to the first of May, who is required to furnish to such persons a list of all dogs licensed for the current year, and to make another list of those not licensed, with the name of the owner or keeper, to be suitably posted or advertised. Any one keeping a dog contrary to these provisions is liable to a fine of ten dollars; and persons appointed to make the lists are required to make complaint and prosecute delinquents prior to the first of July. Such persons and constables and police officers are required to kill and bury all unlicensed dogs, and any person may lawfully do so, and for such service the sum of one dollar shall be paid. Removal of a collar is punishable by fine not exceeding fifty dollars. Damages to sheep are recoverable upon proof made within thirty days from the town or city treasury on the first day of June, or a *pro rata* proportion of them if the tax fund is insufficient for payment in full; and the city or town may then recover from the owner of the dog doing the mischief. By the law of Connecticut for the protection of sheep—that of July, 1863—the tax upon male dogs is one dollar each, females two dollars. The selectmen are authorized to collect of negligent collectors the taxes unpaid, as in the case of other arrearages due from collectors; and they are not empowered to abate such tax unless upon satisfactory proof that the dog is dead. The selectmen are also empowered to institute suit against the owners of dogs for the amount of damage for sheep maimed or killed; and if the owner resides in another town, the suit may be brought against that town. The provisions of the former law, yet partially in force, require the registry of all dogs over three months old, and sanction the killing of all not registered, and persons neglecting or refusing to register are liable to a fine of three dollars each. Dogs of known bad character shall be killed, although registered; and it is lawful to kill any dog taken in the act of worrying sheep. The laws of New York upon this subject, as amended by that of 1862, impose a tax of fifty cents for the first dog, $2 for each additional; $3 for the first female dog, and $5 for each additional. The assessors are required to annex to the assessment roll the names of persons liable, and supervisors must return them, when, if failure in paying the tax occurs, it becomes the duty of the collector, and the privilege of any other man, to kill the dog. The collector has a commission of ten per cent. on fines, and one dollar for each dog killed. The previous enactment provided that the owner of dogs killing sheep should be liable for injuries perpetrated; and in case the owner should not be found, the loss should be paid out of the fund arising from the dog tax. By the laws of New Jersey dogs are taxed from fifty cents to one dollar each. Persons may lawfully kill a dog found worrying or wounding sheep: damages sustained by such depredations are collectible from the township committee, if the fund arising from such tax is sufficient. If the owner of a dog committing depredations shall neglect for twenty-four hours after notification to kill the animal, he shall forfeit ten dollars and costs to any person suing, and triple damages to the owner of the stock injured or killed. A provision is made for the assessment of damages sustained, to be certified by two disinterested freeholders, the amount not to exceed five dollars for each sheep or lamb killed. Some counties have had special enactments allowing full damages to be paid. By the provisions of a more recent act actual damages sustained by any person are estimated by appraisement by two disinterested freeholders, the oath of the owner being also required as to real cost and value, the township where the injury was committed paying the owner, and the amount annually ascertained being laid upon the owners of dogs as a dog tax. No effective law is in existence in Pennsylvania for the protection of sheep. The owner of a dog, knowing that he has worried or killed sheep, and failing to kill him after such knowledge, is liable for all damages done by him thereafter. A dog may destroy a flock of sheep, without danger to himself or loss to his master, until he has offended a second time. If he kills a second flock, and his owner conveniently ignores the fact of the former offense, he may await, with the wool yet in his teeth, for an opportunity to return again and kill. Delaware legislation, relative to protection of sheep, was initiated early in that State. A law of 1811 made the owners of dogs liable to the value of all sheep killed by them; that of 1820 forfeited the lives of dogs at large, without collars on their necks. By the law of 1811 the tax was from twenty-five to fifty cents for the support of the poor; by that of 1817 it was from fifty cents to $3 for a fund to pay for sheep killed by dogs; by that of 1839 from fifty cents to $1 for county purposes; by that of 1843 one dog was exempt, others $1 each for county purposes; by that of 1853 from $1 to $2 for a fund to pay for sheep killed by dogs. These are repealed, their principal provisions being incorporated in the following laws: The owner or possessor of a dog which shall kill, wound, or worry a sheep, or lamb, shall be liable to pay the owner of such sheep, or lamb, the full value thereof, and it shall be lawful for any person to kill such dog. It shall be lawful for any person to kill any dog running at large in Newcastle county, beyond the owner's premises, without a collar upon his neck with the owner's name upon it. The law of 1832 requires an assessment list, of persons owning dogs, to be returned to the levy court. The tax is placed at fifty cents for each male and $1 for each additional dog, and $2 for each female dog, which shall procure the fund from which damages shall be paid, not to exceed $3 for each lamb and $5 for each sheep injured or killed, the remainder, if any, to go into the school fund. A dog not on the assessment list, which may be wandering or caught worrying sheep, may be killed. Persons paying taxes upon dogs are deemed to have property therein, and may recover damages for theft of or injury to such dogs. In Maryland the owner of a dog proved guilty of killing or injuring sheep, is required, upon complaint and exhibition of proof, to kill such dog, in default of which the owner of the sheep may kill him off the premises of his owner, or require a constable to do so, wherever found. If the dog shall be killed immediately by his owner, the owner of the sheep injured can have no cause of action; if not thus killed, his owner is liable for double damages, with costs, recoverable by an action of debt. Several laws have been enacted in Ohio to restrain dogs, none of which have been very stringent or effective, or generally executed. One was passed by the general assembly in 1863, declaring it unlawful for any dog to run at large off the premises of the owner in the night season, between the hours of seven o'clock in the evening and six o'clock in the morning, unless accompanied by the person owning or harboring the animal; and the owner or keeper is required to keep the dog upon his premises between those hours. It is of so negative and incomplete a character as to be practically worthless. The only real protection of an Ohio flock is a well loaded gun in the hands of its owner. In Indiana a license is required, at fifty cents for the first male dog, one dollar for each additional dog, and one dollar in every case for a female dog. All unlicensed dogs are declared nuisances that may lawfully be killed. Accruing funds are set apart for the payment of damages suffered from injuries to sheep in the several townships. The sufferer has his option of the following remedies: Within ten days after having knowledge of such depredations, he may substantiate it to the satisfaction of the township trustee, and draw the amount at the end of the current year, or a *pro rata* proportion if the fund is deficient; or he may recover by suit full damages from the owner of the dog. A fine of from five to fifty dollars and liability to damages, recoverable by the owner, are the penalties for killing licensed dogs that maintain a fair canine character. The Secretary of the Board of Agriculture reports that the law is so defective that it virtually amounts to nothing. In Michigan a law approved March 29, 1850, authorizes the destruction of dogs attacking any kind of domestic animals, except on the premises of the owner of the dog, and such owner is liable for double the amount of damages done by the dog. When notified of such damage, neglect of the owner to kill the dog is punishable by a fine of $3, and $1.50 additional for every forty-eight hours thereafter, until such dog shall be killed. Supervisors, upon complaint of a citizen, verified by his oath, are required to prosecute and recover the fines imposed by this act. An act was passed March 20, 1863, requiring township assessors to ascertain the number of dogs liable to be taxed, and the names of their owners; and if such owners refuse for ten days after demand to pay the taxes assessed, it becomes lawful to kill the dogs so taxed. By the law of 1860, dogs in Wisconsin are required to be numbered, collared, registered and licensed on payment of one dollar for males and three dollars for females; and police officers, constables, and marshals are required to kill and bury all unregistered dogs, and to receive twenty-five cents for such service. A person may be fined fifty dollars for removing a collar. Persons suffering loss from dogs are paid full damages at the first of April, if the tax fund is sufficient; if not, *pro rata;* and the owner of the dog is liable to the town for the full amount. The fine for keeping unregistered dogs is five dollars. Officers neglecting, or refusing to obey the law, are fined $20 for every twenty-four hours of such neglect. Towns may increase the license not more than one dollar, and the penalty not more than ten. The following is an epitome of the law of Minnesota, of March, 1863, which repeals previous enactments on the subject: Every owner or keeper of a dog shall cause such dog to be registered, numbered, described, and licensed, paying one dollar for each male and two dollars for each female. The township or city clerk shall conspicuously post a list of all licensed dogs, and furnish one to constables and chief of police. Failure to license shall make one liable to a penalty of ten dollars. Stealing or poisoning a dog is punishable by fine not exceeding fifty dollars, and killing subjects to liability for damages double the value of the dog Constables and police officers shall and any person may, kill any unlicensed dog; any one may also kill a dog assaulting him, or worrying sheep out of the enclosure of his owner. Within thirty days after suffering injury or loss of sheep by dogs, proof of damages may be presented to the county auditor, who may draw an order upon the treasurer, payable from the fund accruing from taxes of dogs, when the city or town may sue and recover full damages from the owner of the dog. It is made the duty of the mayor and aldermen of cities, and the supervisors of towns, to require the destruction of unlicensed dogs, and officers refusing or neglecting to perform these duties are liable to a fine of twenty-five dollars for the benefit of schools. All of these penalties may be recovered, on complaint by any householder, before any justice of the peace of the county. Money remaining after the yearly payments from the tax fund is turned over to the school fund. A law was passed in 1862 by the Iowa legislature for the protection of sheep against the ravages of dogs. At the following session, called with reference to legislation in the interest of the soldiers, the law was repealed. We have given considerable space to the summary of the dog laws, for the reason that they interest many—those who keep animals subject to be worried, and those who keep dogs. From these, communities will easily understand the laws necessary to be enacted in the special cases that may occcur in each State. The laws concerning manures (commercial) are constantly varying in those States where the sale is an important industry. No commercial manures should be bought, except accompanied with an analysis, and from parties of known business probity. (See Manures.) The fence and stock laws are contained in the article Fencing, which see. The laws in relation to Forestry by the general Government grants eighty or 160 acres to the settler who plants and cultivates a certain area in forest. Individual States have done something to encourage tree planting through the remission of taxes. Horticultural Societies and State Boards of Agriculture have offered premiums, and have discussed the benefits of tree planting. Thus inducing the prosecution of this necessary and important work. So far as the laws of Congress are concerned the new settlers who have planted groves have been illy able to incur the labor of tree planting, as necessary as this work is, for the land that from one to three hundred dollars would have bought. Speculators, first incited the laws that they might reap the benefits, in having groves adjacent to the lands which they were holding until the new settlers had made them valuable by demonstrating the adaptability of the soil to cultivation. These laws have been several times amended until now the settler acquires title to 160 acres of Government land if he shall plant and keep in cultivation ten acres of the same for five years. In relation to taxation for road purposes in Iowa, it is as follows: The Board of Supervisors has the general supervision of roads in the county, with power to establish or change them as provided by law. The town trustees levy a road tax each year of not less than one mill nor more than three on the dollar of the taxable property in each road district. A road supervisor is elected in each district, who has the supervision of the roads in his district, and it is his duty to keep these roads in as good repair as he can with the funds at his disposal; it is also his duty to require each able-bodied man between twenty-one and fifty years of age to perform two days' labor on the roads, between April and August of each year, himself or by proxy. There is great similarity in the systems of taxation, it being generally a poll tax in labor, varying in the different States from one day to five per annum; and in some portions of the country a money tax, varying from one mill to two cents on the one hundred dollars; and in others a tax for bridge purposes alone, as high as four cents on the one hundred dollars of taxable property. Owing to the abundance and excellence of material in some regions, and the scarcity and inferiority of it in others, there is a difference of at least tenfold in the cost of construction and maintenance of good roads. Good ones are the exceptions in all the States. In a majority of the States there are general stock laws prohibiting cattle and other stock from running at large; in some instances, however, authority is delegated to counties or towns to make by-laws upon the subject, or there is special legislation for particular counties or districts. The law of estrays differs in the various States in no essential particulars. If an animal is found running at large, in violation of law, it may be taken up and impounded, where public pounds have been provided; or it may be held by the person so taking up, on his own premises. If the owner is known, notice must be given him at once; if unknown, the animal must be advertised for a specified time; and no owner making claim, it must be sold to the highest bidder. The person taking up the estray is entitled to a reasonable compensation for maintaining the beast. In some States, after a certain time, the estray becomes the property of the person taking it up, the prescribed legal notice having been given. When an animal is found doing damage on the land of another, the fences being constructed according to law, it may be held as security for damages. In all cases where the owner is known, he must be notified of the facts, and a reasonable time allowed him to reclaim and to inspect damages. In the majority of the States, also, owners of stock are required to adopt certain ear marks, marks, or brands, and to make a record of them. A glance at some of the principal features of the laws relating to stock in the several States will show the importance attached to the subject, and may prove suggestive to communities where legislation is defective. In Maine and New Hampshire, towns may make by-laws concerning the running of animals at large. The laws of Maine provide that persons injured by beasts may sue for damages, and distrain the animal. New Hampshire allows the owner of stock impounded for doing damage, four days to respond to notice of the fact; and if he fails to answer, the animals may be sold and the amount of the damage be deducted from the proceeds. In Vermont, twenty days are allowed for redemption. Ungelded animals are not allowed to run at large Rams must be restrained from August 1st, to December 1st, and be marked with the initials of the owner's name; and if found at large, a forfeit of five dollars is due for each one taken up, to the person so taking up. The owner of such animals is responsible for all damage done by them. Sheep infected with foot-rot or scab, must be diligently restrained, and for all damages resulting from neglect of this provision the owner is responsible, and is also subject to a fine of ten dollars. Any person finding such diseased animals at large, may take them as forfeit, and no action at law, or in equity will lie for their recovery. Any person who shall drive, or in any manner bring, into the State any neat cattle, knowing them, or any of them, to have the pleuro-pneumonia, or of having been exposed to that disease, is liable to a forfeit of a sum not over five hundred dollars, or to imprisonment in a county jail for not more than twelve months, nor less than one month. Towns may establish regulations, appoint officers or agents, and raise and appropriate money for the purpose of preventing and arresting the spread of pleuro-pneumonia. The laws of Massachusetts provide that when a person is injured in his crops or other property by sheep, swine, horses, mules, or neat cattle, he may recover damages in an action of tort, against the owner of the beasts, or by distraining the beasts doing the damage; but if it be found that the beasts were lawfully on the adjoining lands, and escaped therefrom in consequence of the neglect of the person who suffered the damage to maintain his part of the division fence, the owner of the beasts shall not be liable for such damages. The selectmen of towns and the mayor and aldermen of cities, in case of the existence of pleuro-pneumonia or any other contagious disease among cattle, shall cause the infected animals or those exposed to infection to be secured in some suitable place or places, and kept isolated, the expense of keeping to be paid, one-fifth by city or town, and four-fifths by the State. They may prohibit the departure of cattle from any enclosure, or exclude them therefrom; may make rules in writing to regulate or prohibit the passage of any neat cattle to, or through their respective cities or towns, or from place to place and arrest and detain them at the cost of the owners. They are authorized to brand infected animals or those exposed to infection, with the letter P on the rump. For selling an animal so branded, there is liability to fine not exceeding $500, or imprisonment not exceeding one year. Notice of any suspicion of the existence of contagious disease must be given, with a penalty for neglect or refusal. A board of commissioners is appointed for the State, with authority to use any measure to control the introduction of diseased cattle into the State, or the spread of the disease. The rules and regulations made by this board supersede those of the selectmen of towns, and mayor and aldermen of cities. The moving of cattle into other States without permission is prohibited. The law of 1867 provides that no cattle diseased, or suspected of being diseased, shall be killed, except by order of the governor. The owners of cattle ordered to be killed are indemnified. In Rhode Island, animals trespassing on lands are held a year and a day; and if a horse, must have a withe kept about his neck during that time. Each town is required to erect and maintain at its own charge one or more public pounds, and it is lawful for any freeholder or qualified elector or field driver, and it is made the duty of every surveyor of highways, to take up and impound any horse, neat cattle, sheep, or hogs found at large on any highway or common. Provisions of the act extend also to goats and geese. In 1860, in view of the dangerous disease which had become prevalent in other States, the general assembly enacted that neat cattle might only be brought into the State from places west of the Connecticut river, upon thoroughfares leading into the western and the southern portions of the State, under regulations established by a board of commissioners, until they should prohibit importations from any of said places. For a violation of the provisions of the act, a penalty was provided, not exceeding $300 for each offense and liability to indictment, and, on conviction, imprisonment not exceeding one year. In case of the introduction of a number of diseased cattle at the same time, the introduction of each animal is to be deemed a separate and distinct offense. Town councils are empowered to take all necessary measures to prevent the breaking out or spreading of any infectious diseases among the neat cattle in their respective towns, and to prescribe penalties in money, not exceeding $500. A board of commissioners is provided for, to be appointed by the governor, consisting of one person from each county, to see that the law is faithfully executed. It is made the especial duty of the board to endeavor to obtain full information in relation to the diseases known as pleuro-pneumonia, and to publish and circulate the same, at their discretion; and in case the disease should break out, or there should be a reasonable suspicion of its existence in any town, they are required to examine the several cases and publish the result of their examination, in order that the public may have correct information. If satisfied of its existence in any town, they must give public notice of the fact in printed handbills, posted up; and, thereafter, any incorporated company or person who may drive, carry, or transport any neat cattle out of the town into any other town in the State, is liable to the penalties above stated. Any person who sells or offers to sell any cattle known to be infected with pleuro-pneumonia, or with any disease dangerous to public health, is liable to indictment, and, on conviction, to punishment by fine not exceeding $1,000, or imprisonment not exceeding two years. The act of March 26, 1864, provides that any person knowingly bringing into the State any neat cattle or other animals suffering from any infectious disease, or who knowingly exposes such cattle or other animal to other cattle and animals not infected with such disease, shall upon conviction, pay a fine of not less than $100, and not exceeding $500. The laws of Connecticut allow owners of sheep to keep flocks in common, and to make their own rules and regulations concerning their care and safety. No horses, asses, mules, neat cattle, sheep, swine, or geese are allowed to go at large in any highway or common, or to roam at large for the purpose of being kept or pastured on the highway or commons, either with or without a keeper. Any person may seize and take into his custody and possession any animal which may be trespassing upon his premises, provided the animal enter from the highway, or through a fence belonging to the owner of the animal, or through a lawful fence belonging to any other person. He must give immediate notice to the owner if known, and may demand for every horse, mule, ass, ox, cow, or calf, twenty-five cents; and for every sheep, goat, goose, or swine, ten cents; together with just damages for injuries occasioned by such animals, if applied for within twenty-four hours after such notice shall have been given. If the owner is not known, the animal shall be sold by the town clerk, after due public notice. The cattle laws of New York allow any person to seize and take into his custody any animal which may be in any public highway, and opposite to land owned or occupied by him, or which may be trespassing upon his premises. Notice must be given to a justice of the peace, or a commissioner of highways of the town in which the seizure has been made, who shall post up notices in six public places that the animal will be sold in not less than fifteen nor more than thirty days. The surplus money, after payment of all charges is subject to the order of the owner for one year. The owner, before sale, may pay all charges and take the animal. If the animal has been trespassing by the willful act of another than the owner to effect that object, the owner is entitled to the animal upon making demand, after paying the compensation fixed by the justice or commissioner, but no other costs; and the person committing such willful act will be held liable to a penalty of twenty dollars. In New Jersey town committees, upon notice of the existence of any disease supposed to be contagious, are required personally to examine the cause, and if the symptoms which characterize contagious diseases are exhibited, shall cause such animals to be removed and kept separate and apart from other cattle and stock, five hundred feet distant from any highway, and the same distance from any and all neighbors. If any die of the disease, or are killed, they must be buried immediately, five hundred feet distant etc., as above. No cattle that have been sick, and have recovered from any supposed contagious or infectious disease, shall mix with other cattle, or be removed, unless permission has been given by the town committee. Any person knowingly storing a hide, or any other portion of a diseased animal, is subject to a fine. The town committee are authorized to prohibit the importation or passage of cattle from other places into or through their respective towns. After notice of prohibition, owners are liable to a fine of $100 for every animal driven into a township. A fine of $100 is imposed for every animal sold and known to be diseased. The act of 1866 authorizes the Agricultural Society of the State to take measures for preventing the introduction or increase of rinderpest, and any other disease among cattle, at their discretion. And also animals affected with glanders are authorized to be killed. Cattle must not be marked by cropping both ears; nor must either ear be cropped more than one inch. The running of cattle at large is controlled in Pennsylvania by towns and counties, through special legislation. The sale of cattle or sheep affected with pleuro-pneumonia, or any other contagious or infectious disease, is punished by a fine not exceeding $500, or imprisonment not exceeding six months. Animals must not be sold alive from, or slaughtered on, premises where disease is known to exist, nor for a period of two months after disease shall have disappeared from the premises. Cattle and sheep are not allowed to run at large where any contagious disease prevails. Constables of townships are required to take up and confine any animals so found, until all costs are paid. In Delaware, by act of general assembly, cattle are forbidden to run at large in certain districts. Stallions over eighteen months old are not permitted to be at large. The laws of Maryland provide that any person aggrieved by trespass upon his premises of any cattle, hogs, or sheep in the possession or care of a non-resident, may impound them, and have the damages sustained by the trespass, valued on oath by two disinterested citizens of his county, and the animals may be sold for the damages and costs. The laws of Virginia provide that if any horses, cattle, hogs, sheep, or goats enter into any grounds inclosed by a lawful fence, the owner or manager shall be liable to the owner of the ground for all damages; and for every succeeding trespass by such animals, the owner shall be liable for double damages; and, after having given at least five days' notice to the owner of the animals of the fact of two previous trespasses, the aggrieved party shall be entitled to the animals if again found trespassing on the same lands. Horses diseased and unaltered, are not allowed to be at large. Every person shall so restrain his distempered cattle, or such as are under his care, that they may not go at large off the land to which they belong; and no person shall drive any distempered cattle into or through the State, or from one part of it to another, unless it be to remove them from one piece of ground to another of the same owner; and when any such cattle die, the owner thereof, or person having them in charge, shall cause them to be buried (with their hides on) four feet deep. Any justice, upon proof before him that any cattle are going at large, or are driven in or through his county or corporation, in violation of law, may direct the owner to impound them; and if he fail to do so, or suffer them to escape before obtaining a certificate that they may be removed with safety, they shall, by order of the justice, be killed and buried four feet deep, with their hides on, but so cut that no one may be tempted to dig them up. For the protection of sheep special laws have been passed taxing dogs in certain 'counties, and for their restraint in those counties. In North Carolina, if cattle are driven from one part of the State to another, they must be certified to be healthy, sound, and free from any infectious distemper; the granting of such certificate by any justice, without affidavit, is a misdemeanor in office. Stallions and mules over two years old are not allowed to go at large, under a penalty of twenty dollars. Damages for injury done by trespassing animals are recoverable as in other States. In South Carolina horses, cattle, hogs, sheep, or goats breaking into any field having a crop of any kind growing or ungathered, with a lawful fence, may be seized and kept confined until notice is given to the owner, within twenty-four hours of the seizure, who shall be bound to pay the owner of such field fifty cents a head for each horse or mule, and twenty five cents for every head of cattle, hogs, etc., before he is entitled to have the animal delivered up to him. For the second breaking, within one month after the first, the owner is liable to the person injured for all damages sustained, in addition to the fine. Full satisfaction lies for injuring any animal found in any field where the fence is not a lawful one. In the State of Georgia, if any trespass or damage is committed by stock on any lands not protected by lawful fences, the owner of the animal is not liable to answer for trespass; and if the owner of the premises should kill or injure the animal in any manner, he is liable in three times the damages. When fences are made pursuant to law, and any animal breaks in, the owner of the inclosure shall not kill or injure him for the first breaking, and not until after notice is given to the agent or owner, if possible, but the owner shall be liable for double the damage done by his stock. In Florida there can be no trespass or damage if the fence is not a lawful one; nor in such case can stakes, canes, or other devices to maim or kill cattle, sheep, swine, etc., be used, under a penalty of ten dollars for each offense, and full damages. Marks upon stock are required. Any person is allowed in Alabama to take up any horse, mare, jack, neat cattle, hog, or sheep found running at large, if the owner is unknown. If any stallion or jackass over two years of age, is found at large it must be taken before a justice, who shall cause it to be advertised. The taker up is entitled to five dollars from the owner, and reasonable compensation for keeping. If such stallion or jackass is not claimed within three months it may be gelded. The laws of Mississippi provide that every owner of cattle, horses, mules, hogs, sheep, or goats shall be liable for all injuries and trespasses committed by breaking into grounds inclosed by legal fence. If any person whose fence is not a lawful one, shall hurt, wound, lame, or kill, by shooting, or hunting with dogs, or otherwise, any cattle, etc., that may have broken into his inclosure, he shall pay the owner double damages. A ranger is elected in each county to attend specially to estrays, of which he is required to keep a record. When any person finds horses, mules, jacks, cattle, sheep, or hogs straying upon his land, he may take them up and forthwith send them to the owner, if known; if unknown, he must give notice to the ranger, or some justice of the peace. The owner of all estrays appraised at ten dollars and not exceeding twenty dollars, is allowed six months, and if less than ten dollars, three months, from the date of certificate of appraisement, to claim and prove his property. It is not lawful for any drover or other person to drive any horses, mules, cattle, hogs, or sheep of another from the range to which they belong; but it is made his duty if any such stock join his, to halt immediately at the nearest pen, or some other convenient place, and separate such stock as does not belong to him, or to the person by whom he may be employed. For neglect a forfeit of twenty dollars for every offense is provided, and liability to all damages. Any person may confine and geld any stallions that are above the age of two years, found running at large, at the risk of the owner, but this will not apply to stallions usually kept up, or to those which accidentally escape. Any animal addicted to fence breaking may be taken up by owner of land, who may recover seventy-five cents a day for keeping, provided owner has been notified, if known; but condition of fence may be shown in mitigation of damages. Double damages may be recovered for injury to animals where fence is not a lawful one. Defacing or altering marks of animals subjects to a penalty of imprisonment in the penitentiary for not more than three years, or fine of not more than $500, and imprisonment in county jail for not more than one year, or both. No neat cattle belonging to non-residents are allowed to be taken into Texas for grazing or herding purposes, under pain of forfeiture to the county into which they shall have been so taken. Severe penalties for altering the brands of animals are provided in that State. In Arkansas, if any horse, cattle, or other stock break into any inclosure, the fence being of the required height and sufficiency, the owner of the animal shall, for the first offense make reparation for true damages; for the second offense, double damages; and for the third the party injured may kill the trespassing beasts, without being answerable. If any stallion or jack over two years old is found running at large, the owner may be fined two dollars for the first offense, and ten dollars for each subsequent offense, and is liable for all damages that may be sustained. Any person may take up such animal, and, if not claimed within two days, may castrate, and recover three dollars for doing so; but the life of the animal must not be endangered. If any such animal can not be taken up, he may be killed, if notice be first put up at the court-house, and at three other of the most public places in the county for ten days, accurately describing the animals. In Tennessee stallions and jackasses over fifteen months old are not allowed to run at large under penalty to the owner of not less than five dollars or more than twenty-five dollars. The animal may be taken before the nearest justice of the peace who shall give public notice. If not claimed within three months the animal may be gelded at the risk and expense of the owner. The party taking him up is entitled to five dollars and reasonable expenses for keeping. There is no law in force in West Virginia to prevent cattle from running at large; but if they break into an inclosure and destroy any grain or crops, the owner is liable; provided the fence is a lawful one. A law exists to prevent diseased sheep from traveling on the highway. In Kentucky, breachy and mischievous bulls may be taken up and altered; a jack or stallion may be gelded if found at large, allowing the owner, if known, at the rate of twenty-five miles a day to reach the place where the animal is held, and recover the animal; when the owner is not known, the animal is dealt with as an estray, and may be ordered by a justice to be gelded. If the owner of any distempered cattle permits them to run at large, or drives them through any part of the State, he is liable to a fine of ten dollars for each head; and if any die the owner must cause them to be buried, subject to a penalty of five dollars for neglect in each case. The State of Missouri has created a board of cattle inspectors to prevent the spread of the Texas or Spanish fever. The county court of each county is authorized to appoint three competent and discreet persons to act as a board for the inspection of cattle supposed to be distempered or affected with the disease known as the Texas or Spanish fever. They may stop any drove of cattle. If they adjudge cattle to be diseased or distempered, and in a condition to communicate any contagious or infectious disease, they are required to order the cattle to be removed from the county without delay, upon the same route upon which they came in, if practicable. If the owners comply with the order they will not be further liable; but if they, or the persons having the cattle in charge, willfully delay or neglect to do so, the president of the board will direct the sheriff to drive the cattle out by the route they came in, or to kill them, if the board think it necessary in order to prevent the spread of the disease. The parties owning, or in charge of the cattle ordered to be removed or killed are liable for all the costs that may accrue in case of examination, removal or killing. The act to prevent the introduction of diseased cattle into the State provides that no Texas, Mexican, or Indian cattle shall be driven or otherwise conveyed into any county in the State between the first day of March and the first day of December in each year, but this does not apply to any cattle which have been kept the entire previous winter in the State. Cattle may be carried through the State by railroad or steamboat, provided they are not unloaded, but the railroad company or owners of the steamboat are responsible for all damages which may result from the Spanish or Texas fever, should the same occur along the line of transportation; and the existence of such disease along the route shall be *prima facie* evidence that the disease has been communicated by such transportation. For every head of cattle brought into the State contrary to law a fine of twenty dollars may be recovered, or the party may be imprisoned in the county jail not less than three nor more than twelve months, or may be subjected to both fine and imprisonment, It is lawful for any three or more householders to stop any cattle which they may have good reason to believe are passing through any county in violation of the act. In Illinois the owner of animals breaking through a legal fence is liable to full damages for the first trespass, and to double damages for any subsequent trespass. Where the fence is insufficient, and the land-owner injures or destroys animals, he is answerable in damages. Stallions over one year old are not permitted to run at large; but if so found may be gelded, if the owner does not reclaim them, one day for every fifteen miles' distance of the animal from home being allowed, after notice. Diseased horses, mules, and asses must be kept within the owner's inclosure, under penalty of twenty dollars damages. Estray hogs must be sold from November 1st to March 1st. To convey any Texas or Cherokee cattle into the State between the first day of October and the first day of March renders the party so doing liable to a fine not exceeding $2,000 nor less than $500, and imprisonment at the discretion of the court. Any and all fines are paid into the county treasury, subject to the order of the board of supervisors, or county court, for the purpose of being divided *pro rata* among persons who may have suffered damage or loss on account of any such Texas or Cherokee cattle. All persons or corporations are liable to injured parties for any damage arising from the introduction, by any of them, of any diseased cattle. It is made the duty of any circuit or county judge, or justice of the peace, upon oath of any householder, setting forth that Texas or Cherokee cattle are spreading disease among the native cattle, to forthwith issue a warrant to any sheriff or constable of the county, commanding him to arrest and impound such cattle, and keep them by themselves until the first day of October following. Texas and Cherokee cattle are defined to mean a class or kind of cattle, without reference to the place from which they may have come In Indiana laws regulating the running at large of stock are local in their application, county boards designating what animals may or may not run at large. However, when any animal is found at large contrary to local law, and has been taken up, the owner may reclaim it within ten days, after which time the animal may be sold. It is unlawful in the State of Ohio for any one to sell, barter, or dispose of, or permit to run at large, any horse, cattle, sheep, or other domestic animal, knowing them to be infected with contagious or infectious disease, or to have them indirectly exposed thereto, unless he first duly informs the party to whom he may sell as to the facts. The fine for so doing is not less than $20 nor more than $200, with costs, or confinement in the county jail not more than thirty days. For allowing infected animals to come in contact with animals belonging to another, a fine is provided of not less than $50 nor more than $500, with cost of prosecution, or confinement in county jail not less than ten nor more than fifty days. If any horse, mule, ass, or any neat cattle, hogs, sheep, or goats, running at large, break into or enter an inclosure other than inclosures of railroads, the owner is liable for all damages, and the animal so breaking into or entering an inclosure is not exempted from execution issued on any judgment or decree rendered by any court. For allowing any such animals to run at large in any public highway or upon any uninclosed land, or for herding any of them for the purpose of grazing on premises other than those owned or occupied by the owner or keeper of the animals, the party offending is liable, for every violation, to a fine of not less than $1 nor more than $5. But a general permission may be granted by the commissioners of any county for certain animals to run at large, and in counties where there is no such general permission, township trustees may grant special permits, such general and special permits terminating on the first Monday of March of each year; and special permits are revokable at the discretion of the trustees, upon three days' notice in writing to the owner of animals. Special permits must be directed to individuals, and for particular animals described therein. The owner of trespassing animals is liable for all damages upon premises of another without reference to the fence which may inclose the premises. Any person may take up and confine an animal found at large contrary to law, and the owner may reclaim the same within ten days. The fees are as follows: For taking up and advertising each horse or mule, $1; neat cattle, seventy-five cents each; swine, fifty cents each; sheep or geese, twenty-five cents each; and reasonable pay for keeping the same. It is unlawful for the owner or keepers of any animals knowingly to permit them to enter the inclosure of any railroad, or, having entered, to remain therein; or to lead or drive any such animals within the inclosure, or along or upon the track of any railroad, at any other place than the regular street or road crossing, or farm crossing or way. In Michigan it is not lawful for any cattle, horses, sheep, or swine to run at large on the highway, except in those counties or parts of counties where it shall be otherwise determined by the board of supervisors in such county. Where the law is in force, any person may seize and hold in his possession any animal found running at large, and give notice to a justice of the peace or a commissioner of highways, who is required to post up notices describing the animal. The animal must be sold at public outcry in not less than thirty nor more than sixty days after date of notice; but the owner may redeem the animal by paying costs and compensation for keeping—redemption to be made within one year. An animal found trespassing by the willful act of another, may be taken by the owner on demand, after paying reasonable compensation, but the person committing the act is liable to a fine of $20. Any person taking up a beast going at large contrary to law, or contrary to any by-law of a township, is entitled to fifty cents per head for all horses, mules, asses, and neat cattle, and ten cents per head for all sheep, goats, and swine. When any person is injured in his land by animals, he may recover damages in an action for trespass against the owner of the beasts, or by distraining the beasts doing damage, unless the animal shall have been lawfully on adjoining lands, and shall have escaped therefrom in consequence of the neglect of the person who has suffered the damage, to maintain his part of the division fence. The laws of Wisconsin permit towns to make regulations concerning the running of animals at large. The owner or occupant of lands may distrain all beasts doing damage within his inclosure, and when any distress shall be made, the person distraining is required to keep such beasts in some place other than the public pound until his damages are appraised; and within twenty-four hours he shall apply to a justice of the peace, who shall appoint three disinterested free-holders to appraise the damage sustained. If within twenty-four hours after appraisement the damages are not paid, the animals may be placed in the public pound, to be there maintained until the amount of damages and costs is recovered by due process of law. If the owner of any sheep infected with contagious disease, permits any of them to go at large out of his own inclosure at any season of the year, he shall forfeit the sum of $5 for each and every such sheep, to the person who may enter complaint, for each time they are so found running at large. If the owner neglects to restrain such sheep, any person is authorized to take them up and put them in some safe place other than the public pound. Rams are not permitted to go at large between July 15th and December 1st, and the owner forfeits $10 to the person taking up the animal for each time so found abroad. The electors of each town in the State of Minnesota have power at their annual meetings to determine the number of pound masters, and the location of pounds, and regulations for impounding animals, and to fix the time and manner in which cattle, mules, asses, and sheep may be permitted to go at large, provided that no cattle, horses, mules, nor asses be allowed to go at large between the 15th of October and the 1st of April. The owner or occupant of lands may distrain all beasts doing damage upon his lands during the night-time, from eight o'clock in the evening until sunrise; and when any such distress is made the distrainer shall keep such beasts in some secure place other than the public pound, until his damages are appraised, unless the same is made on Sunday, in which case, before the next Tuesday morning thereafter he shall apply to a justice of the peace of the town, who shall appoint three disinterested persons to appraise damages. No damage can be recovered by the owner of any lands for damage committed by any beasts during the day-time, until it is first proved that the lands were inclosed by a lawful fence. Distress may be made at any time before the beasts doing damage escape from the lands, and without regard to the sufficiency of fences. The owner of any horse or other animal, having the disease known as the glanders, who knowingly permits such animal to run at large, or be driven upon any of the highways of the State, or any hotel keeper, or keeper of any public barn, who permits any animal having such disease to be stabled, such person shall be deemed guilty of a misdemeanor, and upon conviction before any justice of the peace, shall be punished by a fine of not more than $100 nor less than $25. In Iowa no stallion, jack, bull, boar, or buck is permitted to run at large. Persons aggrieved are allowed to distrain any such animals, and compel the owner to pay damages. If the animal is not redeemed within seven days, seven days' notice of its sale at public auction must be given, the proceeds to apply on damages after deducting costs. If any domestic animal, lawfully on adjoining land, escapes therefrom in consequence of the neglect of the person suffering the damage to maintain his part of the division fence, the owner of the animal is not liable for any damages. If beasts are not lawfully upon the adjoining land, and came upon it, or if they escaped therefrom into the injured inclosure, in consequence of the neglect of the adjoining owner to maintain a partition fence or any part of one, which it was his duty to maintain, then the owner of the adjoining land shall be liable as well as the owner of beasts. Fence viewers appraise all damages. An act of April 8, 1868, forbids any one to bring into the State, or to have in possession, any Texas, Cherokee, or Indian cattle. Transportation on railroads through the State is not forbidden, nor the driving through any part of the State of such Texas or southern cattle as have been wintered at least one winter north of the southern boundary of the State of Missouri or Kansas. The penalty of violation is a fine not exceeding $1,000, or imprisonment in county jail at the discretion of the court, not to exceed six months, together with all damages that may accrue by reason of such violation of the law. Any one driving or importing diseased sheep into the State, knowing the disease to be contagious, is deemed guilty of misdemeanor, and is punishable by fine of not less than $50 nor more than $100. The same fine is imposed upon any person who may turn out of his inclosure, or sell sheep, knowing them to be diseased. In Kansas, when a majority of the electors in any township petition county commissioners for orders to confine animals during the night-time, such orders shall be made and notice thereof given. The owner is liable for depredations of animals during the continuance of such orders, without regard to condition of fences. Persons damaged in their property have a lien upon the stock. If any stallion or jack over the age of two years is found at large, the owner, if known, must be notified of the fact; and if he fails or refuses to confine the animal he is liable to a fine of $5 for the first offense, and $10 for each subsequent offense, and all damages. Stallions and jacks, not used for breeding purposes, may be castrated by the person taking them up, if the owner fails, after three days' notice, to reclaim the same, and pay damages, or such animals may be killed after six days' notice. Any bull, boar, or stag found running at large may be taken up at any time or place. Electors of townships may decide whether swine may run at large or not, at least ten voters having petitioned for the submission of the question. No horse, mule, or ass diseased with glanders is allowed to be at large, under a penalty of not less than five dollars nor more than $100. Knowingly to import or drive into the State sheep affected with contagious disease is a misdemeanor, with a fine not to exceed $200. The same penalty is provided for any owner allowing such sheep to run at large, together with responsibility for damages to other owners. Rams must be restrained between June 15th and December 15th, under penalty of five dollars for each day allowed at large. Electors of townships determine whether or not sheep shall run at large. In February, 1867, a sanitary measure was passed for the protection of cattle from the ravages of the Spanish fever. Stock from Texas and the Indian Territory brought into the State between the first day of March and the first day of December in any year, are not to be driven through the State except in the remoter parts on the plains, and then not within five miles of any highway or ranch, except by consent of the owner of the latter. Violation of the law is treated as a misdemeanor, and the first offense is punishable by fine of $100 to $1,000, and imprisonment from thirty days to six months; for subsequent offenses the penalties are doubled. In Nebraska cattle and other stock are restrained in particular counties. The legislation concerning cattle etc., is also of a local character in the State of California. The laws of Oregon interdict the running at large of any stallion, jack, or mule, over eighteen months old, within the months of April, May, June, July, September, and October. If not kept for breeding purposes, the animal may be gelded. If kept for breeding purposes, the distrainer may return him to the owner, and recover two dollars. The owner of such an animal is liable for damages. Animals affected with contagious diseases must not be brought into the State under a penalty of not less than $50 nor more than $500 for the introduction of each animal so diseased.

LAWN. The lawns of England have been celebrated the world over for their verdancy, closeness of texture and general beauty. This is owing to four reasons: A most thorough preparation of the soil, the moist climate, thick sowing of grass seed, and frequent cutting with the lawn mower. In preparing for a lawn, the ground should be plowed deep and heavily manured, because deep tilth and decomposed manure are favorable to the retention of moisture. Thick seeding brings a close firm sward which keeps the ground shaded, frequent mowings, say once in two weeks keeps the sward dense, and prevents the roots from becoming long and straggling. They form a dense mat under the surface and prevent evaporation of moisture from the surface. Thus a closely mown lawn, acts as a constant mulch and the earth will be moister and cooler than on a surface wholly or partially exposed. The thermometer will quickly show this. The moist climate we have not got. Hence, during July and August, it is impossible to keep a lawn perfect in its greenness without a good soaking once a week. Hence, during this time it is not a bad plan to let the grass grow even to a height of ten or twelve inches. After the first heavy rain of the late summer cut the grass as closely as possible, and then go over it with the lawn mower and in three days it will again be perfect. In making a lawn, never use lawn grass mixtures. They are as high priced as they are generally worthless. The basis of a good lawn is in the preparation of the soil. Kentucky Blue grass, *poa pratensis*, Spear grass, *poa compressa*, Red top, *Agrostis vulgaris*, and White clover, *Trifolium repens*, should form the bulk of the grasses used. Rye grass, *Lolium perenne*, is sometimes used, but it does not stand close cutting. Timothy two pounds per acre is good in the formation of a lawn, since it acts as a kind of a nurse to the other grasses. The sowing of oats is often advised for the same purpose. Do not use it. It robs the young grass of nourishment, and is dead just at the time the grass wants the protection most. Timothy is not a good lawn grass, it is too coarse, but it may be easily killed by close cutting late in the summer, since it has a bulb just at the top of the ground, which if cut destroys the grass. Sow lawn grass in August. The following is a good mixture: Red-top, one bushel; Kentucky Blue grass, one bushel; Spear grass, one bushel; and two pounds White clover. Then sow two pounds flat turnip. Divide the grass seed into two parts, sow one-half one way and the other half the other way. This is sufficient for one acre. Finish with the turnip seed and you will not only have your seed sown evenly, but the turnip leaves will partially shade the land, and act as a mulch. Just before it freezes up cover with slough hay or other mulch to protect the grass from heaving the first winter; early the next spring rake off the mulch cleanly, sow two bushels salt per acre, roll as soon as the land is firm enough, and if you have prepared the whole as directed you will have a first class lawn. At any cost, the surface of the land must be perfectly smooth and level before sowing. This may generally be accomplished by means of a revolving or other harrow and a leveler, two or three hard wood scantling eight feet long, one side brought down to a sharp edge, the whole fastened together two feet apart, and drawn by means of a chain from each side ending in a toggle link. If the soil is clayey, plant it to some hoed crop, as potatoes, before making the lawn, and in this case leave it rough for the winter. Then when quite dry in the spring, level and sow. Thus you have that most beautiful of rural objects, a perfect lawn. The following are the general rules, by which a good lawn may be had and kept intact. To have a perfect lawn, says Mr. William Saunders, it is absolutely necessary to have it properly laid down at the outset. This, however, does not consist so much in enriching the soil as in rendering it friable and porous by draining, subsoiling and pulverizing. The main feature in keeping lawns is frequent mowing, and if this is neglected fine lawns can not be maintained. It will matter but little how much expense and skill may have been incurred in the preparation and seeding of the ground if it is allowed to grow at random afterwards, as the strongest foliaged grasses and clover will eventually supersede the finer kinds if the cutting is not regularly attended to. On the other hand, lawns that have been but indifferently prepared may be rendered close and regular by frequent mowing and judicious top-dressing. Early cutting prevents the growth of the coarser grasses and induces lateral growth on the finer, thus covering the surface with a dense foliage, which resists the effects of sun and long-continued dry weather. Every lawn of any pretensions should be kept smooth by a machine. Not only is it economical as regards labor, but it is scarcely practicable to keep it with a scythe so smooth, thick, and velvety as can be done with a good lawn-mower. Another advantage is that the grass is not removed, but falls down in a shower over the roots, forming a very efficient mulching and enabling us to impart to our pleasure grounds all the character of the finest lawns, an attainment that has hitherto been deemed beyond our ability to realize. When the grass becomes thin and of weakly growth a top-dressing of good stable manure should be laid over the surface in December. It is important that the manure should be well rotted before being used, and as occasion offers during winter it should be broken up and manipulated with an iron rake. The object in view is to distribute it evenly over the whole surface. Break it finely, so that it will settle down and nourish the grass roots. When spring opens, the rough, strawy portions, if any are left, should be removed; otherwise it would interfere with the proper keeping of the surface.

LAXATIVE. A gentle-purging medicine.

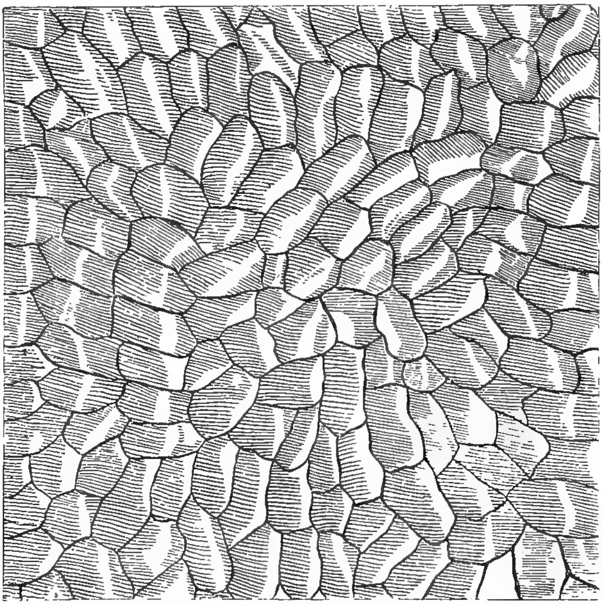
LAYERING. The laying down of a branch, and covering with earth, in order to induce the formation of roots is termed layering. It used to be extensively practiced with all that class of plants, as carnations, that were supposed not to strike readily from cuttings, and indeed they do not, except under special conditions. But modern scientific horticulture has demonstrated that any plant that will strike from layers will do so from cuttings. Layered plants are stronger however, than those from cuttings. Layering is still quite common with some varieties of grapes, as the Delaware, for instance, that is shy in striking. In the farm garden it is a simple and easy way of propagating, and is done as follows: The branch or shoot to be operated on is cut with a rather long gash, say one or two inches in length, according to size. A sliver of wood is thrust in to hold it apart. It is then bent down and laid in a trench so it may be covered two or three inches deep in moist earth, and firmly pegged in place. In the case of grape vines, the whole branch is covered, when it will generally form roots, and a separate plant at every joint. With carnations and that class of short stemmed plants, the cut portion is pegged down and covered, and the tip of the shoot left out. The following cut will explain the manner of rooting a branch without severing it from the plant. It has been in use for many years with pot plants, and is also useful with hard wooded plants. Select the shoot to be operated upon, pass a small pot carefully over the branch, cut diagonally half way through the branch, about midway of the pot, with a long cut, hold this slit open with a chip, and pack the earth firmly about the branch, fastening the pot so it will not move. The details for layering the grape will answer for all plants that can be layered out of doors. They are as follows: For the propagation of plants for removal, the vine dresser selects such parts of the branches as may suit his purpose when he is going over his vineyard at the season of winter pruning. These are left, instead of being cut off as in the regular trimming; and they must be so situated as to be easily bent down to the ground. After dressing the vineyard in the spring, these branches are either at once pegged down and buried in the soil, with the smaller twigs protruding, or shallow trenches are opened, into which the branch to be layered is simply pegged down, if it be a vigorous cane of the last year's growth. As the spring opens, the shoots must be then tied to a stake. As soon as the new wood at the lower joints begins to harden, mellow earth should be gradually drawn up to them, and they will immediately put forth a circle of roots from near their junction with the old shoot, which roots greatly aid their growth and relieve the mother vine. In the autumn, the layered branches may be taken up and divided, when every bud which has forced up a shoot will be found to have become a strong well-rooted plant; so that, in this way, a large increase may be made, and the roots, being in a circle, are well disposed for planting, and may be removed from the soil without injury. Layers should never be allowed to remain attached to the parent vine after the first season, as they are believed to be injurious. It will also be perceived that this sort of robbery of a plant will materially affect its bearing; so that, where cuttings grow readily, as is remarkably the case with the Catawba, Concord, etc., the plan is not generally pursued. With the Herbemont and the Schuylkill or Cape, which are difficult to grow from cuttings, and with new varieties which it is proposed to multiply, this plan is generally adopted. Some persons prefer layered plants to those grown from cuttings, on account of the arrangement of the roots. For home use, they are greatly to be preferred, because they may be brought into bearing much sooner than cuttings planted in the vineyard at the same time, and because a large number may be grown from the old vines.


POT LAYERING.

LEATHER WOOD. *Dirca palustris.* A small indigenous shrub with very flexible branches, and a tough, leathery bark.

LEAVEN. A piece of sour dough used to make other dough light; it is well kneaded into it, and produces fermentation, but inferior to yeast.

LEAVES. The leaves of plants act, in a sense, both as do the stomach and lungs of animals. They are the vital organs and may not be unduly taken away without serious injury to the plant, for just in proportion to the leaf surface so will be the roots. Hence the more leaf surface that is acquired by a newly transplanted tree, the more vigorous will be the root action, for root action can never become vigorous until leaf action is established. Many persons are in the habit of stripping the lower leaves of plants in the garden to feed to pigs and cows. Nothing could be more senseless, since it directly reacts upon the vigor of the plants. The leaves remaining when plants are mature, if suitable for the food of animals, as corn, beets, cabbage, etc., are of value, and the dried or dead leaves are valuable as manure. The leaves of forest trees are especially valuable for mulch, and as a separator for strong heating manure in making hot-beds, since they not only counteract violent fermentation, but cause the heat to be held for a long time through their slow decomposition. As mulch, leaves are cleanly, easily gathered and applied and keep the ground cool, and when decomposed are valuable through the humus, and potash they contain. Bagasse, the stalks of sugar cane after it is crushed, makes an excellent mulch in the South, and the bagasse of sorghum in the North.


STRUCTURE OF THE LEAF.

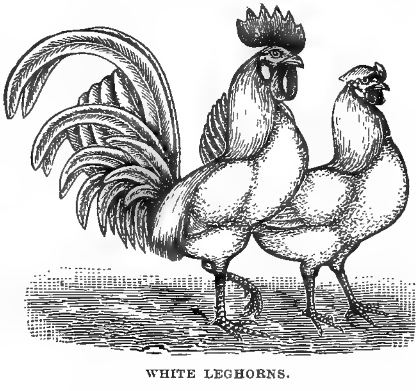
Potato and tomato stalks dry, make an admirable mulch for strawberries in the garden. Where forest leaves are plenty and bedding scarce, these should by all means be gathered in the autumn, and stored away dry for use. The structure of the leaf presents a curious and instructive study. A section of leaf properly prepared, and placed under a strong microscope, will show the breathing pores, numbering often over 60,000 to the square inch, the cellular structure, and the branching vascular bundles. Accompanying we present a section of leaf highly magnified, showing the cellular structure of the orange leaf. When viewed under a high power it becomes an object of much interest. The branching vascular bundles will be distinctly seen, resembling in some respects the arteries and veins of the human body. A careful examination will show that these are also covered with a very fine lace-work of cells under and over them, and interspersed among the latter will be seen a vast assemblage of translucent dottings, each having an opening across it corresponding to those of the stomates, under which they were situated before dissection. The structure of the leaf, taken as a whole, indicates the great necessity of cleanliness and high culture; for the more complicated the organic structure of the plant is, the greater will be the number of its economic products, and the more apt are abortions in the form of fruit to be produced in the case of neglected culture or unfavorable climatic conditions. In plants there are milk-vessels, turpentine, oil-receptacles, and the like, which form canals or cavities between or among the cells, and are filled with the particular product of the plant. Not so with the lower forms of fungi. Their roots may grow in profusion, although frequently torn to pieces, because of their simple form of structure and habits. A single cell of mycelium will germinate, bud, or reproduce its kind as perfectly as will a spore of its fruit.

LEDGERS. In building, the pieces of timber used in scaffolding, which lie parallel to the wall, and horizontal.

LEECH. *Sanguisuga officinalis* and *medicinalis.* They inhabit shallow brooks and ponds, and are valuable in relieving local inflammations, by drawing off an excess of blood.

LEEK. *Allium porrum.* In the United States the leek is less cultivated than in most other countries. It belongs to the onion family. It has always been regarded with particular favor by the Egyptians, who eat it raw with their bread, or as a sauce for meats. It is frequently associated with the name of St. David, the patron saint of Wales, for the reason that Welshmen are accustomed to sport leeks in their hats upon his festival, the first of March. This is a very ancient custom, and we find frequent mention of it among the old writers. Some persons have thought that it commemorates the introduction of the plant into that country by St. David; but more probably, as Shakspeare says, in his Henry the Fifth, it is worn as a memorable trophy of predeceased valor. According to an ancient tradition, in a celebrated victory of the Welsh over the Saxons, in the sixth century, the former under the prelate's directions, were distinguished by leeks which they gathered near the battle ground. As he was supposed to have power to work miracles, it is not strange that their glorious success should have been attributed to this cause. Whatever may be the origin of the custom, it would be quite as remarkable to find a Welshman without his leek on the first of March, as it would to discover a genuine Hibernian without a shamrock in his buttonhole on St. Patrick's Day. For certain purposes the leek is preferred to the onion. The seed of the leek should be sown as early as possible, in a well prepared bed, and transplanted when large enough, in shallow trenches one foot apart. In the row they should be left six inches apart; the soil should be light, rich, and mellow. If the weather turns dry, the plants must be watered, since they are impatient of drought; keep the soil mellow, and draw it about the stems from time to time. The London-flag-leek is hardy, and the variety usually cultivated in the United States. The whole plant is used in various ways, either boiled, or in soups, stews, etc.

LEGHORN FOWLS. The Leghorns are called by Tegetmeier, a well known English authority, an American breed. They certainly are a thoroughly Americanized breed, but are undoubtedly an Italian breed originally, being said to have been first imported from Leghorn, whence their name. They are among the best of our breeds, a modified Spanish fowl, with all their good qualities, and lacking the weak points of the Spanish. They are bred of various colors, except black, but the White and the Brown Leghorns are the most fashionable. The white variety much resemble the Spanish in size and plumage, but are their direct opposite in color. The combs of the cocks are upright, single, large and much serrated; wattles full and large, cream colored or white ear-lobes. The combs of the hens frequently fall or double over. The cut will furnish a good illustration of this strain of Leghorns, as the description will also of the Brown. The Brown Leghorn is precisely like the White, except in color, which is a rich brown. The comb is the same as in the White, legs bright yellow in both White and Brown. The Brown Leghorns have the breast black, splashed with brown, the wings reddish brown, the tail large, full and with the sickle well curved. In the White the sickle is carried more upright. The ear-lobes, pure opaque white, rather pendent, thin and close fitting to the head, smooth and free from wrinkles. The neck, hackle and saddle of the White Leghorns may be tinged with gold or straw color, but all



WHITE LEGHORNS.

the rest of the plumage must be pure white. As showing the appreciation of the Leghorns in England, whence they were sent from breeders in the United States, Tegetmeier says, the birds are of a sprightly, active carriage, good foragers, they are abundant layers of full sized eggs, the hens rarely showing an inclination to sit, the chickens are hardy, and unlike those of the Spanish, they feather quickly and mature rapidly. He fully endorses all that American breeders hold to be excellent in these admirable fowls.

BROWN LEGHORNS.

LEGUMEN, LEGUME. A pod like that of the pea, bean, etc. A one-celled, one or many seeded, two-valved, superior, and commonly dehiscent fruit.

LEGUMIN. The caseine of leguminous plants.

LEGUMINOSÆ. An extensive natural family, very important in agriculture, from yielding peas, beans, clovers, indigo, etc. The genera are often immense trees in the tropics, as logwood, mahogany, but are usually small herbs in the North. The most remarkable characters are the presence of legumens with irregular, often papilionaceous flowers.

LEGUMINOUS CROPS. Crops of clover, beans, tares lucerne, and other leguminosæ. Some writers, however, very improperly allude to root and leaf crops under this term, imagining that all ameliorating crops should be called leguminous, as being distinguished from white or culmiferous crops, which also exhaust the soil.

LEICESTER SHEEP. Originally the Leicester Sheep were large, coarse, heavy, poor in flavor as to the meat, with long, thin, flat-sided carcases; large boned, long, coarse wooled, and poor feeders. Robert Bakewell in the last century, by selection and proper feeding and breeding, brought them into great celebrity, beginning in 1775. In 1780, it is recorded that his rams were let at fifty dollars each for the season's use; in 1784, at $525 each; and in 1786, one ram was let for $1,575. Subsequently seven were let for $10,500 for the season, and $2,200 was paid by each of two breeders for the use of a ram. Mr. Bakewell reserving one-third of the use of this ram for himself, making his yearly value $6,600. After his death, his successors not having the tact of Mr. Bakewell, the sheep declined, became delicate in constitution, and of late years they have become mixed with the blood of the Cotswolds. So far as we can learn the Leicesters have not held their own in the United States or in Canada. It is an open question, however, whether the Leicester might not be used in certain cases to refine the Cotswold, in the hands of breeders whose close study of anatomy and form, would enable them to breed them intelligently.

LEMON. A tropical plant of the citrus family, including the orange and citron. The lemon is not cultivated to any considerable extent; but in some of the Gulf States, notably Florida, oranges are largely cultivated. (See Orange, for the cultivation of the lemon).

LEMON, ESSENCE OF. The oil distilled from the peel, mixed with alcohol. The pure oil is termed the oil of lemons.

LEMON SYRUP. Lemon juice is kept with difficulty in bottles; made into a strong syrup, it is better preserved. The fluid sold by this name is often common syrup, acidulated with a little oil of vitriol.

LENITIVE. Medicines which gently soothe. A gentle purgative.

LENS. A thin solid, the faces of which are curved, and the general figure usually circular. The glasses of spectacles are lenses. Those lenses which have two convex or protuberant sides, or one side plane, magnify objects, and concentrate the rays of heat to a burning focus; hence they are termed magnifying or burning glasses. Concave lenses minify, and do not collect heat to a real focus. The name of the lens differs with the figure of the curved surface.

LENTICULAR. Shaped double convex lens.

LENTICELLS, or **LENTICULAR GLANDS.** The specks or knots on the stems of some trees, from whence, if in the soil, roots would proceed.

LENTIL. *Ervum lens.* A leguminous annual, similar to the vetch. It is much cultivated in France and some parts of Germany as food for man.

LENTOR. Viscidity, clamminess in fluids.

LEPIDOPTERA. Insects of the moth and butterfly tribe.

LEPIDOTUS, LEPIDOTE. Scurfy, scaly.

LEPISMA. A family of wingless insects, the bodies of which are covered with glistening scales, the feet short. They are very active, and found about old wool, and in dark, moldy places.

LEPRA, LEPROSY. A disease of the skin, which becomes rough and covered with scaly patches.

LEPTURA. A genus of longicorn beetles, of the family *Lepturidæ.* Head inclined posteriorly behind the eyes, or contracted at its junction with the thorax into a neck; thorax conical or trapezoid, narrowed anteriorly; elytra becoming gradually narrower; eyes rounded and entire, or, if emarginate, antennæ inserted before emargination.

LETHARGY. Drowsiness, morbid desire to sleep. It is sometimes a precursor of apoplexy, and calls for blood-letting if occurring in a full habit.

LETTUCE. *Lactuca sativa.* Lettuce is a hardy annual of which the original country seems to be unknown, but thought to be a native of Asia. It has been found wild in many different parts of the world, and was first cultivated in England about the year 1562. It is divided into two families, called the Cos and the Cabbage lettuces. The first, distinguished by an upright growth—was introduced from the island of Cos; and the second—the habits of which are somewhat indicated by its name—from Egypt. Our climate is not altogether favorable to the Cos family. The botanical term *Lactuca* is derived from *lac*, the Latin word for milk, in allusion to the milky juice which exudes from the stem when broken. This juice when the plants are young, contains but a small quantity of the narcotic principle; but it gradually acquires a strong, bitter taste, and becomes notably sedative. This property seems to have been known at a very early period, and a lettuce supper was thought highly conducive to repose. Lettuce can only be grown to perfection in a rich, mellow soil, and one cool and moist. Hence it is always best in the West, when started in a cold frame and transplanted to the open air as soon as danger of hard frosts are over. It may be transplanted when it has only three or four leaves, or when it has formed six or seven. For succession the seed may be sown in a warm border, and again in the open garden in rows twelve inches apart, allowing the plants to stand finally six inches apart in the row. When it is to be transplanted set the plants six inches apart every way, take out every other row as may be required for use, and again alternate plants in the remaining rows, allowing the plants to stand twelve by twelve inches, when, if the soil be rich enough and plenty of moisture be present, they will form handsome heads completely covering the ground. Among the cabbage lettuces, the White Silesian is the one generally cultivated, and all things considered one of the best.

LEVELER. (See Lawn.)

LEVELING. The art of discovering the level of surfaces, or how high one place is above another; in agriculture, the reduction of hills or mounds to a level or plain surface.

LEVELING STAVES. Straight rods, six or more feet high, and divided into marks at the inches, which can be distinctly seen at a short distance; in more delicate observations the staff carries a movable sight with a central mark, which is adjusted by an assistant, according to the signs of the surveyor, until the level line is reached.

LEVER. A bar capable of moving around a prop or fulcrum; leverage gained depends on the distance at which the power acts from the prop, and weight or resistance. The lever is the simplest mechanical power. Levers are of the first, second, and third kinds: in the first, the fulcrum is between the power and weight; in the second, the fulcrum is at one end and the power at the other, the weight being between them; in the third, the fulcrum and weight are at the ends, the power intermediate; in this case there is loss of power, but gain in the rapidity of movement of the weight; the treadle of a lathe is an instance.

LEVERAGE. The advantage gained in power by using a lever.

LEVERET. A young hare.

LEVIGATION. The reduction of a solid to an impalpable powder with the assistance of water or other fluids; this may be done in a mortar or on a slab; the mixture is afterward diffused in water, and the light parts, which remain suspended some seconds, poured off and retained, the heavier portions being again triturated.

LEY. Grass land.

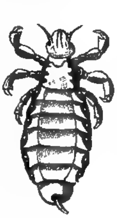
LEYDEN JAR. (See Electricity.)

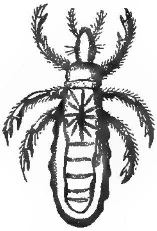
LIAS. An argillaceous limestone of the secondary rocks; abundant in Europe, but unknown in the United States.

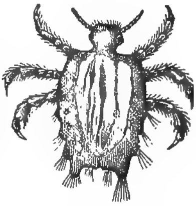
LIBELLULINES. A tribe of neuropterous insects like the dragon fly, which are found about water, and prey upon other insects.

LIBER. The innermost bark of trees. (See Bark.)

LICE. There are so many forms of these vermin infesting animals and plants, that an enumeration of the various species and a description of their habits would fill many large volumes, as various genera of plants and animals have their distinct parasites. Some plants and animals are difficult to keep clear of parasites, but as a rule, lice will not be found on either when in a state of perfect health. Snuff, tobacco-water, ashes, lime, soot, dust, and various other substances are employed to remove them. The best means of prevention however, is to keep the animal in perfect health, watching for the first appearance of the parasites. These usually are brought into flocks and herds by infested animals, and consequently when strange stock is bought, if thin in flesh, they should be carefully examined. The forms of lice in animals are many, each species however, having its particular forms. Human lice are of three principal forms. The head louse (*pediculus humanis*), the body louse (*P. vestamenti*) and the crab louse (*P. pubis*). The three forms are given below. Scab in sheep, mange and itch, are often attributed to lice. These are, indeed, caused by parasites which burrow under the skin, and may be destroyed by the same general means that will kill lice; that is by dipping in a decoction of tobacco-water to which flowers of sulphur is added. True lice, however, and ticks also, being confined to the surface and not under the skin may be destroyed by gentler means. On cattle, by an application of a preparation of lard oil and creosote, in the proportion of four parts of the first to one part of the latter. On horses, they may be clipped, and washed with a decoction of two ounces of powdered stavesacre seed in one quart of boiling water, applied cool, care being taken that the animal does not lick the wash, will be effectual. In mild cases, an ointment of two ounces of Scotch snuff thoroughly mixed with six ounces of lard will suffice, or one drachm of calomel and one ounce of crude petroleum, will not only kill the lice but allay the irritation. Hen lice are often irritating to horses. They usually congregate about the roots of the tail and mane. They are almost microscopic and hence not readily noticed. When found they should be eradicated with the last named remedy, and all parts of the stables whitewashed with lime, in which carbolic acid has been dissolved.


HEAD LOUSE.


BODY LOUSE.


CRAB LOUSE.

LICHENS. Plants of a very low organization, which grow on the bark of trees or rocks, where they form a kind of incrustation, or upon the ground, where they consist of irregular lobes, parallel with the earth's surface. Occasionally, in all situations, they are found in a branched state; but their subdivisions are generally irregular, and without order. Their fructification consists of hard nuclei, called shields, which break through the upper surface of the thallus or main substance of the lichen, are of a peculiar odor and texture, and contain the reproductive particles. Lichens abound in the cold and temperate parts of the world. The greater part are of no known use; but some, as the reindeer-moss (*Cenomyce rangiferina*), the Iceland moss (*Cetraria Islandica*), and various species of *Gyrophora*, are capable of sustaining life, either in animals or man. The Iceland moss, when deprived of its bitterness by soaking in an alkali and then boiling becomes, indeed, a diet recommended to invalids. Others are used as tonic medicines, as *Variolaria faginea* and *Parmelia parietina* Their principal use is, however, that of furnishing the dyer with brilliant colors; archil, cudbear and perolle, with many more, are thus employed.

LICHENIN. The starchy matter of lichens.

LIFE, ANIMAL AND VEGETABLE. Animal and vegetable life has been defined, by Auguste Le Comte, as resulting from a double molecular motion, general and continuous, of composition and decomposition, in relation to the organism and inorganic medium. This definition is correct enough as an hypothesis showing the action of life. What is life, is a question as yet too profound for the mind of man to elucidate. The action of life upon the medium has been defined to be as supposing not only a being organized in such manner as to permit the phenomena constituting the vital state, but supposes further the not less indispensable idea of the ensemble of external agents, physical and chemical, proper to furnish to the organism the principles necessary for its nutrition and the manifestation of the properties of its anatomical elements. This ensemble of conditions we name the medium. The idea of life and that of the medium are two conceptions so inseparable from each other that no life is possible in a medium improper for the accomplishment of organic phenomena. There must be a certain harmony between these two media. As this harmony diminishes, the phenomenon passes from the normal state to that of sickness or perturbation, a prolongation of which occasions death. Organic perturbation may occur in three different modes, which it is important to fully understand before proceeding to analyze the nature of the perturbation. Prof. Poey says: 1. If the medium is much more permanent, simpler, and more general, the living being alone is modified. 2. If the medium is much more unstable, more complex, and special, it is then more modifiable than the living being. 3. If the medium be as complex as the living being the modifications will correspond in both terms. In the capital question of the reciprocal influence of climatologic agents upon living beings, and *vice versa*, the problem to be first resolved by way of experiment is the following: To learn and separate, in meteorological observations, the sum of the actions of the medium, gravity, heat, light, electricity, etc., favorable for organic existence, from the sum of actions unfavorable for this existence, and, after this correction, to calculate the effects of action and reaction between the being and the medium. This problem having been formulated by Alphonse de Candolle, solely with reference to the influence of temperature on vegetation, was extended by Prof. Poey to all the other meteorological influences, by introducing the most capital element of the action of media upon living beings, and of their reaction upon media—a consideration overlooked by this savant. The persistent harmony between vital forces and external modifiers, which concur in the phenomena of life, being thus established in the theory of media, the last problem remaining to be practically resolved is the following: A living being and a medium being given, to determine their reciprocal influence. Such was the course pursued by Prof. Poey in examining those meteorologic and climatologic elements that exert any influence upon vegetable life, in its relation to the agricultural art. The principle of the correlation, conservation, and equivalency of heat and motion has been extended to all the forces both of organic and inorganic nature, and lately to the intellectual and moral functions. We thus identify all the forces acting in the living body with those acting in the inorganic universe, the former having only a higher degree of complexity. Hence the organic constitution (animal and vegetable) may be compared to an engine in which heat is the principal agent. The power of the steam engine is derived from the heat applied to its boilers, which heat is but the expression of the chemical changes involved in combustion. The same with vegetable activity, the force of the solar light being used up in the decomposition of the carbonic acid of the atmosphere by the growing plant. Combustion in the furnace of the steam engine is sustained either by wood which is the product of vegetation or by coal which represents the vegetable life of a remote geological epoch. In either case, therefore, we come directly or indirectly to solar radiation. But as Liebig says, our animated machines create no power, but only return what they have received from the external medium. In fact, Liebig defined life to be that plants live and grow; while animals live, grow, and feel. This, while as a rule being correct, is not so, strictly speaking, since it is not possible to verify the statement as to the lowest forms of life, any more certain than to state as a verity that vegetables do not feel. Some of the low forms of animal life seem to have no feeling, or indeed, power of voluntary motion. Some plants have the power of voluntary motion, as in the Sensitive plant, which immediately folds its leaves upon being touched; others again, as some of the acacias, fold the leaves at night and seem to sleep. Again, an animal may consist of a single cell, and in the lowest forms of life, there is neither muscular fiber, nervous filaments, head, heart, stomach, nor other organs common to most animals; they seem to live simply by absorption. Yet the absence of all these do not demonstrate that the substance is not animal. Albumen is the great nutritive element of animals, and starch of plants. So the chemical composition of the tissues of animals differs from that of plants. The basis of vegetable structure is cellulose, (see Cellulose,) and yet in the lower protozoa, cellulose is found; just as in some low forms of vegetable life, (fungi,) starch is deficient. Plants absorb and assimilate by their roots and leaves, and give off oxygen, retaining the carbon of carbonic acid, while animals digest their food, consume oxygen, and give off (respire) carbonic acid from the lungs. (See articles Generation and Germination)

LIGAMENTS. Elastic fibrous textures uniting the bones together.

LIGATURE. A bandage. In farriery, a ligature is a fine, strong thread of silk, with which blood vessels, etc., are tied in operations.

LIGHT. Light is that natural force which, acting on the retina of the eye, produces the sensation of vision. Upon light, the continued vitality and growth of plants is dependent, and in its absence animals soon lose vigor, and at length their health is broken. In agriculture, the growth of plants is dependent upon the quantity of light received, and hence in seasons when the sun is much obscured by clouds, vegetation sensibly suffers. In the effort to produce seed, although if sufficient heat be present, the vegetation may be luxuriant, but will lack in vigor. The sun is the great source of light and heat, for so far as vegetation is concerned, both are necessary to successful growth. Besides the sun, all the planetary and starry systems give off light, but not appreciable heat, although some late experiments with delicate instruments would seem to show that appreciable heat was thrown back by the moon. Plants during light nights have been observed to grow faster than during dark nights, but experiments in this direction have not yet been carried forward sufficiently far to prove this beyond doubt. The principal phenomena and discoveries in the relation of light to vegetation, have been compiled by Prof. Poey, which will be interesting. The condensation of the principal experiments and facts are given below as follows: The paleness or whiteness of the parts of vegetables, when they are sheltered from the action of light, called by the moderns the etiolation of plants, did not escape the observing mind of Aristotle, who described it correctly enough, only he wrongly believed that the roots owed their paleness to their underground position; for they do not become green when exposed to light, and those which grow there are white. Still some roots are in themselves green, with or without the production of green matter or chlorophyl. The celebrated botanist, John Ray, first among the moderns, proved in 1686, by many experiments, that light alone exerts an influence upon the green color of plants, that they scarcely vegetate at all under an opaque vase, and that their stems become extremely elongated; this phenomenon was neither owing to the want of air, nor to the influence of heat. Charles Bonnet established that it was owing to the dark. Meese and Senebier analyzed the cause and the circumstances. Michellotti also first proved that light was injurious to germination, and Ingenhousz and Senebier found that seeds germinate more rapidly in the shade than in sunshine. After the tendency of stems to turn toward the light, three other phenomena were discovered at the commencement of this century relating to the influence of solar rays upon vegetation. Thomas Andrew Knight indicated for the first time in 1812 the tendency of some stems to shun the light in place of seeking it, and Dutrochet demonstrated it in the most incontestable manner. Dutrochet himself pointed out, in 1824, the tendency of roots to turn toward the light, and, in 1844, J. Payer discovered the contrary disposition in other roots to shun the light. After recognizing the action of natural and artificial light upon the growth of plants and the production of green matter, it will be interesting to study the influence of the different colors of the spectrum upon vegetation, by the aid of colored glass and liquids, and by the colored rays of the solar spectrum. Senebier, who appears to have been the first to take up this important question, published in 1783 experiments which he began seven years before, which were continued during four years. His conclusions are as follows: 1. The size of the stems and their whiteness are so much the greater as the plant's illumination is less; but the green color of the leaves does not follow this rule absolutely. 2. The highest illuminating rays, the yellow and red, do not give the leaves the most decided green tint; the violet ray produces this effect with the lowest illuminating power. Senebier draws the conclusion that the green color will be deeper when there is less light reflecting from the leaf and more penetrating it, and on account of this the violet ray gives the leaves a deeper green than natural light. 3. After the violet rays, plants become more developed in the red rays than in the yellow. By submitting plants to the action of light transmitted through glass of different colors, l'Abbé Tessier remarked, in 1781, that the intensity of the green tint of leaves went on decreasing from white glass to deep yellow; that leaves become sensibly green under the influence of lamps and of the light of the moon. He also observed that the stems are very strongly inclined when we place black materials behind the plant; the inclination is very feeble when the stuff is white; and it is almost nothing when we place a looking-glass behind the vegetable. Leaves which were placed behind a pane of white glass were green; less, however, than if the pot had been outside of the apartment. Leaves behind a pane of blue glass were still more green, there being between them and the preceding a sensible shade. Leaves behind a clear yellow pane differed from the last only by being a shade less green. In fine, the least geeen of all were those which had been placed behind a deep yellow pane; the difference was striking. In 1817, Dr. Sebastian Poggioli, instead of submitting plants to light transmitted through colored glass, conceived the happy idea of placing them under the rays of the solar spectrum. He observed, after the third day, that the smallest plant submitted to the violet rays, surpassed, in development, those under the influence of the red rays, the latter, on the fourth day, appearing to be blanched. The cotyledonous leaves of the plantlets in the two vases changed their positions and directed their upper surfaces one toward the red light, and the other toward the violet. The direction was more rapid with the plantlets submitted to violet rays than with those which had been submitted to red rays. The two cotyledonous leaves which crown the plantlets of *Raphanus rusticanus* directed their upper faces, in the first place, toward violet light, and in the second, toward red. The seeds of *Brassica eruca* germinate more promptly under the influence of red rays than under green rays, and more promptly under green than violet rays. In 1830, Adolphe Brogniart and de Jussieu saw the two opposite leaves which terminate the plantlets of *Alsine media* direct in the same manner their upper faces toward the red light to which alone they were submitted. Thus the phenomenon was the same as that observed twenty-seven years before by Poggioli. Brogniart remarks that he had observed, as had Charles Morren, that the yellow rays approached, in their action, nearer than any of the others to white light; but, as this depended upon the fact that yellow glass allowed a very large quantity of white light to pass through it, while green and blue passed but a little, and red glass none at all, the intensity of light differed extremely in all these experiments. In 1832, Charles Morren, by the aid of experiments with colored glass, reached the following conclusions: 1. That the colors of the spectrum, excepting green, only, like darkness, assist germination as their luminating power becomes less. 2. That under the colored rays of greatest illuminating power, the radicles develop least and slowest, and that the plumules, on the contrary, grow best and quickest. 3. That under the rays with low illuminating powers, the radicles and plumules develop as they do in the shade. 4. That, consequently, the etiolation of vegetables, under the prismatic rays, happens in inverse proportion to their illuminating property. 5. That the green color of vegetables is developed much more rapidly under the influence of composite light than under decomposed rays. 6. That the yellow rays possess the maximum, and the orange rays the minimum degree of coloring plants green, and the other rays do not turn them green at all. 7. That the yellow ray greens them more when it is less intense, but that it requires much more time to produce this effect than white light does, and that it can never produce the same depth of color. In 1837 and the following years, Dutrochet made a great number of experiments upon the influence of light on vegetation. None of the stalks of *Lepidium sativum* showed the least inflection toward light transmitted by red glass. At the end of eight days they had increased considerably in length, but remained straight and vertical. These observations completely confirm those of Payer upon the same plant. On the contrary, the stalks of *Alsine media* were, at the end of three days, all turned toward light transmitted through red glass. On turning the vase in such a way as to direct the inflection of the stalklets toward the base of the apparatus, four hours afterward they were bent anew toward the red light. Dutrochet then proved that this depended on the size of the stalklets of the two plants; that the only plants bent toward red light were those whose diameter was less than fifty-five hundredths of a millimetre; a tenth of a millimetre difference between the diameter of one stalklet and another of the same species, near a certain limit, sufficed to bend one toward the light, and leave the other in its natural position. The experiments of Dutrochet prove that the stalks of plants are bent toward red light transmitted without mixture by glass of this color; while, according to Payer, they inclined toward blue or violet light. Dutrochet here raises an important question, whether it is not the luminous intensity of the colored rays which determines the inflexion of vegetable stalks, an intensity varying with the transparency of the glass. The first flexion in the stalks toward the light is shown without exception in those submitted to the violet rays; afterward, in the indigo and blue rays, and ordinarily at the same time in the lavender rays which form the almost invisible continuation of the spectrum beyond the violet; then in the yellow and green rays, in the orange, and finally in the red rays. Beyond violet the flexion of stalks reaches twenty and sometimes even thirty centimeters, according to the intensity of the light; but beyond the red rays the flexion of the stalk extends very little. Previous to 1837, Dr. John William Draper, of New York, having made several experiments on the action of different rays of the solar spectrum, concluded that the yellow ray, the most luminous, had the power of producing chlorophyl. Plants become also green in light that has been submitted to the action of the yellow solution of bichromate of potassa, and so deprived of those rays which blacken chloride of silver; the same is true of light which passed through sulphocyanate of iron, and sulphate of copper and ammonia; in every instance the leaves becoming green. Seeds of common cress were caused to germinate and grow under these circumstances. It is not this or that ray, adds Draper, which gives rise to the color of beans. The absence of the chemical or the calorific ray does not appear to affect it, nor have we any direct proof that the calorific ray exerts any influence. Humboldt has stated that in the mines of Germany plants grow in recesses where the sun's light never comes, and, provided hydrogen gas be present, the color is green. In the abysses of the ocean, at depths to which no solar beam can penetrate, and where there is perpetual night, green plants are found flourishing. Light, which seems to act merely as a stimulus on the green organs of vegetables, indirectly bringing about the decomposition of carbonic acid, though accessory, is not, however, essential to the growth of plants. From 1840 to 1847 Robert Hunt was engaged in an extensive series of experiments on the process of germination and vegetable growth as affected by solar radiations. These experiments were undertaken under the auspices and at the expense of the British Association for the Advancement of Science. The results to which he was led are: 1. Light prevents the germination of seeds, as was formerly asserted by Michellotti, Ingenhousz, Meese, Senebier, and others. 2. Actinism, or chemical rays, quickens germination. 3. Light acts so as to effect the decomposition of carbonic acid by the growing plant. 4. Chemical action and light are essential to the formation of the green matter of leaves, or chlorophyl. 5. Light and chemical rays, independently of the calorific rays, prevent the development of the reproductive organs of plants. 6 The heat radiations corresponding to the extreme red rays of the spectrum facilitate the flowering of plants and the perfecting of their reproductive principles. As to the conditions in which the luminous, chemical, and caloric principles exist in light during the different seasons, he has found that—in the spring, chemical action is the most powerful, and is in very considerable excess of pure light and heat. As summer advances the quantity of light and heat increases to a very great degree above chemical action. In the autumn, light and chemical action both diminish, and the calorific radiations predominate. These facts bear strikingly upon all Hunt's experiments; they appear to confirm his conclusions in a most satisfactory manner, and also to point to a singularly interesting order in nature, which is the following: In the spring, when seeds germinate, and young vegetation awakes from the repose of winter, we find an excess of the principle which imparts the required stimulus—that is of chemical action; seeds then germinate, and young buds and shoots are developed. In the summer this agent is counteracted by another possessing different powers, upon the exercise of which the formation of the plant's structure depends—that is luminous action. As the sun becomes more active the formation of woody fiber proceeds under this agency, and the chemical power is rendered less active by the purity of the light. Finally, in the late summer and in the autumn these are checked by another agency with diminished power of light, upon which the development of the flower appears to depend, the ripening of the fruit, and the perfection of the seed—and this is thermic action. The experiments of Hunt have also led him to detect some curious influences which appear due to dissimilar rays, and in their action exhibit great inconstancy of effect. One class of rays, the same to which Sir J. Herschel has given the name of parathermic rays, are so subdued by the influence of more refrangible rays, as to be nearly inactive during the spring and early summer months; indeed in the spring they scarcely produce any effect upon dead vegetable coloring matter, unless their action is assisted by the use of some decomposing agent such as sulphuric acid. These rays increase in power toward autumn, and to them appears due the browning of the leaf. In all his writings Hunt has repeatedly stated that seeds would not germinate under the influence of light, when deprived of that principle on which chemical change depends; and has declared as a law, that in its relation to vegetable life, light prevents germination. This statement has been decidedly objected to by Doctors Draper and Gardner, of New York. By numerous experiments Hunt also found that the chemical principle of solar radiation produces an acceleration of the germinating process, so that in every instance the seeds influenced by these chemical rays germinated in one-half the time required by the seeds placed in the dark. In ascertaining if the influence of the chemical rays was confined to the surface of the soil, or extended below it, he obtained the most satisfactory evidence, that under the rays which passed through blue glass, germination began at a depth below the surface, where it did not take place under ordinary conditions. In every instance germination through the agency of radiations, which had permeated the blue glass in less time, and to a greater depth in the soil than was possible in comparative experiments where the seed was exposed to the full influence of light and its associated radiations as combined in the solar beam. As to different colors of light, Hunt says, that if the young plant continues to grow under the influence of blue rays, it will for some time exhibit luxuriance and present in its earlier stages an appearance far superior to that of plants grown under other influences, or even white light. The leaves will be of a darker green, and altogether show external signs of vigorous health. Even in the earliest stages it will be found that the plants grown in the full sunshine, or under yellow or red media, representing the luminous and calorific principles, give a larger quantity of woody fiber and less water than those grown under chemical influence. Plants growing in the shade, in like manner, contain more water than those in full sunshine; hence, we can not infer that anything more than the deprivation of light influences the condition of plants in these experiments. He ascertained that as great a difference exists in the quantity of water found in plants growing in artificial shade, and plants of the same class growing unsheltered, under the ordinary conditions of sunshine. It is therefore evident that all those experiments, which have been made on the increase of grass crops by littering the fields with the boughs of trees and the like, are liable to the error alluded to; and it is questionable if the increased product of an acre is not principally due to water, rather than to any carbonaceous product; consequently the increase of the nutritive property is not in the ratio of the increase of weight. Hunt further observes that it frequently happens, when the media employed cut off a large quantity of light, and admit the chemical principle freely, that no formation of leaves takes place after the development of the plumule or first leaf bud; the ground stem, instead of solidifying, remains soft, and without increasing in diameter, extends to an enormous length. Nothing like this occurs under the influence of either light or heat. It would appear that this abnormal condition is due to the excitement of the chemical rays, acting possibly with great power upon the living principle in the roots, by which the elaboration of some organizable matter is produced, which they supply as food to the stem. As there is but little power to decompose carbonic acid, there is not the necessary supply of carbon to give rise to those stems and leaves which naturally form the primitive stem. That this is something like a true explanation is further proved by the fact, that in the practice of planting shoots, the use of blue media is highly advantageous. It appears to increase the tendency to develop roots, and it is satisfactory to learn that some gardeners have, without any knowledge of the cause, employed cobalt blue-glass to aid in the striking of cuttings. According to Senebier, plants decompose the carbonic acid absorbed by their leaves much more readily under the influence of violet rays than under any other. In his early experiments Hunt thought he had found the correctness of Senebier's opinion. Dr. Daubeny and Dr. Gardner both think that the decomposition of carbonic acid increases with the increase of light, and that it is more rapid under the influence of the yellow ray than any other. In the experiments of Hunt, by which the quantity of woody fiber increases with light, this agent seems to be essential to its formation. But Hunt explains this fact by saying that the decomposition of carbonic acid by plants under the agency of light is not a simple chemical operation, as has been supposed by some, effected by the chlorophyl, but the result of an exertion of the vital principle of the growing plant which requires the external stimulus of light to call it into action. Hunt seems to have discovered a capital point, to which he has not himself done justice, and which has passed entirely unacknowledged by other observers. It is that in all his experiments he has found that each variety of plants employed was influenced by different rays. Cress and mustard, for example, become green most rapidly in the green ray, mignonette in the yellow, and peas in the blue ray. He observes, however, that the influence was always most decided between the limits of the mean orange and the mean blue ray, and that it took it much longer to green plants in the red than in the blue ray. The importance of this discovery, should it be confirmed, will consist in showing the action of light upon plants to be identical with that of heat. If each plant, as we have seen above, possesses its own zero of temperature and requires a certain different degree in order to accomplish each of its physiological functions, in light the greening of the leaves or production of chlorophyl (and probably the decomposition of carbonic acid and the fixation of carbon) needs also the chemical action of a certain colored ray of the solar spectrum. The difference existing between each color of the spectrum being only a difference in greater or less velocity of vibration, and of properties purely relative, as in heat and light, each plant will be therefore chemically affected by rays of different colors. Hunt thinks that the manner in which the power of solar radiation is exerted on seed beneath the soil is not clear to us. We do not know whether it is a mere disturbance of something already diffused through matter, or in the seed, or an emanation from the sun. All which we are enabled to declare is that the germination of seed is more rapid under the influences of chemical rays, separated from the luminous, than it is under the influence of the combined radiations or in the dark. That the formation of chlorophyl is not directly dependent upon either light or chemical action, regarded as isolated principles, but on the action of both forces acting upon plants. It has been stated by Dr. Gardner, adds Hunt, that plants exhibit a lateral movement bending toward the yellow ray. This appears to be a mistake; plants under the influence of the red rays bend from the light but along the line of the ray; and those exposed to the most refrangible rays turn toward it, but still in the line of the ray. Now the plants which first become green, by careful treatment in this way, are those exposed to the rays between the mean green ray and the extreme blue. The action is continued eventually to the edge of the most refrangible violet below the yellow ray. No change is effected beyond the visible spectrum, notwithstanding the abundance of dark chemical rays; and the change is shown only where there is really the largest amount of light. He therefore concludes that the luminous rays are essential in producing the decomposition of the carbonic acid and the deposition of carbon, which is afterward, in all probability, continued with hydrogen under the influence of the purely chemical rays of solar light. Finally, Robert Hunt communicated a letter to the Brittish Association at its meeting in 1853, from Messrs. Laws and Co., of Edinburgh, in which it was stated that by adopting the plan of cutting off luminous rays by the use of cobalt blue glass, as recommended by Hunt, they succeeded in obtaining healthy germination far more rapidly than in ordinary circumstances. They constructed a house glazed with blue glass, and in this their seeds were tested. The practical application of a scientific discovery was of the utmost value to them. Tropical seeds, under the same circumstances, were found to germinate in a few days, when in ordinary conditions many weeks were required for the process. According to l'Abbé Zantedeschi, Carradori had, in 1841, confirmed the results of Senebier, so far as that the power of light to color vegetables green, resides in an eminent degree in the violet and blue rays, although it is more feeble than in ordinary light. In 1843, J. Payer, by making use of colored glass, and afterward of the solar spectrum, found that the tendency of stems toward the light was so much greater as the light was less intense or reached a lower point. As the plant found between two luminous rays of different intensities is always curved on the side of the stronger light, between the blue and violet, the blue region has always the greater amount of this action, and in it is found the maximum. But Payer has not studied the action of invisible chemical rays beyond the violet, upon the flexion of the stems, as Guillemin has done later, although Hunt found no influence upon vegetation in the ultra-violet rays. Hence, Prof. Poey is also inclined further to believe that Hunt has not paid attention enough to the obscure and chemical rays. In 1842, l'Abbé Zantedeschi drew the following conclusions from his experiments upon the influence of solar rays transmitted by colored glass: 1. Vegetation under the influence of light transmitted by any kind of colored glass is languishing and sickly, as was observed by Senebier and Carradori. 2. The order observed for germination, under colored glass, is different from that observed by Senebier. 3. Violet light has a power little inferior to that of ordinary light to green certain vegetables, as Senebier has said: the balsam is in this condition, but it does not take place with *Oxalis multiflora.* 4. As to the vigor of vegetation it is no greater under violet glass than under yellow and red glass, as Senebier has observed. 5. Green light is less favorable to vegetation than red light. 6. The most vigorous vegetation for *Oxalis multiflora* takes place under blue glass. In 1844, Dr. D. P. Gardner, of New York, claimed to have settled the question beyond dispute, that the yellow rays produce chlorophyl in leaves, as Dr. Draper had first advanced; but he is in complete disagreement with Hunt and other experimenters. Here are his conclusions: 1. That chlorophyl is produced by the more luminous rays, the maximum being in the yellow. 2. This formation is due to pure light. 3. That the ray toward which plants bend occupies the indigo space in Fraunhofer's lines. 4. This movement is due to pure light as distinguished from heat and chemical action. 5. That pure light is capable of producing changes which result in the development of palpable motion. 6. The bleaching of chlorophyl is most active in those parts of the spectrum which possess no influence in its production and are complementary to the yellow rays. 7. This action is also due to pure light. In the same year, Robert Harkness, of England, objected to Gardner's conclusions, and made the following very judicious remarks, which were approvingly quoted by Hunt: If the absence of solar light is one of the conditions almost necessary for the germination of seed, one should not expect that ray in which the maximum of light is found, to facilitate germination; but on the contrary, according to Hunt, to retard it. If, again, the yellow ray is the operating cause by which carbonic acid is decomposed and chlorophyl produced, we should also expect that, so far from assisting in germination, it would exercise a highly injurious influence. We know that the presence of oxygen is necessary for the vegetation of seeds, also that this oxygen is absorbed, and by uniting with a portion of the carbon in the seeds reappears in the form of carbonic acid, a process the opposite of that which takes place when chlorophyl is produced. So if the decomposition of carbonic acid is owing to the yellow ray, this ray ought to be the last to produce any effect on the germination of seeds. Moreover, seeds, as well as fully developed vegetables, possess the power when deprived of light, of absorbing oxygen and evolving carbonic acid; and to this circumstance we must ascribe the effect of the blue ray shown by Hunt's experiments. In 1850, Cloez and Gratiolet advanced the opinion that the decomposition of carbonic acid by the green parts of plants with the aid of colored glass is at its maximum with colorless polished glass ; next comes yellow glass, then colorless transparent glass, red, green, and in the last place blue glass. In 1852, J. H. Gladstone, in experimenting with peas, drew the following conclusions, in entire opposition to Hunt's experiments: The cutting off of the chemical rays favors the first germination of the seed, and this appears to be the principal, if not the only advantage obtained by burying the seed in the soil. The development of roots also requires the absence of the chemical ray, yet it does not go on to the greatest extent when all the solar influences are excluded, but is favored, rather than otherwise, by heat and luminosity. The first development of the plumule also proceeds best under the same circumstances; yet these are not the conditions which produce a healthy plant ; If all the solar radiations are withdrawn, whether entirely or only to a great extent, the plants absorb much water and grow very tall, without developing secondary branches or many leaves. The whole force of these radiations, on the contrary, prevents or greatly impedes the growth of those plants under the circumstances of the experiments. The chemical force is the most antagonistic to the growth of the pea, and luminosity also militates against it; the heating rays are favorable. If the plant is fairly established, those radiations which are, comparatively speaking, devoid of light, but replete with chemical power, are the most suitable to a healthy growth. The influences which facilitate rapid growth are diametrically opposed to healthy development. Upon the question whether the yellow light stops germination by some specific action or merely by excess of light, Gladstone says that the yellow light did not at all interfere with germination in his experiments. In the case of wheat and peas it decidedly facilitated the early development of both root and plumule. He thinks that the yellow ray, however, has a specific action of its own, and that the yellow and obscured yellow give quite different results from those of any other glasses. On the whole, Gladstone's experiments are in accordance with Draper's. In one or two cases, the seeds exhibited a tendency to germinate more readily under a blue glass. In 1854, Robert Washington, in some experiments made on the influence of colored glass on the growth of plants in sea-water, found that red sea-plants grew best in cases whose light was allowed to pass through green colored glass, and that the brown and green confervoid growths were thus destroyed. The first observer, as far as I am aware, who studied the action of the ultra-violet or invisible rays of the spectrum upon vegetation, and according to exact scientific methods, was C. M. Guillemin. His first care was to vary the nature of the prisms which he employed, in order to turn to account the special transparency that each prismatic substance presented to rays of different refrangibility. He chose, for instance, quartz for all rays more refrangible than blue, rock-salt for the red and calorific rays, and flint for the mean rays of the colored spectrum. Heavy flint which he had also employed, is the most dispersive of all; but it absorbs in great part the calorific and ultra-violet rays, transmitting only the least refrangible of them. In a paper presented to the Academy of Sciences of Paris, in 1857, Guillemin reached the following conclusions: The ultra-violet rays determine the formation of the green matter of vegetables. These same rays effect the flexion of the stems more rapidly than the rays of the visible part of the spectrum. In a second paper to the same academy he acknowledged that in his first communication he had given as certain the first proposition, but that he had some doubts on the second ; further researches, however, had fully confirmed both of these prior propositions. His conclusions are the same as those he afterward published in a third, more extended work. They are as follows: Young etiolated plants curve under the influence of all the rays of the solar spectrum; the least refrangible calorific rays or those of low temperature appear to form the only exception. The calorific rays less refrangible than the red, and the chemical rays more refrangible than the violet, present two maxima of action for the flexure of vegetable stems; intermediate colored rays determine, on the contrary, more actively than the preceding the formation of chlorophyl. In the spectrum obtained with a quartz prism, the limit at which the flexion of the stem ceases, passes beyond that of rays more refrangible than violet, indicated by fluorescent substances and iodide of silver. Lateral flexion extends beyond the red and violet extremes ; its center is in the indigo rays ; it is often produced in spite of screens which separate the different colored rays. The development of green matter has its maximum in the yellow; it diminishes slowly as it proceeds toward the violet, passes this limit and becomes *nil* in the last fluorescent rays. Blue, green, yellow, orange, and red rays turn etiolated leaves green more quickly than direct solar rays. The action of yellow is almost equal to that of diffused atmospheric light. Polarized rays appear to act at close intensities, like common rays. The principle of the identity of radiations, which already rested on the observation of a large number of physical phenomena, is here fully confirmed in the physiological order, by the analogy of the mode of action which the calorific and ultra-violet rays exert upon the flexion of stems and the development of green matter. Unhappily for these important researches, if we compare Guillemin's first conclusion with the eighth of his second note, we find a flagrant contradiction upon a question of the highest importance, the maximum action of the colored ray of the solar spectrum, under the influence of which the formation of the green matter or chlorophyl takes place. According to the first conclusion it is in the ultra-violet rays that this is produced, while in conclusion eight it is in the yellow ray, and even diminishes slowly proceeding toward the violet. Thus it is wholly the reverse of the first case. Such a contradiction throws a weighty doubt on the whole of these experiments. In the following paragraph we see that Prof. Henry agrees with Robert Hunt and Prof. Poey as to the noxious influence of light on the germination of seed: Germination can be carried on in the dark, and, indeed, the chemical ray which accompanies light retards rather than accelerates the process. Its office is to separate the atoms of carbon from those of oxygen in the decomposition of carbonic acid, while the function of the power within the plant results from the combination of these same elements. The forces are therefore antagonistic, and hence germination is more rapid when light is excluded; an inference borne out by actual experiment. In 1869, Dehérain proves that the evaporation of water by the leaves of plants takes place under conditions entirely different from those which regulate the evaporation of an inert body, as it occurs in a saturated atmosphere; that it is especially effected by light; and that the luminous rays efficacious in causing the decomposition of carbonic acid by the leaves, are also those which favor evaporation. The yellow and red rays, which have little action on photographic paper act with most intensity in causing the reduction of carbonic acid, while the blue and green rays decompose the chloride of silver, and have no action on the leaves. These experiments confirm the old observation of Guettard, that the hard and smooth upper part of the leaves evaporates the most water. Boussingault has shown that the greatest amount of carbonic acid is decomposed by the same portion. Prof. Poey concludes as follows: After the long series of experiments I have announced, and which each one should utilize for himself, I must formulate my own conclusion, which I advance only with the title of hypothesis until I have the means of submitting it to experimental test. I remark first, that these experiments have been performed after different methods, and are therefore not to be compared with each other. Some experimenters have made use of colored glasses, others of colored liquids or solutions, and others still of the solar spectrum. In these three methods the nature and action of the colored rays must have undergone modifications so various as to make the results very discordant. For example, the most of colored glasses are impure, because they allow white light and various tinted rays to pass besides those of their own proper color. Yellow and green glasses, which are usually too clear, allow a great amount of white light to pass. The thickness of glass, the density of liquids, and the composition of analyzing prisms, are points of the highest importance, which no one has taken into account, and which modify greatly the tints of colored rays. Another cause of error is, that each observer is contented with submitting the plant to the action of this or that colored ray, and not to each of the seven colors of the spectrum. In short, no observer except Guillemin, not even Hunt, conceived the idea of studying the influence of invisible rays beyond red and violet, which afford: the first, the maximum of calorific action, the second, the maximum of chemical action. These are errors of method only, without counting the personal errors of experiment, or even the errors which could result from the physiological and physical action of the plant. We have already seen in the case of Dutrochet, that one-tenth of a millimetre's difference in the diameter of two twigs of the same species was enough to bend one toward the light and the other away from it. In analyzing the action of light on vegetables, three great physiological acts of the plant must be considered: 1 The germination of the seed. 2. The decomposition of carbonic acid from the atmosphere and the fixation of carbon by nutrition in the tissues of the plant, which results in the formation of chlorophyl. 3. The flowering and fructification. In germination, according to Theodore de Saussure, we should distinguish two periods, the one during which oxygen is transformed into carbonic acid, which is the period of germination, properly speaking; the other during which carbonic acid is decomposed and oxygen is exhaled, which is the commencement of vegetation. The green color in which the plant clothes itself is the index and the consequence of that function which takes place only under the action of light; in its absence the plant continues the phenomena of the first period of germination without development, and remains colorless. If the physicists who have studied the influence of light on germination had taken the chemico-physiological action which it wrought in the plant more into consideration, they would not have committed another grave error, as Gladstone has done, in saying that the yellow rays, which possess the maximum of luminous power, and by consequence the minimum of chemical force, could in any manner favor the germination of seeds. The physicists who sustain this opinion have not sufficiently distinguished germination from vegetation, properly speaking. During germination the plant loses the carbon furnished by the carbonic acid, and only respires. On the contrary, during vegetation the plant retains the carbonic acid, fixing the carbon and drawing in oxygen, and therefore the functions of nutrition and assimilation of plants do not really begin till the moment of the appearance of green matter. The relations of plants and light are altogether different during the two periods; injurious during the period of germination, light is, on the contrary, indispensable in the second period of vegetation. It is for this the plant seeks always after light. Its shoots cling toward the side of incidental rays and inflect themselves constantly in that direction. It is a phenomenon general in plants, from the phænogamia to the cryptogamia, and in microscopic vegetation. Light is as indispensable to the nutrition of plants as the gastric juice is to digestion and the transformation of food. The assimilation and fixation of carbon in plants is greatest and most rapid when, all other things being equal, the supply of light is greatest. In the light of the solar spectrum, besides the special property of the seven colors which reduce themselves to three primary ones, three forces also are found intimately combined and working simultaneously. These are the luminous, the calorific, and the chemical force. Each one of these three great powers acting diversely on inorganic matter, there is no reason why they should not act equally after their nature on organic matter, whose chemical elements are the same. In fact, modern chemistry conclusively demonstrates that the vegetable, like the animal kingdom, is formed of but four elements, carbon, oxygen, hydrogen, and nitrogen. These four elements being combined in the most diverse and variable relations, it results that an innumerable quantity of organic components enjoy properties most distinct. On the other side, these four simple bodies are precisely those which constitute the atmospheric air. We can say with Dumas, that the whole vegetable kingdom is only the air condensed, and that it forms a vast apparatus of reduction. The base of these vegetable productions is always the same, the atmospheric air; the arrangement of molecules and their number is all which varies for constituting that mysterious force which one commonly calls life. From these considerations we establish hypothetically—1. That it is the purely chemical rays or ultra-violet with the aid of a certain quantity of obscure heat found mixed with the rays, which penetrate the vegetable stratum of the soil and determine the germination of seeds. 2. It is the purely luminous rays of the spectrum, the yellow, which determine, principally by the leaves, the decomposition of carbonic acid from the atmosphere and the roots, the fixation of carbon and the production of chlorophyl, and which explains the spontaneous and natural tendency of the plant to the light. 3. It is the purely calorific or ultra-red rays which determine the two physiological acts of flowering and fructification. Now the blue and violet rays on one part, the green on another, and the red rays have a purely secondary action in the production of these three great physiological acts of the plant, as the chemical, luminous, or calorific actions predominate in the second place. But it must be remembered before all that what we call the vital force proper to the plant precedes and modifies at will the three actions of the solar rays, chemical, luminous, or calorific in all the physiological acts of the vegetable kingdom. If this is true, we see at once the application to be made to agriculture and horticulture. First, in the arrangement of greenhouses, which leaves much to be desired at present. They should have compartments covered with pure glass, whose maximum chemical, luminous, and calorific properties would be more advantageous to each development of the plant. For example, in germination the glass should have chemical properties of the highest degree. For coloring the leaves and giving growth to the plant, glass should have the maximum of light; for flowering and fructification, the maximum of heat. As for the colors of the spectrum, the blue-violet, the yellow, and the red will yield the most advantage in these physiological acts of the plant. In general practice, however, these conclusions of Prof. Poey have not been found applicable, and yet in certain cases, especially in the case of plants requiring peculiar conditions, they are worthy of consideration. A few years ago prominent individuals, apparently jumping to conclusions, advocated the adoption of blue glass indiscriminately and as a means of securing health to invalids as well as plants. It resulted in a great sale of blue glass, but the great results not coming about that was expected, the sale soon ceased. The glaziers, however, made handsomely by the sale. The experiments here collected will show the facts in the case. (See Chemistry, Agricultural.)

LIGHTNING. One of the visible exhibitions of electricity. It occurs in several characteristic states, as, sheet lightning, or the reflection of invisible lightning on the clouds, in direct and zigzag lightning, and in what appears to be balls of fire, occasioned it is supposed by extraordinary accumulations passing through a conducting medium. (See Electricity.)

LIGNEOUS. Wood like.

LIGNIN. The pure fiber of wood divested of starch and other impurities; according to Payen, it consists of an investing or cellular matter, cellulose, isomeric with starch. Fine linen from hemp or flax is insoluble in water, decays very slowly, and is converted into dextrine by the action of dilute sulphuric acid and heat, and finally into starch sugar.

LIGNIPERDOUS INSECTS. Those insects which bore into or otherwise destroy wood.

LIGNITE. A kind of partially formed coal, in which the wood structure is distinct. It belongs to the secondary formations.

LIGULA. An appendage of the sheathing petioles of some grasses. The lower lip or labrum of insects.

LIGULATE. Shaped like a riband. The outer florets of some composite flowers are called ligulate.

LILAC. *Syringa.* A well known hardy shrub found in almost every garden, and of two principal colors, the lilac, and white. *S. vulgaris,* is the more common variety. *S. Persica,* is more profuse in its flowering; and in some respects is the better of the two species. It has been used for hedging occasionally. It will not form a protection against stock, but it holds its green color and bears the shears well. It is hardly to be recommended where either arbor-vitæ or privet will stand.

LILIACEÆ. A family of endogenous plants, remarkable for their brilliant flowers, including the lilies, hyacinths, tuberoses, etc. They are characterized by six petals, six stamens, superior ovary, anthers bursting inwardly.

LILIACEOUS. Flowers resembling the lily.

LILY. A class of superb flowering bulbs, or perennial plants, the most of them either hardy or surviving the winter in the North, under a good protection of mulch. There are many species, including the white lily, *L. candidum;* Martagon, *L. martagon;* tiger, *L. tigrinum;* orange, *L. aurantium,* and the bulbous, sorts, *L. bulbiferum.* The sorts named are all hardy and common. The Japan lilies contain some magnificent specimens, as for instance, *L. auratum,* the splendid gold banded lily. These may be left out over winter under a protection of mulch, and will make a profusion of magnificent bloom. The half hardy sorts require to be taken up in the fall and kept over winter in half moist sand. The hardy sorts should be taken up every three or four years and replanted. For pot culture of the tender sorts, they should be removed from the pot only when they require repotting. That is when the bulbs become too close. The best soil is equal parts of peat, strong loam and fine sand. They should have pots of large size and the bulbs should be deep enough to allow the stem fibers to grow freely. They should never be repotted except when the bulbs are dormant, then they may be turned out of the old pots, and the drainage, potsherds, if any, carefully removed, so as to avoid injuring the fibrous roots, or shaking off the earth. Repot in a larger pot in proper soil, being sure the drainage is good. The varieties are propagated from seed and the small offsets. The lily hyacinth is *Scilla Lillia-hyacinthus;* the lily of the valley, *convallaria majalis;* the lily pink, *Aphyllanthes*, and the lilly-thorn, a *catesbea*. The day lily is a *Hemerocallis*. *Amaryllus*, a splendid and extensive genus of plants, mostly hothouse, are sometimes but incorrectly called lilies, the same may be said of the calla sometimes called Ethiopean lily.

LILY, AMERICAN WATER. *Nelumbium luteum.* The sacred bean. It bears the largest flower in the Northern States. The beans are edible. *Nymphæ odorata*, of botanists, or sweet scented nymph, is the large double-flowered water lily of our ponds and sluggish streams, and altogether the most interesting of our aquatic flowers. While the yellow nelumbo is interesting as being the only American representative of the sacred lotus of the Egyptians, the white pond lily will always be regarded for its rare beauty and fragrance. As we go South it increases in size and beauty, but may be grown North in ponds that do not freeze to the bottom, and the water is not more than five or six feet deep, wherever the Concord grape will ripen.

LILY, DAY. *Hemerocallis fulva.* This has been recommended as an herbage plant. It is perennial, stands the summer well, and cattle are very partial to the leaves. It yields abundantly.

LILY OF THE VALLEY. *Convallaria majalis.* Sheep and cattle browse on it. Propagated by parting the perennial root.

LILY, YELLOW WATER. *Nupar lutea.* Common in ditches and ponds, bearing a yellow flower.

LIMACIDÆ. The family of slugs and snails.

LIMB, LIMBUS. The flat or extended portion of the petal.

LIME. What is generally understood by the term lime is quicklime, the protoxide of calcium, produced by burning limestones or sea-shells in the free draft of a fire. The process of calcination, drives off the carbonic acid contained in the limestone. If fresh burned lime be kept from access of air and moisture it will retain its condition unchanged. Its affinity for moisture, however, renders this difficult. Quicklime does not absorb carbonic acid from the atmosphere until it has first absorbed moisture. It then absorbs carbonic acid, and becomes a combined carbonate and hydrate of lime. For agricultural uses, lime is used air-slacked, after being burned, in which state it is a fine powder. Its mechanical action is to render heavy soils more porous, and light soils more tenacious. It does not act chemically on soils when freshly burned, and hence it is often mixed with three or four times its bulk of earth and spread upon the surface of the land. The weight and exceeding fineness of lime causes it to sink in the soil, hence it should always be applied near the surface. Lime is not a manure. It does not bring plant food to the soil, but assists that which is there for vegetable nutrition. It produces physical conditions enabling plants to assimilate the nutrition already in the soil. Hence the effect of lime on rich soils deficient in lime, and hence also the fact, that lime should not be used except in connection with other fertilizers, since one of the principal actions of lime is to convert insoluble matter of the soil into available plant food. Sometimes its effects are surprising upon worn soils. In this case it may be inferred that the fertility was then but locked up in an insoluble condition, a not by any means uncommon state of things. Hence the well known adage that, the only way to know if land wants lime is to try it. Theoretically a soil should contain three per cent. of lime, in connection with the percentage of vegetable matter and other plant food. The following table shows the am)unt in tons necessary to add from one-quarter of one per cent. to four per cent. of lime as it comes from the kiln, to a soil at the varying depths three, six, nine, and twelve inches in depth.

Tons.	3 inch. per cent.	6 inch. per cent.	9 inch. per cent.	12 inch. per cent.
4 tons give.....	¼	⅜	½	1
8 " "	½	¾	1	2
12 " "	¾	1	1½	3
16 " "	1	1½	2	4

The quantity generally applied is from four to twelve bushels per year, or from twelve to fifty bushels every three years. Lime is always found in plants, not as pure lime but chiefly as the carbonate, phosphate, or sulphate of lime, that is in combination with acids. Therefore, when it is found that a soil does not contain three per cent. of lime, it should be added. Prof. Way has determined the amount of lime in various plants; in 100 parts of the ash of the following plants, he found:

Of the grain of the creeping wheat....................	6.76
Of the straw and chaff..................................	7.46
Of the grain of chevalier barley......	1.48
Of the grain of potato-oats................	1.31
Of the chaff of oats.....................................	8.65
Of the grain of rye......................................	2.61

It is recorded as noticeable that the amount of lime present in the ash of various specimens of wheat was the most considerable—8.21 per cent. in some Hoptoun wheat grown on silicious sand, and that in another specimen of the same wheat grown on a chalk soil, the ash only contained 1.83 per cent. of lime. In the ash of various green crops, Prof. Way found, in 100 parts, the following amount of lime:

	Parts.
Red-clover hay..................................	35.02
White clover hay....	26.32
Sainfoin, (in flower)........	24.30
Sainfoin, (in seed).............................	29.67
Italian rye-grass, (in flower)...................	9.95
Italian rye-grass, (in seed).....................	12.29
Flower of hope, (mean of three specimens).......	19.33

The amount of lime in the red and white clover did not vary in different specimens grown on silicious or clay soils. It would have been reasonable to expect a large proportion of lime in the sainfoin, which flourishes best in a calcareous soil. The specimen, however, analyzed by Prof. Way was grown on a light gravelly loam, with a subsoil of gravel above chalky clay. In a ton of the ordinary roots and legumes (the entire plant) Prof. Way found the following amount of lime:

	Pounds.
Turnip	3.70
Mangold	0.87
Carrot	8.24
Kohl-rabi, (bulb)	10.20
Kohl-rabi, (leaves)	30.31
Peas	2.28
Pea-straw, (2,989 pounds)	86.80
Beans	2.75
Bean-straw, (2,270 pounds)	22.25

So that, as the professor remarks of the roots, twenty tons of bulbs and four tons of tops will require of lime:

	Pounds.
Turnips	90
Mangolds	21
Carrots	197

The ash of the various natural grasses was found by Prof. Way to contain from 14.94 per cent. (the *Phleum pratense*) to 3.94 (the *Alopecurus pratensis;*) in that of the artificial grasses he found from 45.95 per cent. (the *Medicago sativa*) to 13.40, (in the *Achillea millefolium*). It is noticeable that the amount of lime present in a plant varies considerably in its different portions. Thus, the ash of the *Kohl-rabi* contains 10.20 per cent. in that of the bulb, but 30.31 in the ash of the leaves. The ash of the root of the carrot yielded 5.64 per cent of lime, that of the leaves 24.04. The ash from the flowers of the hop 9.59 per cent., that from the leaves 30.73 per cent., that from the vine 23.71. The ash of the potato analyzed by Prof. Way contained in that of the tubes 4.50 per cent., in that of the haulm 29.86. The action of lime when applied to soils abounding in inert, organic matter, like the peaty, is not only to furnish a supply of lime to the plants which tenant such soils, but caustic lime tends to bring any dead vegetable matters which they contain into a state of decomposition, so as to render them more soluble in water, and so more available as food for growing plants. It is in this way that we account for the success of the mixture of lime with the scrapings of ditches, collections of weeds, pond mud, etc. This compound, after allowing it to remain in a heap for two or three months has been found to be a very useful manure, and acting quickly. It should be distinctly remembered that lime must never be applied as a part of the compost with fermenting manure, unless muck enough is used to take up the ammonia set free, since the effect of lime is not to fix ammonia, but to free it; to fix it, copperas or gypsum is to be used. This requires to be well remembered, for nitrogen is one of the most important and expensive in the whole category of substances necessary in the soil when maximum crops are to be raised. The following analyses of six samples of lime will enable the reader to get a good idea of the constituents:

Constituents.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.
Lime	74.23	69.76	79.87	88.44	86.97	89.93
Magnesia	2.44	12.12	.66	.51	3.35	2.15
Alumina and iron oxide	1.50	6.44	2.85	6.13	4.55	5.77
Residue, insoluble	3.93	2.80	.09			
Water and carbonic acid	17.90	8.88	16.53	4.92	5.13	2.15
	100.	100.	100.	100.	100.	100.

An analysis of hydraulic limestone gave the following results: Insoluble in acid, 27.49 per cent., consisting of:

	Per cent.
Silica	18.67
Alumina	6.23
Iron oxide	1.63
Manganese oxide	.64
Lime	.31
Soluble in acid, 72.51 per cent., consisting of:	
Lime	38.04
Magnesia	60
Iron and alumina	2.92
Carbonic acid	.23
Phosphoric acid	26.27
Soda	1.56
Potassa	1.90
Water	1.00
	100.00

In agriculture lime assists in pulverizing the soil, by acting chemically upon the silicates therein, dissolving out a portion of the silica and liberating potash and soda. It is for this cause that lime tells so well on poor granitic soils. From 100 to 600 bushels to the acre are used; wet, stiff lands, and those destitute of calcareous matter, requiring most. Lime corrects injurious substances in the soil, as sulphate of iron, etc. For this purpose a heavy dose is required. Lime breaks up or pulverizes stiff clays, improving their texture. For this purpose a heavy dose of quicklime is most effective. It decomposes inert vegetable matter, as peat, roots, etc. The dose for this purpose may be less than above; thirty to 100 bushels will be enough, if lime has been previously employed; but on peat lands, well drained, much more is necessary. Lime is found in large quantities as an ingredient in leguminous plants, potatoes, and other roots; hence it may be added as a special manure to such plants, three or four bushels being placed in the manure used for them. It hastens the decay of stable manure and putrescent substances and may be sprinkled over them when plowed into the soil, but not allowed to be added for any length of time to heaps of manure, for it drives off any ammonia already formed, and ultimately reduces the action of the dung. One bushel to three or four loads will be enough. A first liming for improvement of barren lands may be heavy; but if afterward a dose of twenty bushels to the acre be added every four or five years, it will save a very heavy addition for some time. Quicklime would be the best to add as an amendment, but it is difficult to handle, from its causticity and must never be added to wet soils, lest it convert them into a hard mortar. On the whole, therefore, water-slacked lime is the most useful. Air-slacked lime is used as a top-dressing to meadows, the other being too caustic; it is also employed to kill and annoy insects, which it does without injury to the plant. It is also added, in doses of a half to one peck, to the roots of fruit-trees, worked into the soil. The best kind of lime for the former is that obtained from burned shells, the common limestone usually containing magnesia, which, in a caustic state, is injurious to vegetation, from the slowness with which it becomes mild, so that it injures the roots of plants long after the lime has become quite mild. The older limestones, and especially those of a bright white, crystalline appearance, form the best lime. Lime is used in composts to pulverize inert vegetable matter, which it does very effectually, converting it in part into humate of lime; the action of the lime is similar to potash or soda, and termed by chemists catalytic, or predisposing. Lime-water and a cream of lime, made by mixing lime with water to the consistence of cream, are much used as a steep for seeds, and to wash the bark of trees, etc., to preserve them from insects; it is also supposed to preserve timber.

LINACEÆ. The family of plants to which flax belongs. They are remarkable for their mucilaginous seeds and tough fibers.

LINCOLN SHEEP. The Lincoln are considered as furnishing the best representative of nice combing wool in England, ewes shearing fifteen pounds per annum. It is also one of the largest of English sheep. The ewe of which a cut is given girted six feet, weighing alive 364 pounds, and when killed dressing sixty-seven pounds per quarter, dead weight. It is recorded that fourteen pounds average has been sheared, as a first clip, from a lot of thirty yearling, wether lambs, and which at fourteen months old averaged 140 pounds live weight. The Lincolns of the beginning of the century were large, coarse animals, with long, ragged, oily fleeces, the flesh of which however, was considered excellent. The sheep were inclined to make fat inside. Improvements in this breed of sheep have increased their value, both in flesh and wool. This improvement resulted through the use of Leicester rams, careful selection, and as careful feeding, and now it is celebrated for its long, lustrous and worsted wool, and in England has a separate class at the fairs. Like the Romney Marsh sheep they do well on rich alluvial soils and drained marshes, requiring plenty of rich succulent food and careful attention. These sheep have been introduced into the United States, West, and into Canada, where they are reported so far as doing well, but it will require some further time to fully establish the fact of their adaptability to our continental climate. This, however, would seem to be probable, since other of the long-wooled sheep do well on our flush summer pastures, and also on our winter food, which is principally composed of hay and grain, neither white nor Swedish turnips doing well in our hot summer climate. Our climate however, is well adapted to beets, carrots and parsnips, which may be very properly substituted.

LINCOLN EWE.

LINDEN. *Tilia.* The American linden, *T. Americana*, is one of our most majestic and beautiful shade trees, and in those sections of country where pine is scarce, it supplies the place of this tree in its lumber. It is generally known as bass-wood, linden, or linn. It is common in all the Northern and Middle States, and the northern Mississippi valley, an allied species *Tilia heterophylla* succeeding it as we go South; the latter larger than the Northern species in its leaves and flowers, and smaller in the size of the tree. Both species produce seed freely, which ripens in the fall. For planting they should be saved over winter in moist sand, or sown immediately. If not carefully kept they are difficult of germination. The European linden has a denser foliage than the American species, but it casts its foliage early, and does not seem adapted to the Western prairie soil. When it succeeds well it is the better tree for shade. The American species is good enough and should be planted more freely than it is. The cut shows one of the ornamental forms—the White Weeping Linden.

LINEATE, LINEATUS, LINEAR. Leaves, etc., which are narrow and of the same width throughout.

LINE OF DIP. In geology, the inclination of strata from the horizontal line; it is estimated in angles, and the direction of the dip toward the point of the compass given.

LINGUA. A tongue. In entomology, an organ placed within the labium, and serving the office of a tongue. Used also to designate the speech of a country.

WHITE-LEAVED WEEPING LINDEN.

LINGUATE, LINGUIFORM. A thick leaf, etc., shaped like the human tongue.

LINIMENT. In farriery, a semi-fluid ointment, or a soapy application to rub upon painful joints. The term is also applied to spirituous and other stimulating applications for external use. Liniments are intended either to lubricate or to stimulate; but in either case they can only be regarded as topical applications, their influence not extending beyond the part to which they are applied. In some instances they are anodyne, and contain solutions of opium in oil.

LINSEED. (See Flax.)

LINSEED JELLY. Is easily made by adding to six quarts of water one quart of linseed, boiling it for ten minutes. This mixed with other substances, is sometimes given to live-stock as food, and, mixed with milk, is very nutritious for calves.

LINSEED MEAL. Ground linseed.

LINSEED OIL. Is an excellent purgative—for sheep, from two to three ounces; for horses, in doses of from sixteen to twenty-four ounces; for cattle, from sixteen to twenty ounces. The quality of linseed oil may be determined in the following manner: Fill a vial with it, and hold it up to the light; if bad it will appear opaque, turpid, and thick; its taste is acid and bitter upon the tongue, and it smells rancid; and strong oil, from fine full-grown ripe seed, when viewed in a vial, will appear limpid, pale, and brilliant; it is mellow, and sweet to the taste, has very little smell, is specifically lighter than impure oil, and when clarified dries quickly and finely.

LINT. The staple of flax, hemp, and other textile plants. The scrapings from pieces of linen, of great use in dressing wounds and stopping slight hemorrhages.

LINTEL. A horizontal timber or stone over a door, window, or other opening, which sustains the weight above.

LIP. *Labellum.* In botany, the divisions of a monopetalous corolla, as the sage, mint, etc. It is divided into an upper and lower lip.

LIPPED AND HARLED. A wall built without mortar, but afterward having the joints filled with mortar, and the whole rough-cast or harled.

LIQUEFACTION. Melting, fusion, converting bodies into the fluid state, solution.

LIQUID MANURES. Manures applied in a soluble state, especially the stable wash. They are of especial service to produce rapid growth in young plants, and for steeps. In very dry seasons manures may also be applied in this state; but when added any length of time before the plants get size there is a loss by drainage; and the expense of application must always be heavy. The liquid soaked into peat, charcoal, etc., and added, as a top dressing, during moist or wet weather appears to be much preferred in the United States, and to be more economical. (See Manures.)

LIQUOR AMNIOS. The fluid surrounding the fœtus in its mother's womb. In botany, a fluid contained in the nucleus of the ovule, and supposed to nourish the embryo. It is absorbed during the ripening of the seed, sometime leaving behind a delicate sac only.

LIQUOR AMMONIÆ. Solution of ammoniacal gas in water.

LIQUORICE. *Glycyrrhiza glabra.* A half-hardy, herbaceous, perennial plant, cultivated for its roots, of which the well known form of glucose called liquorice is made, by extracting the juice and boiling. An American form of this plant, *G. lepidota,* is found in the Northwestern States and in Alaska, and is eaten by the Indians. The liquorice of commerce is obtained by slicing the roots and boiling in water. The liquor is then strained and evaporated to a proper consistency. It is refined by redissolving, purifying, and again evaporated, and formed into quill-sized rolls. It is used somewhat in medicines, and by brewers and confectioners. The cultivation of the root was introduced into some of the Middle and Southern States some years ago, but the results did not prove profitable.

LIQUORICE, WILD. *Galium circæzans.* The leaves have the taste of liquorice.

LIQUOR OF FLINTS. A solution of silicate of potash, made by fusing three parts carbonate of potash with one of sand.

LIRELLA. In lichens, a linear shield, with a furrow in the center.

LITHARGE. An impure fused protoxide of lead. It is used for some plasters.

LITHIA. A rare alkali, resembling potash. It corrodes platinum.

LITHIC ACID. Uric acid.

LITHIUM. The metal of lithia. Lithia is the protoxide.

LITHOLOGICAL. Relating to the structure, characters, etc., of minerals or stones.

LITHONTRIPTICS. Remedies which dissolve stones in the bladder. An abundance of water acidulated with cabonic acid is the best.

LITHOTOMY. The operation of cutting through the perinæum into the bladder to extract a stone.

LITHOTRITY. The operation of introducing an instrument into the bladder through the natural passage, to crush and break to small pieces a stone.

LITMUS. Turnsole. A blue color prepared from a lichen (*Rocella tartarea*), and used in the arts (*archil*) and in chemistry. Solution of litmus, or paper stained thereby, is of great use in detecting acidity in a fluid, the blue changing rapidly into red by the acid. Alkaline mixtures restore the paper so reddened.

LITRE. The French standard measure of capacity in the decimal system. The litre is a cubic decimetre; that is a cube, each of the sides of which are 3.937 inches; it contains 61.028 English cubic inches, and is, therefore, rather less than our quart. Four and a half litres are a close approach to the imperial gallon.

LITTER. The straw, weeds, or other dry substances which are placed under horses and cattle in the stables, cow-houses, farm-yards, piggeries, etc., for the purpose of keeping the animals clean and warm, and providing a supply of manure. In this last view all sorts of dry materials should be carefully collected and stacked up for winter use.

LITTORAL, LITTORALIS. Of the seashore. Littoral formations, in geology, are such as have evidently been ancient sea beaches.

LIVE OAK. *Quercus virens.* Evergreen swamp oak.

LIVER. A large gland or viscus, placed in quadrupeds, on the right side of the body, immediately under the chest, and adjoining the stomach. It is saturated with blood-vessels, and separates the bile from blood. The bile is stored up in a small bag, called the gall-bladder, and thrown from hence, during digestion, into the small intestines, to be mixed with the chyme. The function of the liver is of the first consequence to health; but it is readily impaired, especially in damp foggy places, subject to ague and bilious fevers. Its action, when insufficient, is rapidly stimulated by the use of calomel. Jaundice and yellowness of the white of the eye indicate disturbance of the liver.

LIVER FLUKES. (See Rot in Sheep.)

LIVER OF SULPHUR. A brownish substance, of a fœtid smell. Fused sulphuret of potassium.

LIVERLEAF. LIVERWORT. *Hepatica Americana.* An herbaceous, perennial rooted plant, of small size, found on the skirts of woodlands. A decoction used to be considered a specific and was prescribed in coughs.

LIVE STOCK. A term used to designate the animals usually kept on the farm; of these, cattle and horses are first in importance, then swine, mules, and sheep follow in respect to money value. The tables given will show the number of horses, mules, cows, other cattle, sheep, and swine in the United States, the average price, the value of each class and the total value as taken from the government statistics:

	Number.	Average price.	Value.
Horses	9,735,300	$64 96	$632,446,985
Mules	1,414,500	75 33	106,565,114
Cows	11,085,400	28 89	320,346,728
Other cattle	16,785,300	19 04	319,623,509
Sheep	35,935,300	2 60	93,666,318
Swine	25,726,800	6 80	175,070,484
Total	....	....	1,647,719,138

In the raising and preparing and transportation of live stock for market, and fitting it for the consumer, the following may be held as a fair exhibit of the real status of the business, from a business stand point, outside of the direct interests of the several persons and firms interested: Raising cattle is a copartnership business. The grower has one share, and the other must go to those who take the bullock off his hands, carry him to market, and slaughter and sell him. The largest item of expense is the transportation, as will be shown. While en route to market he is generally the property of the drover, who has purchased him from the grower, and who is the second factor in this trade. The drover looks after him while on the road, and sells him the first opportunity, provided he can make a fair profit. If no such opportunity occurs the bullock goes on to the seaboard, where he must leave the car and go into a yard. He has already had this experience, and had the cost charged to his account two or three times. This yarding costs forty cents a head. If the cattle are not sold immediately, and must remain over night, feed must be bought at a high price. The next operator who appears on the ground to make his profit and livelihood out of the cattle is the wholesale butcher, who purchases at the yards and either slaughters there or transports the animal by barge at an additional cost of forty cents to his own slaughtering establishment, from whence the quarters of beef, if designed for domestic consumption, are sent to the city

STATES.	Horses.			Mules.			Milch-Cows.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	79,400	$81 41	$6,463.954	....	....	....	164.300	$37 00	$6.079,100
New Hampshire	47,000	80 94	3,804.180	....	....	....	98.200	38 50	3,780,700
Vermont	74,500	83 24	6.201.380	....	....	....	209.500	33 70	7,060,150
Massachusetts	104,700	89 94	9,416,718	....	....	....	140,300	48 33	6.780,099
Rhode Island	14,700	97 87	1,438,689	....	....	....	20,400	39 60	795,600
Connecticut	51,100	82 14	4,197,354	....	....	....	110,900	43 33	4,805,297
New York	679,100	90 00	61,119,000	18,500	$98 35	$1,819,475	1,496,300	37 50	56,111,250
New Jersey	115,700	110 84	12,824,188	15,000	128 32	1,924,800	144,900	44 37	6,429,213
Pennsylvania	585,100	84 70	49,557,970	26,300	96 15	2,528,745	837,000	34 68	29,027,160
Delaware	19,600	83 45	1,635,620	4,000	95 00	380,000	23,000	32 00	736,000
Maryland	105,500	83 22	8,779,710	11,000	105 86	1,164,460	100,700	30 31	3,052,217
Virginia	194,900	69 53	13,551,397	29,800	85 60	2,550,880	227,000	22 77	5,168,790
North Carolina	139,700	74 97	10,473,309	51,700	82 54	4,267,318	201,000	15 48	3,111,480
South Carolina	56,900	88 58	5,040,202	44,700	94 07	4,204,929	159,300	19 75	3,146,175
Georgia	118,300	79 37	9,389,471	96,200	87 12	8,380,944	265,100	17 02	4,512,002
Florida	16,700	78 22	1,306,274	9,600	91 65	879,840	66,800	14 62	976,616
Alabama	104,400	71 36	7,449,984	101,400	80 20	8,132,280	168,200	20 27	3,409,414
Mississippi	89,100	76 04	6,775,164	96,100	97 07	9,328,427	174,600	21 03	3,671,838
Louisiana	76,300	58 78	4,484,914	79,900	83 96	6,708,404	89,600	20 71	1,855,616
Texas	770,400	33 17	25,554,168	110,700	53 59	5,932,413	500,100	15 72	7,861,572
Arkansas	158,900	54 09	8,594,901	83,400	67 50	5,629,500	160,900	16 20	2,606,580
Tennessee	318,000	62 64	19,919,520	101,900	67 82	6,910,858	225,700	20 83	4,701,331
West Virginia	111,900	59 44	6,651,336	2,400	68 08	163,392	125,500	25 77	3,234,135
Kentucky	364,700	56 94	20,766,018	85,000	58 93	5,009,050	244,700	27 94	6,836,918
Ohio	760,800	69 14	52,601,712	26,500	72 04	1,909,060	809,600	32 65	26,433,440
Michigan	296,900	82 31	24,437.839	3,800	96 12	365,256	361,100	33 70	12,169,070
Indiana	675,600	61 76	41,725,056	58,400	71 71	4,187,864	434,900	27 40	11,916,260
Illinois	1,091,700	59 75	65,229,075	111,100	71 37	7,929,207	717,800	29 05	20,852,090
Wisconsin	352,100	67 05	23,608,305	5,200	85 26	443,352	474,000	26 75	12,679,500
Minnesota	172,400	75 09	12,945,516	3,200	95 79	306,528	233,500	25 19	5,881,865
Iowa	685,800	63 83	43,774,614	37,000	82 21	3,041,770	621,800	26 90	16,726,420
Missouri	581,500	45 40	26,400,100	126,200	56 03	7,070,986	438,200	20 86	9,140,852
Kansas	227,300	49 63	11.280,899	20,700	64 40	1,333,080	235,700	23 76	5,600,232
Nebraska	67,900	69 42	4,713,618	4,600	98 00	450,800	59,700	28 09	1,676,973
California	209,200	45 46	9,514.778	19,400	77 20	1,497,680	363.800	31 46	11,445,148
Oregon	91,400	42 68	3,900,952	3,700	45 68	169,016	80,900	21 75	1,759,575
Nevada	10,900	54 00	588,600	1,100	78 00	85,800	9,900	33 00	326,700
Territories	115,100	55 00	6,330,500	26,000	71 50	1,859,000	290,500	27 50	7,988,750
Total	9,735,300	....	632,446 985	1,414,500	....	106.565,114	11,085,400	....	$320,346,728
Grand Average	....	$64 96	....	....	$75 33	....	....	$28 89	....

market, to be sold by a commission merchant at five per cent. commission. The retail dealer then carries them to his stall or shop, where they are cut up and sold by the piece to the consumer. So the grower has one share of the bullock for his part, and the consumer pays for that and the other share which is divided among the others. It is a close business; the drovers not averaging over one dollar per head for their net profits, and the wholesale butchers realizing from two to three dollars as their share of gain, with a heavy expense to come out of it, viz.: The use of a large capital, buildings and appliances, and the cost of killing. The seller gets five per cent. with all risk of debts, etc., and the retailer cuts his meat and figures to sell at ten per cent. increase on the cost. It costs now in New York forty dollars to transport a hundred cattle from the railroad termini to the private slaughter-houses, as they all have to go by barges on the water; whereas they were formerly driven across the city on foot at an expense not exceeding two dollars. This is required by local law. There is but little probability of reducing the various expenses connected with the trade in fresh meat, unless it be possible to get rid of the speculative drover, whose fitful profits really average but little. He seems, after all, to be a necessity, as breeders are not used to the transit, dislike its risks, and will probably continue to sell to the drovers rather than to send forward their stock on their own account. Many cattle are sold by brokers at the yards, who charge a commission on their sales. This is an extra tax on the beeves, which the consumer pays. Cattle sent to Europe are purchased at the yards by the shippers, who select and slaughter their stock on the ground, and thus avoid some of the extra expenses which follow stock which are designed for home consumption. The wholesale butcher, in order to make his profit of two or three dollars per head, turns every part of the animal to account. Every thing possible is saved and sold for cash. The retail dealer must cut his profit out of one-third of the beef. If the balance can be made to bring cost he is satisfied. When the carcase costs nine cents a pound he must sell one-third in roasts and steaks at an average of eighteen cents per pound. One-fourth of a sheep can be cut into chops, which must be sold at eighteen cents and the legs of the hind quarters for fifteen cents, to make an advance of ten per cent. on the cost at eight cents per pound by the carcase, as the balance of the sheep will not sell for more than five cents per pound. The profits of dealers on a beef weighing six and one-half hundred pounds would be less than six dollars, and on a sheep weighing fifty pounds the advance would be but forty cents. These figures, of course, will vary, according to location, nearness to market, etc., but they will approximate nearly enough for all practical purposes. In fact, experience as a rule is simply the basis for calculation.—The following table shows the estimated number, average price, and value of oxen and other cattle, sheep and hogs, from government statistics:

STATES.	Oxen and other Cattle.			Sheep.			Hogs.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	201,900	$35 44	$7,155,336	525,900	$3 78	$1,987,902	58,800	$11 66	$685,608
New Hampshire	118,000	38 12	4,493,160	242,400	2 70	654,480	37,300	16 20	604,260
Vermont	130,500	29 33	3,827,565	490,500	3 74	1,834,470	51,800	12 19	631,442
Massachusetts	120,000	47 59	5,710,800	76,300	3 63	276,969	75,600	18 03	1,363,068
Rhode Island	16,000	49 72	795,520	25,300	3 96	100,188	16,300	17 05	277,915
Connecticut	114,100	36 68	4,185,188	92,500	4 18	386,650	57,900	16 73	968,667
New York	663,200	31 85	21,122,920	1,936,500	3 95	7,649,175	568,700	11 39	6,477,493
New Jersey	83,000	36 60	3,037,800	125,800	5 01	630,258	153,000	13 83	2,115,990
Pennsylvania	708,100	29 03	20,556,143	1,640,500	3 58	5,872,990	875,000	11 50	10,062,500
Delaware	31,700	24 72	783,624	23,600	3 67	86,612	46,700	10 61	495,487
Maryland	119,300	22 87	2,728,391	141,200	3 89	549,268	233,500	7 10	1,657,850
Virginia	397,500	16 86	6,701,850	356,400	2 93	1,044,252	589,800	4 45	2,624,610
North Carolina	313,200	10 19	3,191,508	283,900	1 58	448,562	758,300	4 01	3,040,783
South Carolina	186,700	11 69	2,182,523	142,700	1 81	258,287	275,900	4 11	1,133,949
Georgia	400,900	8 91	3,572,019	371,200	1 73	643,176	1,360,700	3 91	5,320,337
Florida	363,400	8 14	2,958,076	37,800	1 94	73,332	175,400	2 26	396,404
Alabama	327,300	12 79	4,186,167	185,930	1 93	358,787	755,900	3 99	3,016,041
Mississippi	307,100	11 85	3,639,135	151,800	1 81	274,758	792,900	4 31	3,417,399
Louisiana	171,900	11 68	2,007,792	68,800	2 04	140,352	222,600	3 98	885,948
Texas	2,343,700	9 57	22,429,209	1,691,400	2 00	3,382,800	1,090,000	4 09	4,458,100
Arkansas	261,300	10 62	2,775,006	192,400	2 01	386,724	901,200	3 31	3,523,692
Tennessee	323,700	12 19	3,945,903	341,700	2 11	720,987	1,026,400	5 22	5,357,808
West Virginia	235,200	21 63	5,087,376	544,500	2 55	1,388,475	248,400	5 38	1,336,392
Kentucky	389,600	21 14	8,236,144	683,600	2 85	1,948,260	1,604,800	5 51	8,839,693
Ohio	864,900	24 87	21,510,063	4,546,600	2 72	12,366,752	1,596,100	8 06	12,864,566
Michigan	410,000	26 35	10,808,500	3,450,600	2 65	9,144,090	459,700	7 93	3,645,421
Indiana	772,300	19 65	15,175,695	1,250,000	2 62	3,275,000	2,136,000	7 70	16,447,200
Illinois	1,287,000	21 54	27,721,980	1,311,000	2 41	3,159,510	2,640,100	8 63	22,784,063
Wisconsin	448,900	20 39	9,153,071	1,162,800	2 74	3,186,072	540,700	7 58	4,098,506
Minnesota	329,500	20 05	6,606,475	190,200	2 63	500,226	213,400	6 99	1,491,666
Iowa	913,200	20 91	19,095,012	1,663,900	2 66	4,425,974	3,296,200	8 08	26,633,296
Missouri	813,800	17 38	14,143,844	1,284,200	1 86	2,388,612	1,874,300	5 94	11,133,342
Kansas	486,200	18 95	9,213,490	123,900	2 80	346,920	246,500	8 91	2,196,315
Nebraska	86,900	20 76	1,804,044	48,900	2 77	135,453	80,900	7 58	613,222
California	1,075,000	20 08	21,586,000	6,750,000	2 02	13,635,000	363,300	7 17	2,604,861
Oregon	137,600	12 75	1,754.400	710.500	1 99	1,413,895	181,500	4 41	800,415
Nevada	46,700	21 00	980,700	20.900	2 60	54,340	5,200	9 00	46,800
Territories	786,000	18 78	14,761,080	3,049,200	2 80	8,537,760	116,500	8 75	1,019,375
Total	16,785,300	......	319,623,509	35.935,300	....	$93,666,318	25,726,800	....	$175,070.484
Grand Average	....	$19 04	....	....	$2 60	....	....	$6 80	....

LIVE-STOCK MARKETS FOR 1879.

Products.	January.	February.	March.	April.	May.	June.
NEW YORK.						
Cattle:						
Extra beeves.....cental	$10 25 to $10 50	$10 25 to $10 50	$10 50 to $10 75	$10 50 to $10 75	$10 50 to $10 75	....
Good to prime “	8 75 to 10 00	9 00 to 10 00	8 75 to 10 75	9 50 to 10 50	9 25 to 10 25	$8 25 to $9 50
Common to fair “	7 50 to 8 50	7 75 to 8 75	8 00	8 25 to 9 25	8 50 to 9 00	8 00 to 8 50
Poor to common “	....	6 75 to 7 50	....	7 00 to 8 00	....	6 50 to 7 00
Texas and Cherokee, cental..............	....	....	....	....	....	6 00 to 6 50
Milch cows........head	40 00 to 60 00	35 00 to 65 00	50 00 to 60 00	30 00 to 50 00	45 00	35 00 to 55 00
Veal calves......cental	2 50 to 7 50	2 75 to 7 50	6 50 to 7 50	4 00 to 6 00	2 50 to 5 00	2 75 to 6 00
Sheep .... “	4 00 to 5 00	4 00 to 5 50	4 87½ to 6 00	5 12½ to 7 00	4 50 to 6 50	3 50 to 5 75
Swine .... “	2 90 to 3 10	3 50	4 25 to 4 60	4 37½	3 80 to 4 00	3 70 to 3 90
CINCINNATI.						
Cattle:						
Fair to good shipping steers..........cental	4 00 to 4 75	4 25 to 4 75	4 25 to 4 75	4 50 to 5 20	4 50 to 5 00	4 00 to 4 50
Common to choice butchers' grades.....cental	1 25 to 4 00	1 50 to 4 35	2 00 to 4 50	2 00 to 5 00	2 00 to 5 00	1 75 to 4 40
Cows, heifers, etc. “	2 50 to 3 75	2 50 to 4 00	2 50 to 4 25	3 00 to 4 75	3 00 to 4 65	3 00 to 4 25
Sheep............ “	2 00 to 4 50	3 00 to 5 25	3 00 to 4 75	3 00 to 5 25	3 00 to 5 00	2 50 to 4 25
Swine .... “	2 25 to 3 00	2 60 to 3 85	3 00 to 4 20	2 90 to 4 25	2 50 to 3 75	2 50 to 3 60
CHICAGO.						
Cattle:						
Extra beeves.....cental	4 60 to 5 00	4 75 to 5 25	4 80 to 5 00	4 85 to 5 10	4 85 to 5 15	4 80 to 5 10
Choice beeves.... “	4 10 to 4 35	4 25 to 4 50	4 50 to 4 70	4 60 to 4 70	4 50 to 4 70	4 65 to 4 75
Good beeves..... “	3 60 to 4 00	3 50 to 4 00	4 00 to 4 40	4 20 to 4 50	4 10 to 4 40	4 25 to 4 50
Medium grades.. “	3 00 to 3 50	3 25 to 3 50	3 75 to 4 00	3 85 to 4 15	3 85 to 4 15	4 00 to 4 25
Inferior natives . “	1 75 to 2 00	1 80 to 2 25	2 00 to 2 50	2 00 to 2 50	2 00 to 2 50	1 50 to 2 00
Texans.......... “	....	....	....	....	....	....
Veal calves...... “	2 75 to 4 50	3 00 to 4 75	3 00 to 5 00	3 00 to 5 00	3 00 to 5 00	3 00 to 4 75
Sheep............ “	2 75 to 4 25	3 00 to 4 60	3 25 to 5 00	3 75 to 5 75	3 50 to 5 75	2 75 to 5 50
Swine .... “	2 65 to 3 00	2 00 to 3 75	3 00 to 4 00	3 70 to 4 15	3 25 to 3 60	2 75 to 3 60
SAINT LOUIS.						
Cattle:						
Choice natives...cental	4 35 to 4 85	4 75 to 5 25	4 60 to 5 10	4 80 to 5 15	4 75 to 5 10	4 75 to 5 00
Fair to prime natives, cental..............	3 37½ to 3 85	4 00 to 4 55	4 20 to 4 35	4 65 to 4 80	4 25 to 4 70	4 25 to 4 70
Fair to good butchers' steers ....cental	2 75 to 3 50	3 60 to 4 00	3 85 to 4 00	4 12½ to 4 65	3 75 to 4 40	3 75 to 4 40
Common to good stock steers..........cental	2 50 to 2 65	2 25 to 2 75	2 00 to 2 90	3 25 to 4 00	3 00 to 3 75	3 00 to 3 75
Texans and Cherokees, cental	2 75 to 3 50	....	....	3 80 to 4 50	3 50 to 4 50	3 00 to 4 00
Sheep.............cental	2 00 to 4 25	2 25 to 4 75	3 50 to 5 50	4 00 to 5 00	3 00 to 4 70	3 20 to 3 45
Swine .... “	2 20 to 2 75	3 40 to 3 90	3 50 to 4 30	2 90 to 4 15	2 50 to 3 75	2 75 to 3 60
Horses:						
Plugs ....head	10 00 to 30 00	15 00 to 35 00	15 00 to 35 00	15 00 to 35 00	15 00 to 35 00	20 00 to 40 00
Southern horses... “	25 00 to 80 00	30 00 to 85 00	30 00 to 85 00	30 00 to 90 00	30 00 to 90 00	30 00 to 85 00
Streeters .... “	75 00 to 90 00	75 00 to 90 00	75 00 to 85 00	75 00 to 90 00	75 00 to 90 00	85 00 to 110 00
Heavy draft. .. “	90 00 to 190 00	95 00 to 190 00	95 00 to 190 00	95 00 to 190 00	95 00 to 190 00	100 00 to 150 00
Saddle horses..... “	....	....	....	....	....	75 00 to 150 00
Extra drivers ..... “	110 00 to 170 00	110 00 to 170 00	110 00 to 170 00	110 00 to 170 00	110 00 to 170 00	100 00 to 145 00
Good matches..... “	250 00 to 400 00	250 00 to 400 00	250 00 to 400 00	250 00 to 400 00	250 00 to 400 00	250 00 to 400 00
Mules:						
14 to 15 hands high “	55 00 to 95 00	40 00 to 80 00	35 00 to 75 00	35 00 to 80 00	35 00 to 100 00	55 00 to 85 00
15 to 16 hands high “	80 00 to 140 00	60 00 to 120 00	55 00 to 115 00	55 00 to 115 00	75 00 to 130 00	75 00 to 140 00
16 to 16½ hands high “	115 00 to 140 00	100 00 to 120 00	95 00 to 115 00	95 00 to 115 00	95 00 to 130 00	110 00 to 140 00
NEW ORLEANS.						
Cattle:						
Corn-fed beeves..cental	2 00 to 4 50	2 00 to 4 50	2 50 to 5 00	3 50 to 5 00	3 00 to 5 00	3 00 to 4 50
Choice Texas' beeves, head..............	....	....	....	....	....	25 00 to 30 00
Texas, 1st quality.head	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	20 00 to 24 00
Texas, 2d quality.. “	15 00 to 25 00	15 00 to 25 00	15 00 to 25 00	15 00 to 25 00	15 00 to 25 00	15 00 to 18 00
Milch cows........ “	30 00 to 90 00	30 00 to 90 00	25 00 to 75 00	25 00 to 75 00	25 00 to 75 00	25 00 to 75 00
Calves............ “	6 00 to 8 00	6 00 to 9 00	6 00 to 9 00	6 00 to 9 00	6 00 to 9 00	6 00 to 9 00
Sheep.............. “	2 00 to 4 00	2 00 to 4 00	2 00 to 4 50	2 00 to 4 50	2 00 to 4 50	2 00 to 4 00
Swine..... ...... “	3 00 to 4 00	2 50 to 3 50	3 50 to 4 50	3 00 to 3 50	3 00 to 4 50	3 00 to 4 50
Horses:						
Common.......... “	50 00 to 100 00	50 00 to 100 00	50 00 to 100 00	50 00 to 100 00	50 00 to 100 00	50 00 to 100 00
Plugs............. “	....	....	....	....	....	....
Good working .... “	100 00 to 175 00	100 00 to 175 00	100 00 to 175 00	100 00 to 175 00	100 00 to 175 00	100 00 to 175 00
Mules:						
First-class......... “	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00
For sugar plantations, head..............	....	....	....	....	....	....
For city use.......head	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00	175 00 to 225 00
For rice culture, small, head	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00

The above table explains itself, and is given as furnishing an indication of the relative view of the live stock markets and prices in the United States, for general reference.

LIVE-STOCK MARKETS FOR 1879—CONTINUED.

PRODUCTS.	July.	August.	September.	October.	November.	December.
NEW YORK.						
Cattle:						
Extra beeves.....cental	$ 9 50 to $10 00	$10 50	$10 50 to $10 75	$ 9 75 to $10 00	$ 9 75 to $10 25	$10 00 to $10 50
Good to prime "	8 00 to 9 25	$ 7 75 to 10 00	7 75 to 10 25	8 75 to 9 50	7 50 to 9 50	7 75 to 9 75
Common to fair "	7 50	....	....	7 00 to 8 50	6 25 to 7 00	7 25 to 7 75
Poor to common "	....	....	....	....	....	....
Texas and Cherokee, cental	....	6 50 to 7 00	6 50 to 6 75	....	....	....
Milch cows........head	30 00 to 50 00	25 00 to 35 00	30 00 to 45 00	35 00 to 48 00	40 00 to 60 00	40 00 to 60 00
Veal calves......cental	2 50 to 5 50	2 37 to 6 25	2 25 to 5 50	4 00 to 6 25	2 25 to 7 25	2 00 to 7 50
Sheep .... "	3 00 to 5 62½	3 75 to 5 75	3 75 to 5 25	3 50 to 5 00	3 00 to 4 80	5 25 to 5 50
Swine .... "	....	4 00 to 4 25	3 60 to 3 80	4 00 to 4 30	3 90 to 4 30	3 50 to 4 31
CINCINNATI.						
Cattle:						
Fair to good shipping steers..........cental	3 75 to 4 35	3 75 to 4 50	4 00 to 4 50	3 85 to 4 40	3 80 to 4 60	3 90 to 4 50
Common to choice butchers' grades.....cental	1 75 to 4 25	1 50 to 4 00	1 50 to 4 00	1 50 to 3 75	1 50 to 3 60	1 40 to 3 60
Cows, heifers, etc. "	3 00 to 4 00	2 75 to 3 75	3 00 to 4 00	3 00 to 3 65	3 00 to 3 50	2 00 to 2 50
Sheep............. "	2 25 to 4 75	2 00 to 4 00	2 00 to 4 25	2 35 to 4 25	2 25 to 4 25	2 50 to 4 50
Swine............ "	3 00 to 4 00	2 75 to 3 70	2 60 to 3 70	2 80 to 3 85	3 00 to 4 00	3 50 to 4 75
CHICAGO.						
Cattle:						
Extra beeves.....cental	4 75 to 4 90	4 80 to 5 15	5 00 to 5 30	4 65	4 70 to 4 90	4 65 to 4 85
Choice beeves.... "	4 40 to 4 60	4 40 to 4 60	....	....	4 35 to 4 60	4 25 to 4 50
Good beeves..... "	4 10 to 4 40	4 00 to 4 10	....	....	3 80 to 4 20	3 75 to 4 15
Medium grades.. "	3 75 to 4 00	3 50 to 3 90	....	3 25 to 4 00	3 25 to 3 75	3 15 to 3 65
Inferior natives. "	2 00 to 2 40	1 75 to 2 25	2 00 to 3 50	2 25 to 2 75	1 50 to 2 25	1 75 to 2 00
Texans.......... "	2 75 to 3 50	2 25 to 2 80	2 25 to 2 65	2 40 to 2 60	2 40 to 3 10	....
Veal calves....... "	3 25 to 5 25	3 25 to 5 00	....	....	3 00 to 4 75	2 75 to 4 75
Sheep............. "	2 25 to 4 75	2 50 to 4 75	2 50 to 4 75	2 50 to 4 25	3 00 to 3 75	3 00 to 4 25
Swine............ "	3 00 to 3 85	2 25 to 3 75	3 00 to 3 75	3 15 to 3 80	3 40 to 3 95	4 00 to 4 70
SAINT LOUIS.						
Cattle:						
Choice natives...cental	4 70 to 5 00	4 70 to 4 80	4 70 to 4 85	4 70 to 4 80	4 70 to 4 80	4 50 to 4 70
Fair to prime natives, cental...............	4 15 to 4 65	4 15 to 4 65	3 75 to 4 60	3 75 to 4 60	3 75 to 4 60	3 50 to 4 40
Fair to good butchers' steers..........cental	3 75 to 4 25	3 75 to 4 40	3 00 to 3 60	3 00 to 3 60	3 00 to 3 60	3 00 to 3 60
Common to good stock steers..........cental	2 25 to 3 40	3 00 to 3 75	2 00 to 3 25	2 00 to 2 75	2 00 to 2 75	2 00 to 2 75
Texans and Cherokees, cental...............	3 00 to 4 00	3 00 to 4 00	2 25 to 3 75	....	2 27 to 3 75	2 25 to 3 75
Sheep..............cental	3 75 to 3 12½	2 50 to 2 95	2 15 to 3 25	2 00 to 4 25	2 25 to 4 15	2 25 to 4 00
Swine .... "	3 40 to 4 00	3 45 to 4 00	2 80 to 3 55	2 50 to 3 75	2 90 to 3 80	3 20 to 4 00
Horses:						
Plugs ....head	25 00 to 40 00	25 00 to 40 00	25 00 to 40 00	25 00 to 40 00	20 00	25 00 to 40 00
Southern horses... "	40 00 to 70 00	40 00 to 70 00	40 00 to 70 00	30 00 to 70 00	40 00 to 70 00	30 00 to 70 00
Streeters .... "	80 00 to 100 00	80 00 to 100 00	70 00 to 100 00	80 00 to 100 00	80 00 to 90 00	80 00 to 100 00
Heavy draft. .. "	90 00 to 140 00	90 00 to 140 00	90 00 to 135 00	90 00 to 125 00	85 00 to 130 00	90 00 to 125 00
Saddle horses..... "	75 00 to 150 00	75 00 to 150 00	75 00 to 150 00	75 00 to 150 00	70 00 to 125 00	75 00 to 150 00
Extra drivers ..... "	125 00 to 175 00	125 00 to 175 00	125 00 to 200 00	125 00 to 200 00	85 00 to 135 00	85 00 to 200 00
Good matches..... "	250 00 to 400 00	225 00 to 400 00	....	....	....	....
Mules:						
14 to 15 hands high "	50 00 to 90 00	55 00 to 95 00	50 00 to 90 00	50 00 to 90 00	50 00 to 85 00	50 00 to 70 00
15 to 16 hands high "	85 00 to 140 00	85 00 to 140 00	85 00 to 135 00	90 00 to 140 00	85 00 to 140 00	75 00 to 140 00
16 to 16½ hands high "	110 00 to 140 00	110 00 to 140 00	110 00 to 165 00	110 00 to 175 00	110 00 to 175 00	110 00 to 175 00
NEW ORLEANS.						
Cattle:						
Corn-fed beeves..cental	....	....	....	....	2 50 to 4 00	2 50 to 4 00
Choice Texas beeves, head................	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	....	....	....
Texas, 1st quality.head	24 00 to 28 00	24 00 to 28 00	24 00 to 28 00	....	....	....
Texas, 2d quality.. "	15 00 to 20 00	15 00 to 20 00	15 00 to 20 00	....	....	....
Milch cows........ "	25 00 to 75 00	25 00 to 75 00	25 00 to 75 00	35 00 to 80 00	35 00 to 80 00	35 00 to 80 00
Calves............. "	5 00 to 8 00	5 00 to 8 00	5 00 to 8 00	5 00 to 8 00	7 00 to 9 00	7 00 to 9 00
Sheep.............. "	2 00 to 4 00	2 00 to 4 00	2 00 to 4 00	2 00 to 4 00	2 00 to 4 00	2 00 to 4 00
Swine............. "	3 00 to 4 50	3 00 to 4 50	3 00 to 4 50	3 00 to 4 50	3 50 to 4 50	3 00 to 4 50
Horses:						
Common.......... "	50 00 to 100 00	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00	....	....
Plugs............. "	....	....	....	....	50 00 to 90 00	45 00 to 75 00
Good working .... "	100 00 to 175 00	90 00 to 110 00	90 00 to 120 00	90 00 to 100 00	90 00 to 120 00	90 00 to 100 00
Mules:						
First-class......... "	175 00 to 225 00	....	175 00 to 225 00	140 00 to 210 00	....	....
For sugar plantations, head..............	....	125 00 to 190 00	....	....	160 00 to 190 00	150 00 to 210 00
For city use.......head	175 00 to 225 00	140 00 to 200 00	140 00 to 210 00	....	160 00 to 200 00	150 00 to 210 00
For rice culture, small, head...............	100 00 to 150 00	....	100 00 to 110 00	100 00 to 120 00	105 00 to 135 00	100 00 to 120 00

The above table explains itself, and is given as furnishing an indication of the relative view of the live stock markets and prices in the United States, for general reference.

The total number of the various live stock of the United States in 1879, the average price and the total valuation is as follows:

	Number.	Average price.	Value.
Horses	10,938,700	$52 41	$573,254,808
Mules	1,713,100	56 06	96,033,971
Milch cows	11,826,400	21 73	256,953,928
Oxen and other cattle	21,408,100	15 39	329,543,327
Sheep	38,123,800	2 07	79,023,984
Hogs	34,766,100	3 18	110,613,044

Or again, the total number of live stock in the United States may be stated, in round numbers, at about 100,000,000, worth $1,500,000,000, an immense aggregate amount considering the low average value, the great bulk being produced at far distant points from the place of consumption. For other matter in relation to stock, see articles Cattle, Horses, Sheep, Swine, Poultry, etc. For birds see articles under the several names of the various kinds noticed.

LIXIVIATION. The process of washing out the soluble from the insoluble portions of mineral substances, as in making lye; hence, lixivium means a lye or alkaline solution.

LIZARDS. *Lacertidæ, Lacertians.* Harmless reptiles, but of utility from the insects which they devour.

LOAD. A vague measure; it is better understood when divided into one, two, or three horse loads. A single horse load is generally estimated at thirty bushels, one cubic yard, or one ton by weight.

LOAM. A vague term, meaning soil, and containing a large proportion of vegetable matter and clay. In Prof. Johnston's lectures, a loam is represented as a soil containing thirty to sixty per cent. of sand, the rest being clay, limestone, or vegetable matter; a clay loam contains but twenty to thirty per cent. sand, and a sandy loam upward of sixty per cent. sand. This word is often improperly written loom, and applied to a friable rich soil, containing much decaying vegetable matter.

LOBBY. An anteroom or hall.

LOBATE, LOBED. Divided into large curved segments more or less circular.

LOBELIA. A genus of plants containing many very poisonous species, as the Indian tobacco (*L. inflata*), which is of use in asthmas, and as an emetic. They are pretty herbaceous plants, with perennial roots, and often cultivated for their beauty.

LOBLOLLY BAY, HOLLY BAY. *Gordonia lasianthus.* A large southern evergreen found growing in swamps, producing large white flowers. The wood is rosy, but light and brittle; the bark is extensively used in tanning in the southeastern States. It very much resembles the magnolia.

LOCKED JAW. *Tetanus, trismus.* A consequence of injuries about the feet, or of worms, severe nervous diseases; the muscles become rigid, and finally locked jaw supervenes. When it arises from a wound or laceration, the case is usually hopeless; when disease (*tetanus*), large doses of opium are found to do most good, with the removal of all causes of irritation. The strength must be sustained by injections of broths and soups.

LOCKING WHEELS. Hindering the rolling of one or more wheels in descending steep hills. It is done by fastening a chain from the body of the wagon to the spokes of the wheel, or by levers of a drag.

LOCOMOTION. Change of place.

LOCUAR. A cell or division in a fruit; thus, fruits are unilocular, bilocular, etc.

LOCULICIDA. A term designating the bursting (dehiscence) of a seed vessel along the back suture.

LOCUST. *Caloptenus. Orthoptera.* The great devastation produced by grasshoppers, as they are generally called, but which are really locusts, deserve more than a passing notice of these destructive insects. In every age of the world they have scourged continental countries. In the United States their depredations have been confined to the trans-Mississippi regions, and hence, until the settlement of that country they have attracted but little notice. The late Dr. Walsh, and his since famous pupil and co-laborer, Dr. Riley, and Dr. Thomas, the present State Entomologist of Illinois, and Dr. Packard, have spent much labor in investigating the history and habits of the American species, and the three latter gentlemen are now just finishing up this work, as members of the Entomological Commission, under a special act of the Congress of the United States. In 1866, Dr. Walsh published the results of his previous investigations of the insect which has since committed such wide-spread havoc, and to which he gave the name of *Caloptenus spretus*, and the English name of hateful grasshopper. In presenting this subject Dr. Walsh remarked that the eggs, which in the autumn of that year were deposited in the trans-Mississippi country, in countless myriads, would not hatch out that autumn, but would lie in the ground until the succeeding spring, and then hatch out, if the conditions for life were proper, and do vast injury. At the same time he distinctly foretold that the locusts developed from these eggs would have their generative functions so impaired by the difference in food, climate, density of air, temperature, moisture, etc., which they met in the lowland country, that they would become incapable of further propagating their species, and that they would then and there die out; also that the species would never cross the Mississippi river. The first of these predictions were fully verified, and the second has so far been as fully correct. The United States Entomological Commission has now been engaged some three years in their investigations of the locust, and have added much valuable information and suggestions to what was known before. From their reports published by the Government, we shall freely extract the principal points of general interest. The account of the visitations up to 1877 will be found in the table on the next page. The classification and nomenclature or characters of the species of our locusts are given as follows: When the popular name of a group of insects or other animals, that is generally accepted, corresponds somewhat closely in its application to the scientific division, it is not difficult to convey to the general reader a correct idea of the position and characters of a given species by reference to and comparison with well-known species of that group. Unfortunately, in the present instance, not only is the opportunity for refer-

TABULAR VIEW OF LOCUST YEARS.

Texas.	Arkansas.	Indian Ter.	Missouri.	Kansas.	Nebraska.	Iowa.	Minnesota.	Dakota.	Montana.	Idaho.	Wyoming.	Colorado.	Utah.	New Mexico.	Nevada.	Washington T. and Oregon.	British North America.
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							1863	1863	1863				1863				
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						1865	1865	1865	*1865			*1865	1865	1865			1865
*1866			*1866	*1866	*1866	1866	1866	1866	*1866			1866	*1866				
*1867			*1867	*1867	*1867	*1867	1867	1867	*1867			*1867	*1867				
1868			1868	1868	1868	1868		1868	1868				*1868				
			1869	1869			1869	1869	*1869	1869		1869	1869				
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1875		1875	*1875	*1875	*1875	1875	1875	*1875	*1875		*1875	*1875	1875			1875	*1875
*1876	1876	1876	*1876	*1876	*1876	*1876	*1876	*1876	*1876	1876	*1876	*1876	*1876	1876		1876 or	*1876
*1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	*1877	1877	1877	1877		1877	1877 or	1877

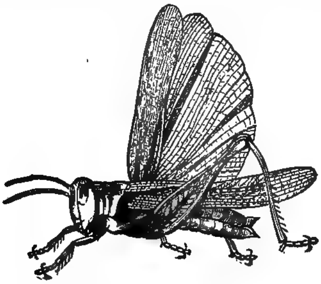
(*) Bad locust years. (?) Doubt of the visitation, ence to well-known species wanting, but the popular names applied to species and groups are so confused and erroneous that their use is calculated to convey incorrect ideas to unscientific readers. Even the name locust as formerly, and yet very generally, applied in this country is incorrectly used, referring to an insect not even belonging to the same order as the locusts of oriental countries. The seventeen-year locust of North America is, in fact, not a locust in the true sense, but a species of *Cicada*, or harvest-fly, belonging to the order *Hemiptera*, which contains only insects with a mouth prolonged into a horny, jointed tube formed for sucking the juices of the plants or animals on which they feed. On the contrary, the locusts of the Old World, to which the term was originally and correctly applied, are species of migratory grasshoppers belonging to the order *Orthoptera*, and are furnished with strong biting jaws or mandibles. There are other very material differences between the two, but these will suffice to show that they are quite distinct. The very common name grasshopper has likewise been unfortunate in its use and application not only in a popular sense, but even by scientists, referring at one time to the true locusts or to the various species of the family to which they belong, and at another to species of a different family, which includes katydids. In fact, the term as generally used applies to most of the species of two different families of *Orthoptera*. In order, therefore to convey a correct idea of the destructive species now under consideration we are necessarily compelled to fall back upon the scientific arrangement and characters of the family, subdivisions, and species. Commencing with the order, we will give briefly the characters of the various divisions and subdivisions leading to the genus *Caloptenus*, to which the Rocky mountain locust belongs, omitting those divisions and groups not represented in the United States, and referring only to those characters which are most easily recognized, and which apply specially to our acridian fauna. The order *Orthoptera* is distinguished from the other orders of the insect class chiefly by the following characters: Mouth furnished with mandibles or strong biting jaws; wings four (occasionally wanting,) upper pair coriaceous or parchment-like and flexible; under pair thin and membranous, folding lengthwise only in plaits like a fan; transformations incomplete, being active in all stages after hatching from the egg. Although not as extensive as some other orders, it contains a large number of species which differ very materially in appearance and characters, and are generally known in this country by the common names earwigs, cockroaches, devil's-horses, walking-sticks, grasshoppers, and crickets. Each of these names, except the next to the last, represents a distinct family of the order, as given below:

Earwigs	Family 1. *Forficuladæ*.
Cockroaches	Family 2. *Blattidæ*.
Devil's-horses	Family 3. *Mantidæ*.
Walking-sticks	Family 4. *Phasmidæ*.
Grasshoppers	Family 5. *Acrididæ*,
	Family 6. *Locustidæ*.
Crickets	Family 7. *Gryllidæ*.

As will be seen from this list, there is no confusion between the scientific and common names until we reach grasshoppers, among which our insect belongs. Other names, it is true, are sometimes applied to insects of the previous families, but with the exception of earwig they correspond in their application with the family limits as here given. As before stated, the term grasshopper is applied to insects of two families—*Acrididæ* and *Locustidæ;* but notwithstanding this difficulty in using the popular name the insects which compose the family are easily distinguished from each other by prominent characters. *Locustidæ* includes those species usually found on the grass, bushes, and trees, which have very long thread-like antennæ, generally longer than the body of the insect; the tarsi or feet are four jointed; the female is furnished at the tip of the abdomen with an exserted ovipositor, usually more or less curved and sword-shaped; and the upper wings of the male are furnished, at the base, with a peculiar arrangement of the nerves, with which, by rubbing them together, they produce sharp, shrill notes. To this family belong true grasshoppers, katydids, and similar insects; and there are other species which strongly resemble and are usually called crickets that belong to this family. *Acrididæ*, includes those species which usually reside on the ground, and are distinguished from those of the other families of saltatorial orthoptera by the following characters: The antennæ are comparatively short, never exceeding the body in length, and in North American species composed of from twelve to twenty-five joints; the tarsi are apparently three-jointed; the females are furnished at the tip of the abdomen with four short corneous pieces, two of which curve upward and two downward; the male is without the shrilling organ at the base of the wings found in the *Locustidæ*. This family contains the true locust, such as those of oriental countries and the Rocky Mountain Locust; also such so-called grasshoppers as the common red-legged species of the States and those found hopping on the ground in open waste fields, along roadsides, etc. Therefore, in speaking hereafter of these species, we shall use the term locust. As the family contains a very large number of species varying considerably in form and character, entomologists have endeavored to divide it into sections or subfamilies, by bringing together those minor groups having certain characters in common. The various results of these attempts can not be introduced here, as this would not only require too much space, but also the introduction of matter of purely scientific interest, and of no practical use in this brief review of the classification. These subdivisions vary in number according to the characters selected by the different authors, some making as many as eleven subfamilies, others only two or three. Yet, as a general rule, the difference is not so much in the grouping as in the value attached to the groups, the sub-families of one author being considered as subordinate divisions by other authors. Without undertaking at this time to decide upon the respective merits of these several arrangements, we have selected for present purposes that which makes but three subfamilies, as it appears to be the simplest and most easily understood by general readers. In our descriptions of these subdivisions we shall confine ourselves to those represented in the orthopteral fauna of that portion of North America north of Mexico, and so far as possible select such characters only as are necessary to distinguish these divisions from each other. The first subfamily, *Proscopinæ*, contains only exotic species, and may therefore be omitted from further consideration. The second subfamily, *Acridinæ*, is distinguished by having the pronotum in the form of a shield, which covers the prothorax and extends backward at farthest only a short distance upon the base of the abdomen, never reaching more than half way to the tip, and seldom half this distance; the prosternum or front breast is drawn up, that is, it is not in the same plane as the rest of the sternum or breast; it is spined, tubercled, or smooth, but never advanced upon the mouth in the form of a muffler; elytra or upper wings, when present, always as long as the wings; tarsi with pads between the claws. The third subfamily, *Tettiginæ*, is characterized by having the pronotum, in the form of a shield, extending backward nearly or quite to the tip of the abdomen, and sometimes even beyond it; the prosternum in the same plane as the rest of the sternum, and advanced upon the mouth in the form of a muffler; elytra when present usually shorter than the wings, and placed at the sides of the body; tarsi without pads between the claws. The two latter families are represented in the United States, but the great body of our locusts belong to the *Acridinæ*, the species of *Tettiginæ* being comparatively few, quite small, and seldom noticed by unscientific observers. As the *Caloptenus spretus* and all other migratory locusts belong to *Acridinæ*, we shall limit our further consideration to this subfamily. It contains several subordinate groups, but the characters by which these are distinguished from each other are not so apparent and uniform as are those separating the various sub-families. Although at least one species of *Oedipodini* is migratory in the Old World, and a species in North America (*Camnula pellucida*, Scudd.) belonging to the same group was formerly supposed to be the migratory locust of California, yet at present our observations are confined to *Acridini*, which contains the destructive locust of the West. This limits us to those species found in the United States which have the head more or less subglobular or ovoid, and the front breast armed with a spine. The latter character is easily recognized by any one, as the spine may be seen by examining the under side of the neck; it usually stands out like a little blunt thorn, very distinct. If this is wanting, the observer may know without further observation that his specimen does not belong to the migratory species of our country. If it has the spine, and the head is not conical or pyramidal, then he must refer to the characters hereafter given of the genera and species. We have now reached the genera, which can not be fully discussed at present, as this would require, if properly done, a revision of the *Calopteni* and *Pezotettigi*, and an examination of all our native species. We will, therefore, simply mention the more important genera of the group represented in the United States, calling attention to a few of the more prominent characters by which *Caloptenus* is separated from those genera most closely allied to it. We will also make use of localities, habits, etc., wherever they will assist the general reader in any way in determining whether or not a given specimen belongs to *Caloptenus*. The following genera of *Acridii* which are mentioned by North American authors may be omitted from further consideration for the reasons given below: *Tropidacris*, *Dictyophorus*, *Rhomalea*, *Ommatolampis*, *Platyphyma*, *Dactylotum*, and *Chromacris*. The first contains only gigantic species, and if represented at all in the United States, it is only by a single species occasionally found along the southwestern border of Texas. *Rhomalea* may be considered as a synonym of *Dictyaphorus*, which is represented by but two subtropical species, which are large, with brightly colored under-wings, chiefly red; while those of our Calopteni are transparent. *Ommatolampis* has been superseded by Mr. Scudder's genus *Hesperotettix*. *Platyphyma* and *Chromacris* have probably been introduced by mistake. *Dactylotum* has been introduced into our nomenclature for the reception of a very short-winged and brightly-colored species—*Pezotettix picta* Thos. This leaves only the following genera as necessary to be considered: *Acridium*, *Caloptenus*, *Hesperotettix*, and *Pezotettix* As *Hesperotettix* contains, so far as we are aware, but three species, easily distinguished from *Caloptenus spretus* by the following characters and facts it may be also excluded: One is short-winged, green, and found only in the Eastern Middle States; another somewhat common in the West is green, with reddish bands around the femora; the other has so far been found only in Arizona; it is yellow, thickly dotted over with black, and the antennæ annulated with alternate colors. There is a difference of opinion in reference to the characters of the genera *Caloptenus* and *Pezotettix;* Professor Stal, of Sweden, maintaining that if properly limited *Caloptenus* does not embrace any of our species. He places *C. femur-rubrum*, and consequently the closely allied species, in *Pezotettix*. Without attempting to discuss the question so far as it relates to the proper characters, we have concluded, for reasons which will be mentioned further on, to retain the name *Caloptenus* and to use the genus in the sense understood by American and most European authors. Although the chief distinction between this genus and *Pezotettix*, as adopted in this country, the difference in the length of the wings, can not be considered satisfactory, yet, as it will answer present purposes, we will avail ourselves of it in order to eliminate the group from consideration. *Acridium*, so far as represented in the United States, may be characterized as follows,: Vertex but slightly inclined, angularly expanded in front of the eyes; antennal grooves profound and extending downward to the clypeus; eyes elongate-elliptical. Pronotum somewhat compressed on the sides, depth usually considerably more than the width, moderately but distinctly expanding behind the last sulcus (very slightly in *rubiginosum*); lateral carinæ obsolete on the anterior lobes, the sides rounding up somewhat as the sides of an arch to the median carina; the dorsum of the posterior lobe more flattened, with the lateral carinæ subdistinct; the lower margin of the lateral lobes straight, the posterior lateral angle slightly obtuse, varying from about 100° to 110°; posterior margin obtuse-angled and rounded at the tip. Elytra and wings, with one exception, considerably longer than the abdomen, and in the exception pass it slightly. Abdomen elongate, rather slender; that of the male not enlarged at the tip; the last segment of the male subconical and distinctly notched at the tip, usually with a square notch; cerci of the male flat, usually broad, oblong, and straight. Prosternal spine, robust, subcylindrical, blunt, and approximating the margin mesosternum. The spines of the posterior tibiæ always have at least the basal portion pale, either yellowish or white, even when the tibiæ are black. Posterior femora long, reaching to the tip of the abdomen, moderately robust, the outer face flat. The species, with one exception, are large, the females exceeding two inches in length, the exception, *rubiginosum*, is rare in the West, and so far has not been found west of the Mississippi. We have omitted *A. frontalis* (Thos.), as it does not properly belong to this genus, having been placed here by the author provisionally. As it is green, there is no danger of its being confounded with *C. spretus*. To this genus belongs *A. Americanum*, a large reddish-brown species, marked on the outer wings with cellular quadrate fuscous spots, which often does considerable injury to crops in the sections south of the latitude of St. Louis, which is nearly its northern limit. In 1875 and 1876, and even in 1877, it was seen migrating in considerable numbers, causing much alarm, as those who saw them supposed they were veritable Rocky Mountain locusts. Such flights were observed in southeast Indiana, southwest Ohio, Southern Illinois, and Georgia. These flights are very limited in extent, reaching at farthest but a mile or two. Their large size, coloring, generic characters, and southern habitats will readily distinguish them from the *C. spretus*. We may remark here that one of the most destructive migatory species of southwestern Asia and northern Africa (*Acridium peregrinum*) is not only congeneric with this species, but so closely resembles it that ordinary observation would scarcely detect the differences between the two. As before stated, the characters by which the genus *Pezotettix* is distinguished are not satisfactory, and undoubtedly require revision, but in this country the abbreviation or want of wings has generally been adopted as a leading character, which, whether well chosen or not, is sufficient to distinguish its species from C *spretus*, which answers our present purpose. This limits us to the genus *Caloptenus*, and the species belonging to it which are found north of Mexico. The character of *Caloptenus* and *Pezotettix*, as given by H. Fischer, (Orthoptera Europea, 1853) were evidently intended to embrace only European species, and although we infer from his remarks that he would include our species of Calopteni in the former genus, yet the characters render it very doubtful where they would fall. Therefore, while we admit that the group stood sadly in need of revision at the time Stal entered upon the work, yet we do not think the facts warrant him in dropping the generic name *Caloptenus*, or in removing *femur-rubrum* therefrom, hence we can not follow him in this change. This is, perhaps, not a proper place to discuss a question of this kind, but we have considered it necessary to say this much in explanation of our reasons for differing with so distinguished an entomologist, in his special field, as Dr. Stal. Under the circumstances it is perhaps best that we should define the genus as we understand it, or at least give the characters which the North American species have in common, which we include in *Caloptenus*. In this connection the editor would say, that for the reasons given above, and also as a means of perfect identification not only by the scientific but the general observer as well, we append the full description, which is as follows:

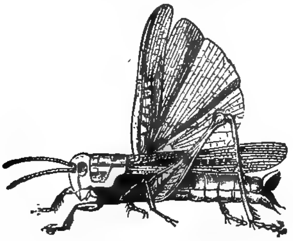
> *Caloptenus*, general character, head subglobular, front vertical, or nearly so. Eyes ovoid, sometimes almost suborbicular, but usually the length is to the breadth as three to two, and the front side is more or less straightened; usually the upper canthus is more or less angular, but sometimes it is rounded so as to obliterate the angle; generally rounder and more prominent in the male than in the female; separated above by a little less than their width. Vertex narrow between the eyes, the width at this point being a little less than the width of the eye; usually though not always sulcate, the sulcus or groove shallow; expanding slightly, abruptly, and angularly immediately in front of the eyes; deflexed (15° to 40°), and generally rounded in front. Frontal costa usually quite prominent, about as broad as the vertex between the eyes; sides parallel; flat, or shallowly sulcate, reaching to or nearly to the clypeus. Pronotum subquadrate, that is to say, a cross section (in the middle) will present a quadrate figure or parallelogram with the upper corners slightly rounded: the sides are nearly perpendicular; the disk or dorsal surface is very nearly flat, with a little thread-like, median carina, usually distinct on the posterior lobe, but sometimes obliterated on the middle and anterior lobes; the lateral carinæ are obtuse, but distinctly marked as the angle where the disk and sides meet; on the posterior lobe they sometimes appear as true carinæ, though not prominent or sharp; the lower margin of the sides is nearly straight, sometimes projecting a little in the middle, where the triangular piece connects; the posterior lateral margin varies somewhat; in some species it forms a distinct entering angle at the shoulder or lateral carina, in others it continues to the tip in an almost straight line; the three transverse incisions are distinct and situated close together, the posterior one being a little behind the middle and always cutting the middle carina; all three sever the lateral carinæ, but the anterior one ends at the upper margin of the sides with a slight and short curve forward; the posterior and middle ones extend down the sides well toward the lower margin, and most generally about midway down the posterior sends out at right angles a branch sulcus which often crosses the intermediate space to the middle one; there is also a fourth sulcus extending down the sides close to the anterior margin; the posterior sulcus and usually the middle one make a short curve forward immediately at the median carina; the posterior margin is obtuse-angled, rounded at the tip; the posterior lobe is usually finely punctured, while the middle and anterior lobes have a velvety or felty appearance. The elytra and wings extend to or beyond the tip of the abdomen; the former are narrow (except in *C. bivittatus*); the latter transparent in all our species; sometimes a very light greenish-yellow or a bluish tinge is observed, the nerves usually more or less dark. The abdomen is usually subcylindrical, presenting no distinct keel above; that of the male enlarged at the tip and curved upward; the cerci are usually flat, rounded at the tip, and curved up but some are straight and others tapering. The last abdominal segment, which curves upward like the prow of a boat, is sometimes truncate above, sometimes with a slight angular notch. Posterior femora robust, much enlarged near the base, the external face more or less convex, in the female never longer and generally shorter than the abdomen; in the male the reverse is the rule. Pads between the claws large, reaching a maximum size in some of the species. Most of our species have the upper portion of the inner face of the posterior thighs marked with three oblique dark bands (the one at the base often indistinct). There is generally a dark stripe on the side running back from the eye to the last transverse sulcus of the pronotum, it is often interrupted, broken, or partially obliterated, but is seldom wholly wanting in those species any way closely allied to *C. spretus* or *C. femur-rubrum*. The antennæ are filiform and slender, reaching their maximum length in the male of *C. differentialis*, where they sometimes attain the middle of the body. The prosternal spine is usually stout and conical, quadrangular at the base, and generally slightly transverse; in one or two species it approximates the mesosternum, but this is not usual. Our species vary in length from six-tenths to two and a half inches.

The genus as thus characterized is represented in the territory embraced in our observations by a number of species, several of which are so closely allied to *C. spretus* that it is difficult for any but an experienced entomologist to determine to which a specimen belongs. We think it more than likely that future investigations will show that several of the species which have been described as distinct, are but varieties of other closely allied species. *C. bilituratus*, Washington Territory, has been observed at but one or two points. There are but three species, *femur-rubrum*, *spretus*, and *atlanis*, which require special mention in this connection, as they are the only ones generally distributed which are so closely allied to each other as to render it difficult to distinguish them. *Caloptenus spretus*, Thomas. As every fact relating to the history and habits of this species is either of economic or scientific interest, we give here a brief history of its nomenclature. About 1860, Mr. Thomas, then residing in Southern Illinois, sent some specimens of Orthoptera collected in that locality, to Dr. P. R. Uhler, of Baltimore, Md., for determination; among those returned was one marked *Acridium spretis*, with a note stating that it was new. In a paper written by Mr. Thomas on Insects injurious to vegetation in Illinois, in 1862, he describes a species of locust under the name *A. spretis* Uhler, as follows: general color a dark, brownish purple, with dusky points and lighter rays. Head brown, with dusky points; antennæ reddish yellow. Thorax an ashy brown, with a velvety luster on the anterior half, the latter half punctured; the lower edges, at the sides, paler—sometimes pale red, at others almost white. Elytra extending about half over the abdomen (or not exceeding two thirds), marked along their internal margins with a light, reddish-brown ray; external margin dusky; a few dusky dots along the internal margins. Wings not quite as long as the elytra; transparent, pale yellowish on the disk, tinged with red at the base (in recent specimens). Posterior thighs crossed by two black bands, and black at the knees; intermediate spaces pale yellow—often almost white. Length of female, one inch and three-eighths; of the male, slightly over an inch. This species is quite common here, along the road-side and among low weeds and grass. In Mr. Scudder's Catalogue of the Orthoptera of North America, published in 1868, it is mentioned under the name *Acridium spretum* Uhler. No description of the species having been published previous to the appearance of the Synopsis of the Acrididæ of North America, Mr. Thomas describes it as follows: Very much like *C. femur-rubrum*, Burm., the principal difference being in the length of the elytra and wings, a notch at the tip of the last (♂) ventral segment. Posterior lobe of the pronotum slightly expanding; median somewhat distinct. Elytra and wings pass the abdomen about one third their length. The last (♂) ventral segment, which is turned up almost vertically, is somewhat tapering and is notched at the apex, which distinguishes it from the *femur-rubrum;* the notch is small, but is distinct. Prosternal spine, robust, subcylindrical, transverse. Migratory. Color, scarcely distinct from the *C. femur-rubrum*. The occiput and disk of the pronotum generally reddish-brown; the posterior lobe somewhat paler than the anterior and middle. Spots as in *femur-rubrum*, arranged in a line along the middle of the elytra; these are a little larger and more abundant toward the apex. The head and thorax are sometimes a very dark olive-brown, at others reddish-brown and even brownish-yellow, the color deepening with age. The wings are pellucid, nerves dusky toward the apex; when flying high and against the sun, their wings look like large snow-flakes. Dimensions: ♀ Length (to tip of abdomen) 1 to 1.2 inches; elytra as long as the body; posterior femora, 0.55 inch; posterior tibiæ, 0.5 inch. ♂ Length, 0.85 to 1 inch; elytra, 0.9 to 1.05 inch. (The sign ♂, signifies male; ♀, female.—Editor.) In relation to the chronological history, the commission say: The history of the American or Rocky Mountain locust is in nearly all respects parallel with that of the locust of the Old World. It breeds over a large continental area, and periodically, in seasons of extreme drought and other favoring meteorological conditions, migrates in immense hordes for several hundred miles beyond its usual habitat. Unlike the locust of the Eastern Hemisphere, our species naturally affects the cooler and more elevated portions of the temperate zone in the New World, though its southern limits extend at times into the hot and dry plains of the Great Basin. Fitful and periodical in its visits to the older, settled portions of the West, the history of the Rocky Mountain locust is difficult to trace beyond a period of about thirteen years. Previous to the year 1864 it had been rarely referred to by travelers in the West, and after examining the reports of the government expeditions and the works of Lewis and Clark, Pike, Irving, and others, we find little or no mention made of it. It is a question in our mind whether in some regions it may not have increased in numbers since the Far West has been partially settled, particularly in those regions where irrigation has been practiced, as in Utah and Colorado and in the western edge of the Mississippi Valley, as in Nebraska, Kansas, Iowa, and Minnesota; but this is entirely uncertain, and it is more reasonable to suppose that as the Western Territories become more thickly settled the numbers of locusts will become diminished. In treating of the history of locust invasions, we will first consider the subject in a very general way, and then state the facts more concisely, arranged according to separate States and Territories; and, thirdly, present a summary of the subject in a tabular view. The latter is calculated to send a chill to the agricultural heart when one sees how dense the figures are from 1864 until 1877, and to lead one to infer that the evil is waxing greater and greater as the years go on. This may be due, however, to the greater extent of the country settled and to the fact that the population is growing denser and denser. However that may be, we shall deal with facts and not with theories, and would remind the reader that in a number of the years there recorded large harvests resulted, the injury done by locusts being local and only confined to a portion of the season, while in 1877 the largest wheat harvest ever grown was safely harvested. Leaving out of account the locust visitations in the Atlantic and Pacific States, which were made by different species from the Rocky Mountain locust, the first authentic statement is to be found in Neill's History of Minnesota, wherein it is stated that in 1818 and 1819 vast hordes of grasshoppers appeared in Minnesota, eating everything in their course, in some cases the ground being covered three or four inches thick. In the same years they were destructive in the Red River country in Manitoba. In 1820, or the succeeding year, they ravaged the western counties of Missouri, and Riley suggests that the 1820 swarms may have also ravaged Kansas and the neighboring regions northward. In 1842, locusts appeared in Minnesota and Wyoming; in 1845, in Texas; in 1846 and 1847, in the limits of what is now Wyoming; and in 1849 in Texas, and possibly in Minnesota. In Utah they have appeared from 1851 until 1877, except only the years 1873 and 1874, and a glance at the table shows that this Territory is liable to suffer annually more or less, especially in the northern portion. Vast swarms of locusts were seen in Idaho in 1852, as well as in Utah, while Dakota was visited, or had native swarms, in 1853. The year 1854 was a year for locusts in Texas, Kansas, and Utah, and 1855, notable for locust ravages on the Pacific coast, was not a bad year east, Texas only having been invaded, although A. S. Taylor states that they abounded on the immense grassy prairies lying on the eastern slopes of the Rocky mountains, a statement supported by no facts, so far as we can learn. In the year 1856, however, locusts prevailed in Texas, Kansas, Iowa, Minnesota, possibly Wyoming and Utah, and in the succeeding year they committed extensive ravages in Manitoba, and the States mentioned as suffering in 1856, with the addition of Nebraska. The States of Texas and Nebraska received slight injury from the progeny of those that migrated thither the previous two years. In 1860, the region about Topeka, Kan., was visited by what must have been a limited and rather local swarm. The year 1861 witnessed the presence of locusts in Nebraska, Montana, and Utah, but the accounts are scanty. Montana and Utah sustained losses from locusts in 1862, but in 1863 they occurred not only in those territories, but also in Dakota and Minnesota. But the most decided increase in the numbers of locusts was felt in 1864, a year of general visitation in Utah, Montana, Dakota, Colorado, portions of New Mexico, and east of the plains in Nebraska, Iowa, Minnesota, as well as Manitoba, and there were resulting swarms, in most cases the progeny of those which came in 1864, in Iowa, Minnesota, Dakota, and Manitoba, while Montana, Colorado, and northern New Mexico had swarms of their own. A notable locust year was 1866, and, as Riley states, the injury committed was sufficiently great and wide-spread to attract national attention. The insects swarmed over the Northwest and did great damage in Kansas, Nebraska, and northeastern Texas, and invaded the western counties of Missouri very much as they did in 1874. They came, however, about a month later than in that year. They were often so thick that trains were seriously delayed on account of the immense numbers crushed on the track. Iowa, Minnesota, Colorado, and Utah also suffered. While in 1867 local damage was done in the spring by the young of the swarms of the previous year, late in the summer new swarms flew across the plains from the West and Northwest, and invaded the border States; in fact, the same States suffered as in 1866, as will be seen by a glance at the tabular view. In 1868 and 1869, local injuries ensued from the ravages of the unfledged locust early in the season, and reports from Montana, Idaho, Dakota, Colorado, and Utah show that there was some trouble in those territories. The year 1870 was a season of comparative immunity from locust invasions, though Iowa and Minnesota received some swarms, and the insects were observed in Dakota, Idaho, Wyoming, and Utah. Kansas received slight injury from these pests in 1872, as well as Minnesota, Dakota, Montana, Colorado, and Utah, but it was not marked. In 1873, the hosts gathered for a fresh onslaught upon the agricultural region bordering the great plains. The invasion of 1873, says Riley, was pretty general over a strip of country running from the northern parts of Colorado and southern parts of Wyoming, through Nebraska and Dakota, to the southwestern counties of Minnesota, and northwestern counties of Iowa, the injury being most felt in the last two more thickly settled States. The insects poured in upon this country during the summer and laid their eggs in all the more eastern portions reached. The cry of distress that went up from the afflicted people of Minnesota in the fall of that year is still fresh in mind, and the pioneers of Western Iowa, in addition to the locust devastations, suffered severe damage from a terrific tornado. By far the most disastrous locust year, however, was 1874, as the more thickly settled portions of the Mississippi Valley west of the ninety-fourth meridian were invaded by dense and most destructive swarms. The States of Colorado, Nebraska, and Kansas were overrun, while portions of Wyoming, Dakota, Minnesota, Iowa, Missouri, New Mexico, Indian Territory, and Texas were ravaged by swarms from the Northwest, as they were abundant that year in Montana and in British America. The loss to these States and territories was estimated at not much less than $50,000,000. Much of the loss this year resulted from the progeny of the invaders of 1873, which early in the season devoured the crops of the region where they hatched, and eventually spread to the southeast. Kansas suffered, perhaps, more heavily than any other State. This, like most other locust years, was one of long-continued drought, and in Missouri the evil was complicated by the ravages of the chinch-bug. The next year (1875) the young hatched in immense numbers over an area variously estimated at from 250 to 350 miles from north to south and from 200 to 270 miles from east to west, embracing portions of Nebraska, Kansas, and Missouri. The tract in which the injury done by the destructive enemy was worst was confined to the two western tiers of counties in Missouri, and the four tiers of counties in Kansas, bounded by the Missouri river on the east. The greatest damage extended over a strip twenty-five miles each side of the Missouri river, from Omaha to Kansas City, and then extended south to the southwestern limit of Missouri. About three-quarters of a million of people were, to a greater or less extent, made sufferers. The experience of different localities was not equal or uniform. Contiguous farms sometimes presented the contrast of abundance and utter want, according to the caprices of the invaders, or according as they hatched in localities favorable to the laying of the eggs. This fact gave rise to contradictory reports, each particular locality generalizing from its own experience. The fact is, however, that over the region described there was a very general devastation, involving the destruction of three-fourths of all field and garden crops. While the injury was greatest in the area defined above, the insects hatched in more or less injurious numbers from Texas to British America, the prevalence of the insects in Manitoba being such that in many parts little or no cultivation was attempted. (Riley.) Missouri had never before been visited by a calamity so appalling and so disastrous in its results as the locust ravages of 1875, and detailed returns of the damage done in that State showed a loss of over $15,000,000. (Riley.) In 1876 no trouble was experienced in the spring, there being in the border States little damage done by the young, except in portions of Minnesota and Colorado, and it was hoped that no further losses would ensue this year. But locusts bred in great quantities in Montana, and in British America, north of this territory, and in Wyoming, Dakota, and Colorado, this being a year of unusual drought in those territories, and in August and the autumn following, immense swarms swept over the plains, falling upon the larger part of Kansas and Nebraska, the western half of Iowa, and some of the western counties in Missouri, and reaching into the Indian Territory, Texas, and the northwest corner of Arkansas. Besides this, local swarms hatching in Minnesota early in the year flew south and southwest into Iowa and Nebraska, and they laid eggs in August. The spring of 1877 opened with dismal prospects all over the States east of the plains, as well as in Colorado. Happily it was a spring in which there was an unusual rain-fall in April, May, and June, the country along the Missouri being flooded in places. The weather was also exceptionally cool; and this condition of things extended over Colorado, northern Utah, Wyoming, central Montana, and British America. In consequence of this season of wet and cold, the young hatched grasshoppers died in immense numbers, and comparatively few lived to acquire wings. South of the parallel of 40° they flew, late in May and early in June, in a general northwest and northerly course; and from Minnesota and Iowa many took flight to Dakota and Montana, whence their progenitors came, and others remaining behind flew about irregularly in the States of Minnesota and Iowa. The six stages of growth of the Rocky Mountain locust, and their metamorphoses, are described as follows: The Rocky Mountain locust requires on an average about seven weeks, from the time of hatching, to attain full growth. Belonging to an Order in which the tranformations are incomplete, the young locust differs but little in general structure from its parent. The most striking differences are the want of wings, and the less flattened, narrower prothorax, which rises from the sides more in the shape of a roof. The abdomen is also more roof-shaped. The perfect winged form is gradually assumed through a series of five molts, at the first four of which the wing-pads become more and more apparent, and at the last of which, from the pupa to the perfect state, the thorax becomes flattened, full wings are acquired, and the insect ceases to grow, except as the female abdomen becomes gravid and heavy with eggs. Yet with each molt, aside from the colorational changes, certain minute and less striking structural changes invariably take place, by observing which we may always know the comparative age and the particular stage of growth of any individual. European authors differ as to whether there are three, four, or five molts in the European migratory species; but we have watched *spretus* from the egg to the imago, and thousands of mounted and alcoholic specimens of all ages show the stages enumerated. The transition from the second to the third, however, is sometimes not very marked, and it is not improbable that, as is the case with many other insects, the number of molts may vary according to the amount of nutrition and rapidity of development. The sexual characters are not well marked, and the sexes are consequently distinguished, with some difficulty in the first three stages. In the first pupal stage the differences become apparent, and in the true pupa the parts are sufficiently well formed to permit coition, which, as we have had evidence, exceptionally takes place thus prematurely. The depth of coloring varies greatly in the immature stages, and the pale mediodorsal line, so conspicuous on some of the larvæ, is entirely wanting in others. The ground-color after the first stage varies from pale-yellowish-gray, the common and typical color, to orange-brown, and even black, and from pale yellow to pure green. A marked green variety (var. *Viridis,* Riley) occurs, in which the normal pale yellowish-gray parts are bright green, the green being first distinctly noticeable in the third larval stage, and enduring to maturity. We have never seen this green variety among the fresh arrivals from the mountain regions, but it is conspicuous among its brown companions when hatching in the Temporary region, and constitutes ordinarily about one in a thousand, though sometimes a much larger proportion, of the progeny of invading swarms. Like all creatures which suffer exuviation or the shedding of skin, our locust quits feeding for a while, and remains quiet during the process. The first three or larval skins are almost invariably shed on or near the ground, the young insects congregating under grass in little hollows or depressions, or under any shelter that offers for the purpose. The cast-off exuviæ are often very abundant in such sheltered places, and are not infrequently mistaken for dead locusts. The last two or pupal molts, on the contrary, more often take place above ground, the insect at these stages of growth preferring to fasten to some elevated object. Immediately after each molt the whole body is soft and colorless, as it was immediately after hatching. In order to illustrate the interesting process of molting; we will trace an individual through the last molt—from the pupa to the winged insect—as it is the most difficult, and, on account of the larger size of the animal, most easily watched. The other molts are very similar in mode of execution. When about to acquire wings the pupa crawls up some post, weed, grass stalk, or other object, and clutches such object securely with the hind feet, which are drawn up under the body. In doing so the favorite position is with the head downward, though this is by no means essential. Remaining motionless in this position for several hours, with antennæ drawn down over the face, and the whole aspect betokening helplessness, the thorax, especially between the wing-pads, is noticed to swell. Presently the skin along this swollen portion splits right along the middle of the head and thorax, starting by a transverse, curved suture between the eyes, and ending at the base of the abdomen. As soon as the skin is split, the soft and white fore body and head swell and gradually extrude more and more by a series of muscular contortions; the new head slowly emerges from the old skin, which, with its empty eyes, is worked back beneath, and the new feelers and legs are being drawn from their casings and the future wings from their sheaths. At the end of six or seven minutes our locust—no longer pupa and not yet imago—the four front pupa-legs being generally detached, and the insect hanging by the hooks of the hind feet, which were anchored while yet it had that command over them which it has now lost. The receding skin is transparent and loosened, especially from the extremities. In six or seven minutes more of arduous labor—of swelling and contracting—with an occasional brief respite, the antennæ and the four front legs are freed, and the fulled and crimped wings extricated. The soft front legs rapidly stiffen, and, holding to its support as well as may be with these, the nascent locust employs whatever muscular force it is capable of to draw out the end of the abdomen and its long hind legs. This in a few more minutes it finally does, and with gait as unsteady as that of a new-dropped colt, it turns round and clambers up the side of the shrunken, cast-off skin, and there rests while the wings expand and every part of the body hardens and gains strength—the crooked limbs straightening, and the wings unfolding and expanding like the petals of some pale flower. The front wings are at first rolled longitudinally to a point, and as they expand and unroll, the hind wings, which are tucked and gathered along the veins, at first curl over them. In ten or fifteen minutes from the time of extrication these wings are fully expanded and hang down like dampened rags. From this point on the broad hind wings begin to fold up like fans beneath the narrower front ones, and in another ten minutes they have assumed the normal attitude of rest. Meanwhile the pale colors which always belong to the insect while molting have been gradually giving way to the natural tints, and at this stage our new-fledged locust presents an aspect fresh and bright. If now we examine the cast-off skin, we shall find every part entire with the exception of the rupture which originally took place on the back; and it would puzzle one who had not witnessed the operation to divine how the now stiff hind shanks of the mature insect had been extricated from the bent skeleton left behind. They were in fact drawn over the bent knee-joint, so that during the process they were doubled throughout their length. They were as supple at the time as an oil-soaked string, and for some time after extrication they show the effects of this severe bending by their curved appearance. The molting, from the bursting of the pupa-skin to the full adjustment of the wings and straightening of the legs of the perfect insect, occupies less than three-quarters of an hour, and sometimes but half an hour. It takes place most frequently during the warmer part of the morning, and within an hour after the wings are once in position the parts have become sufficiently dry, and stiffened to enable the insect to move about with ease; and in another hour, with appetite sharpened by long fast, it joins its voracious comrades and tries its new jaws. The molting period, especially the last, is a very critical one, and during the helplessness that belongs to it the unfortunate locust falls a prey to many enemies which otherwise would not molest it, and not infrequently to the voracity of the more active individuals of its own species. The differences in the immature stages between the Rocky Mountain, the Lesser, and the Red-legged Locusts are thus stated. *Spretus*, (the Rocky Mountain Locust) though palest when mature, has the most black in the immature stages, and its black face is quite characteristic. One who has great familiarity with these three species in life can distinguish them at any stage (they all three go through the same number of molts), and can even distinguish between the exuviæ, those of *spretus* being darkest, those of *atlanis* most gray and uniformly speckled, and those of *femur-rubrum* palest, with the black streaks more strongly contrasting. The continuation of the report is as follows: The eggs may be laid in almost any kind of soil, but by preference they are laid in bare, sandy places, especially on high, dry ground, which is tolerably compact and not loose. It is often stated that they are not laid in meadows and pastures, and that hard road-tracks are preferred; in truth, however, meadows and pastures, where the grass is closely grazed, are much used for ovipositing by the female; while on well-traveled roads she seldom gets time to fulfill the act without being disturbed. Thus a well-traveled road may present the appearance of being perfectly honey-combed with holes, when an examination will show that most of them are unfinished and contain no eggs; whereas a field covered with grass-stubble may show no signs of such holes and yet abound with eggs. In fact, wherever holes are noticed, it may generally be taken for granted that they contain no eggs, for the mother covers well the hole when she has time to properly complete her task. Furthermore, the insects are more readily noticed at their work along roads and road-sides than in fields, a fact which has also had something to do in forming the popular impression. Newly-plowed land is not liked; it presents too loose a surface; but newly-broken sward is often filled with eggs. Moist or wet ground is generally avoided for the purpose under consideration. We have noticed that in the Permanent breeding-region, wherever the vegetation is scant the females show a decided preference for the shaded base of shrubby plants, among the roots of which they like to place their eggs; whereas in the Temporary region, where the vegetation is generally so much ranker, exposed situations, or those comparatively bare of vegetation, are preferred. The experience of 1876 proved very conclusively, also, that they are instinctively guided toward cultivated fields, where the young will find good pasturage; for the eggs were noticeably thickest, and hatched most numerously in 1877 in cultivated areas. In the Cypress Hills region of British America, as Mr. J. G. Kittson informs us, the high lands and protected slopes of the hills are preferred. The soil of the mountain-region, where the insects permanently breed, is mostly of a compact, scantily-covered, gravelly nature, and the notion that they lay most in pure sand is an erroneous one. Sandy soil that is compact, especially when having a south or east exposure, is much chosen, but in loose and shifting sand the eggs would perish. In 1876, it was generally remarked that the insects were more indifferent than usual in ovipositing, and that eggs were much more frequently laid in low, and even wet, land than in former years. The mass seldom reaches more than an inch below the surface, except where some vegetable root has been followed down and devoured, and the insect leaves her eggs before emerging; in this way the mass is sometimes placed a foot below the surface. In abnormal or unhealthy conditions, the eggs may be laid in exposed places without any hole, in which case they doubtless never give birth to young. In other cases, the female will fill her hole almost entirely with the sebific matter. Nor are the eggs invariably laid in the ground, for while we know of no exceptions to this normal position in *spretus*, yet Mr. Boll informs us that around Dallas, Tex., in 1876, the eggs of *differentialis* were very numerously placed under the bark of elm and hackberry logs that had been felled on low lands. We have also received from A. W. Hoffmeiser, of Fort Madison, Ia., some of the eggs of a species of *Stenobothrus*, and the young that hatched from them, the eggs having been thrust into holes made by some carpenter-bee in a fence-post; while *Chlöealtis conspersa* habitually bores in dead wood. The female, when about to lay her eggs, forces a hole in the ground by means of the two pairs of horny valves which open and shut at the tip of her abdomen, and which, from their peculiar structure, are admirably fitted for the purpose. With the valves closed she pushes the tips into the ground, and by a series of muscular efforts and the continued opening and shutting of the valves she drills a hole, until in a few minutes (the time varying with the nature of the soil) nearly the whole abdomen is buried. The abdomen stretches to its utmost for this purpose especially at the middle, and the hole is generally a little curved, and always more or less oblique. Now, with hind legs hoisted straight above the back, and the shanks hugging more or less closely the thighs, she commences ovipositing. When the hole is once drilled there exudes from the tip of the body a frothy, mucous matter, which fills up the bottom of the hole, and bathes the horny valves. This is the sebific fluid which is secreted by the sebific or cement gland. The mucous matter binds all the eggs in a mass, and when the last is laid, the mother devotes some time to filling up the somewhat narrower neck of the burrow with a compact and cellulose mass of the same material, which, though light and easily penetrated, is more or less impervious to water, and forms a very excellent protection. When fresh, the mass is soft and moist, but it soon acquires a firm consistency. During the operation the female is very intent on her work, and may be gently approached without becoming alarmed, though when suddenly disturbed she makes great efforts to get away, and extricates her abdomen in the course of a few seconds, the time depending on the depth reached. The legs are almost always hoisted straight above the back during the process, with the shanks hugging more or less closely the thighs. Sometimes, however, especially when the abdomen is fully buried, the ends of the hind feet may rest firmly on the ground, as has been observed by Mr. Packard in the case of *femur-rubrum*. The time required for drilling the hole and completing the pod will vary according to the season and the temperature. During the latter part of October or early in November, 1876, when there was frost at night and the insects did not rouse from their chilled inactivity until nine o'clock a.m., the females scarce had time to complete the process during the four or five warmer hours of the day; but with higher temperature not more than from two to three hours would usually be required. The soils and locations preferred by the female in ovipositing will be those in which the young will most freely hatch, viz, compact and sandy or gravelly knolls and hillsides, with a south or southeast exposure. The experience of 1877 shows also that hatching takes place very freely in late-mown meadows or prairies, or grazed pastures, where the exposure of the ground permits ready oviposition, and the warmth of the sun. In dry, well-drained, and compact soils of a light nature the eggs are much better preserved than in heavy clays and loams, where they are more subject to mold and rot. The experience of 1877 is rather misleading on this point, and indicates the necessity of generalizing, not from the experience of one, but of many years. The insects were most numerous, and seemed to hatch most numerously in the low lands and in sheltered situations along river-courses. The facts are that in such situations those which did hatch survived in larger proportions than did those which hatched in more exposed places because the former were better protected from the cold rains and storms of spring. Those eggs which are laid earliest the previous year will also hatch earliest, and since, as we have already seen the egg-laying covers an average period of six or eight weeks in the same locality, and lasts generally till frost, it follows that the eggs pass the winter in every state of development—some with the fluids clear and limpid; others with the embryo fully formed and ready at the first approach of spring to hatch. In the same locality hatching will take place—*cæteris paribus*—first on light dry soils and on south and southeast exposures; latest on low, moist, and shaded or tenacious ground. We see, therefore, that the hatching will not alone vary according to temperature and the earliness or lateness of the spring, but that it is quite variable under the same conditions. In every instance there will be a few hatching when the first hatched in the same locality are getting wings, and we give it as a general rule that the bulk of the eggs hatch out in the different latitudes about as follows: In Texas, from the middle to the last of March. In the southern portions of Missouri and Kansas, about the second week in April. In the northern parts of Missouri and Kansas and the southern sections of Iowa and Nebraska, the latter part of April and first of May. In Minnesota and Dakota, the usual time of hatching ranges from early in May in the southern portions to the third week

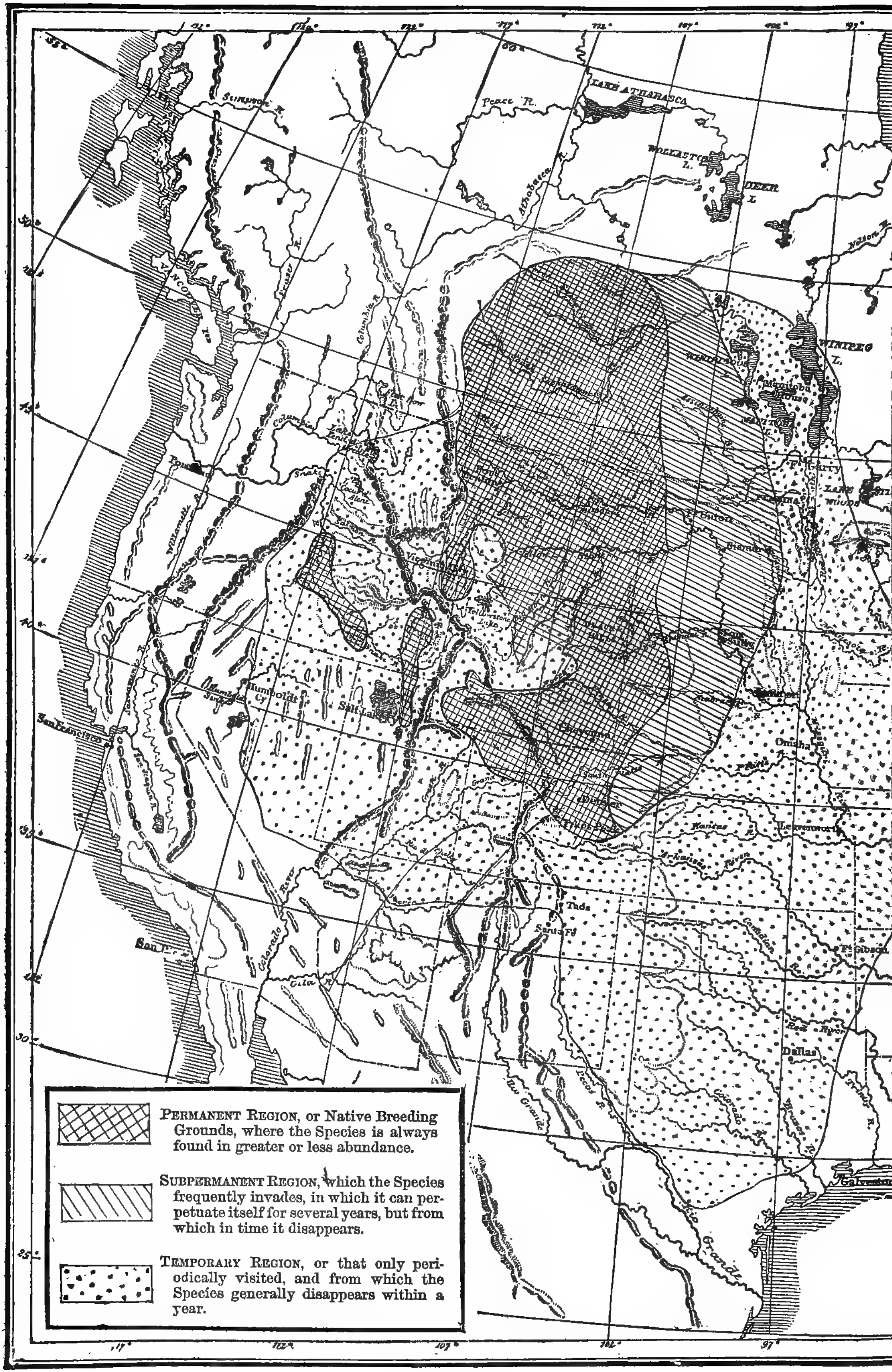


RED-LEGGED LOCUST.

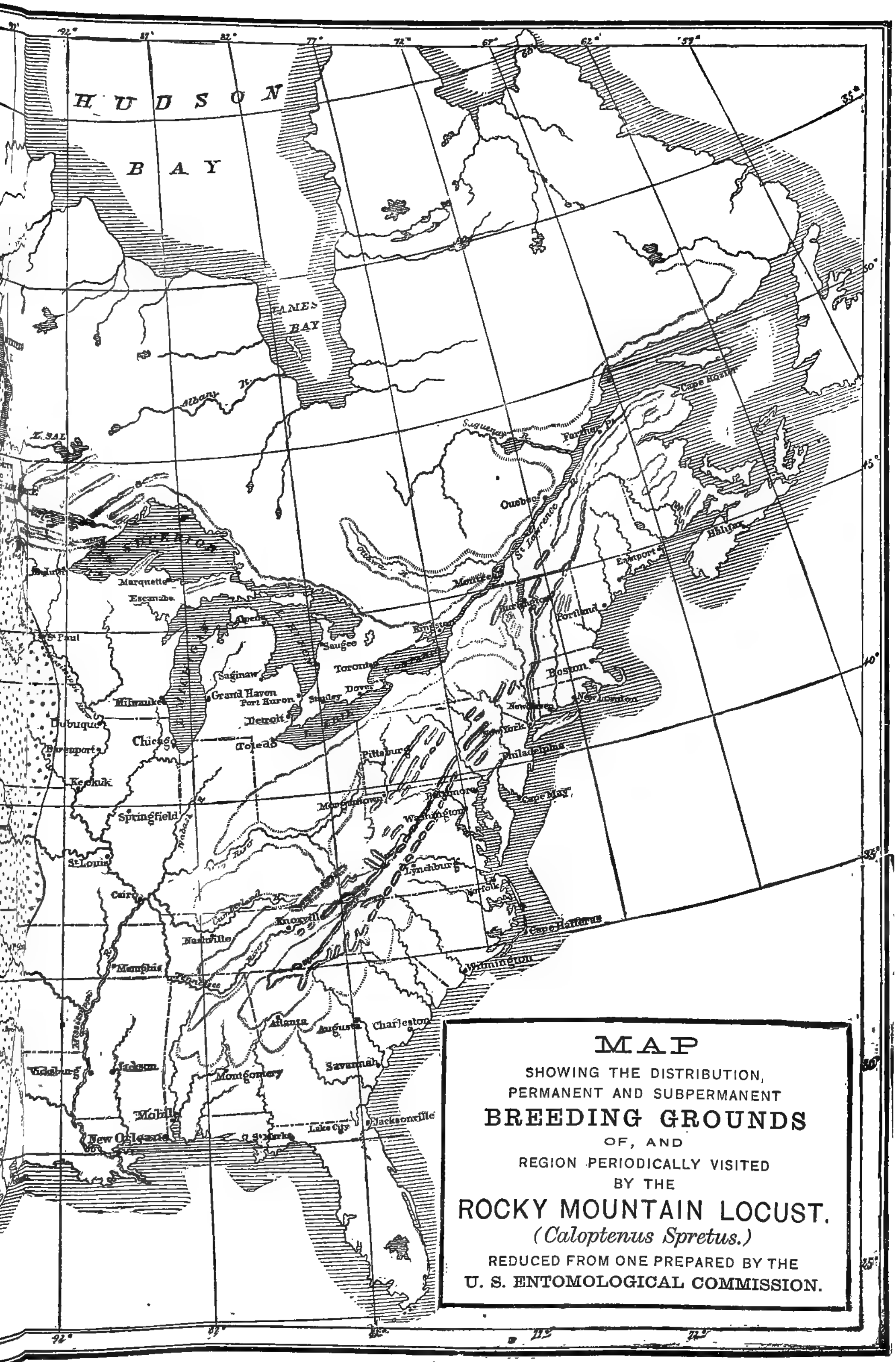
in the northern extremity. In Montana and Manitoba, from the middle of May to the first of June. In short, the bulk of the insects hatch in ordinary seasons about the middle of March in latitude 35°, and continue to hatch most numerously about four days later with each degree of latitude north, until along the forty-ninth parallel the same scenes are repeated that occurred in southern Texas seven or eight weeks before. The summary of our present knowledge of the locust is as follows: The eggs are laid an inch below the surface of the ground in July, August, and September, as the latitude varies; and the young hatch in April and May, becoming fledged in about seven weeks from early in June until the last, swarming from the first of July until the last of September. Birds and insects eat the eggs and young, and a mite, Tachina fly, and hair-worms infest the adults. While the Rocky Mountain locust occurs permanently on the eastern slope of the Rocky mountains, on the high, dry plateaux between 4,000 and 7,000 feet elevation, the district liable to its periodical invasions is between latitudes 30° and 52°, and longitudes 102° and 93°. It occurs, though of smaller size, in California and New England, and probably in British America from the Atlantic to the Pacific. Its migrations take place at irregular intervals during or after hot or dry seasons, when immense swarms are borne from the Rocky Mountain plateau by the prevailing westerly and northwesterly winds, sometimes 500 or 1,000 miles into British America, Minnesota, Nebraska, Kansas, Missouri, and Texas, where they lay their eggs. The progeny of the emigrant swarms return the following season in a general northwest direction for at least hundreds of miles, to near the original habitat on the plains. The periodical invasions may after a while be predicted with more or less certainty, should the Government take measures to appoint suitable persons to observe them, or delegate the task to the Weather-Signal Bureau; meanwhile, by the use of the telegraph, the arrival of swarms may be announced several days in advance. In years of plenty in the border States and Territories, grain should be stored up for use in locust years. Preventive measures, such as planting of forests along lines of railroads, around towns and extensive farms; the use of irrigation, oiling ditches and canals, bonfires and prairie fires, rolling the soil, and collection of eggs; bounties to be paid by Government in the Territories, or by the local authorities in the States infested, for the egg-sacs. Co-operation among farmers and others, in resisting the attacks of insects, to be enforced by proper legislation, both in the Territories and border States. We still need more light on the natural history and migrations of the locust, and the United States Government should appoint entomologists, who should study the locust comprehensively for several years in succession. Local entomologists should be appointed for each Territory, and the border State legislatures should appoint salaried entomologists to further study and report on the locust, and serve for a term of years, until the entire subject be studied, and the knowledge thus acquired be freely diffused among the agricultural community generally. In relation to the geographical distribution of the Rocky Mountain locust, a glance at the map, pages 602 and 603, showing the distribution of the Rocky Mountain locust (*Caloptenus spretus*), will show the probable limits within which it will be found. At least there is no probability that the locust will ever afflict farmers east of the limits assigned. The eastern limits have been defined by Professor Riley, for Texas, Indian Territory, Missouri, Kansas, Nebraska and Minnesota, while the northern and northeastern limits have been indicated by Prof. G. M. Dawson. The southwestern limits are somewhat conjectural, but they have been indicated by Maj. J. W. Powell; also the western limits in Nevada and Idaho have been pointed out by Prof. Cyrus Thomas. The range of the small variety (*atlanis?*) in California and British America (Vancouver's Island) has been indicated by Messrs. Edwards, S. H. Scudder, and Dr. Packard; while the eastern range of the eastern variety *atlanis* has been indicated by Messrs. Riley, Thomas, Scudder, and Dr. Packard. The locust area is divided into two regions, one the permanent breeding-places, on the elevated plains among the Rocky Mountains and the great plateau lying east and extending approximately to longitude 102°. Beyond the edge of the great plains are found the temporary breeding places of the locust, which comprise the prairie-lands of the border States as far east as longitude 93° or 94°. (The deeply shaded portions show the permanent breeding places; those shaded with single lines, the sub-permanent breeding places, and the dotted portions, the districts devastated by the migrating swarms in their periodic flights. Editor.) In dealing with this fearfully destructive insect, which has attracted so much notice from the public, and in seeking for remedies against its devastations, it is of prime importance to have a thorough knowledge of its breeding-places, the frequency and extent of its migrations, and to seek for the connection between the direction of the winds and other meteorological phenomena and the flights of the locust itself. The locust is quite or nearly as destructive in Africa, Asia, and southern Europe as in this country, but the laws of their migrations and their connection with meteorological phenomena have never been studied in those regions, and it remains for the United States, with its Weather Signal Bureau, to institute, in connection with the scientific surveys of the West, investigations regarding the nature of the evil and the best means to overcome it. In endeavoring to trace the connection between the migrations of the locust and the course of the winds at different months, the writer has been led into some theoretical considerations which seem to be supported by the facts presented in the unpublished report, and which may be confirmed or disproved by future investigations. The following table, com-



ROCKY MOUNTAIN LOCUST.



▨ PERMANENT REGION, or Native Breeding Grounds, where the Species is always found in greater or less abundance.
▧ SUBPERMANENT REGION, which the Species frequently invades, in which it can perpetuate itself for several years, but from which in time it disappears.
⁘ TEMPORARY REGION, or that only periodically visited, and from which the Species generally disappears within a year.
LAKE ATHABASCA
WOLLASTON L.
DEER L.
Peace R.
Athabasca R.
Simpson R.
Fraser R.
Columbia R.
VANCOUVER ISD.
WINIPEG L.
Manitoba
Ft. Garry
LAKE OF THE WOODS
Pembina
Ft. Benton
Bismarck
Snake
Virginia City
Yellowstone Lake
Humboldt Cy
Humboldt Sink
Salt Lake
San Francisco
Sacramento R.
San Joaquin R.
Cheyenne
Pikes Pk.
Omaha
Leavenworth
Kansas R.
Arkansas River
Taos
Santa Fé
Colorado River
Gila R.
Canadian R.
Ft. Gibson
Red River
Dallas
Trinity R.
Brazos R.
Colorado R.
Pecos R.
Rio Grande
Galveston
San D.



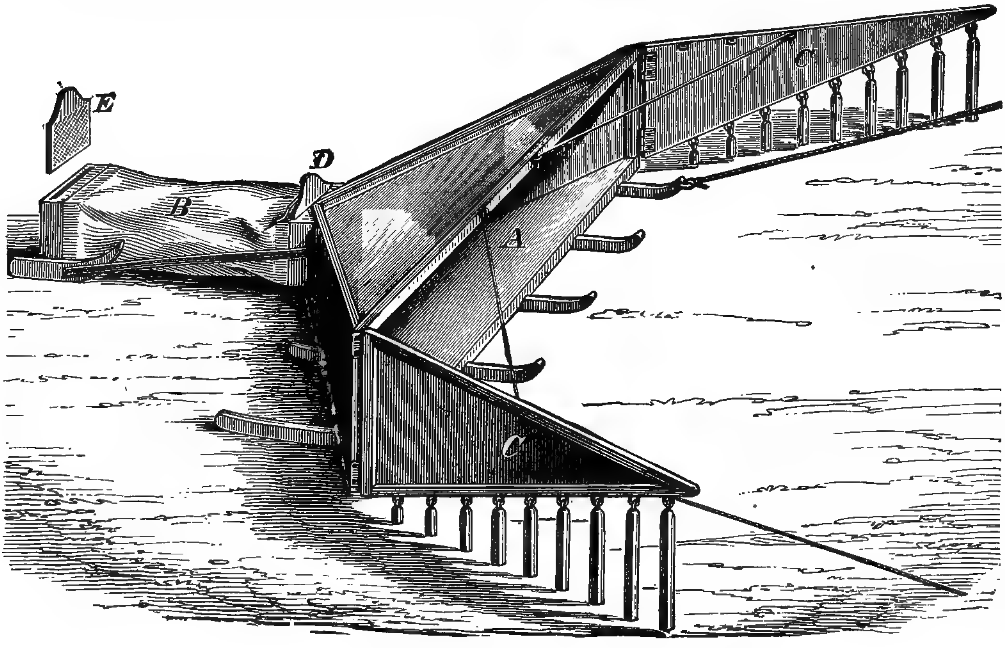
MAP

SHOWING THE DISTRIBUTION,
PERMANENT AND SUBPERMANENT
BREEDING GROUNDS
OF, AND
REGION PERIODICALLY VISITED
BY THE
ROCKY MOUNTAIN LOCUST.
(Caloptenus Spretus.)
REDUCED FROM ONE PREPARED BY THE
U. S. ENTOMOLOGICAL COMMISSION.

piled from the reports of A. S. Taylor, the late Mr. B. D. Walsh, Prof. C. V. Riley, Prof. C. Thomas, Mr. G. M. Dawson, and the observations of Mr. W. N. Byers, together with the reports in the Monthly Weather Review, will show the years when the locust was excessively abundant and destructive in the different Territories and States, and also serve to roughly indicate the frequency and extent of the migrations of the destructive locust of the West. The dates which are starred are years when the progeny of the locusts of the preceding year abounded, and when in most cases there were no fresh incursions from the westward. The species referred to under the head of California, Washington, and Oregon may be some other than *Caloptenus spretus.* This table and the data on which it is based are necessarily very imperfect, owing to the vast extent of the territory over which the locust swarmed, and the fact that the greater portion is uninhabited, while the inhabited portions have been settled only within comparatively few years. It will be seen, however, that since 1873 the evil has been greater and more widespread than ever before. The immediate cause of the migrations of the locust from its original breeding places is the unusual abundance of the species during certain years. It has been found in some cases that the exceptional years when the locust migrates are periods of unusual heat and dryness, conditions unusually favorable to the excessive increase of insect life. As may be seen in the accounts of the eastern locust, the grass-army-worm, the grain-aphis, the chinch-bug, and other less destructive insects, when the early part of the season, the spring and early weeks of summer, are warm and dry, without sudden changes of temperature, insects abound and enormously exceed their ordinary numbers. When two such seasons occur, one after the other, the conditions become still more favorable for the undue development of insect life. Now it is well known that in the Eastern States the summers of 1860 and 1874, preceding the appearance of the army-worm and grain-aphis, were unusually warm and dry, and favorable not only for the hatching of the eggs laid the year previous, but for the growth and development of the larvæ or young. Look now at the conditions for the development of locust life on the hot and dry plains, chiefly of Dakota, Montana, Wyoming, and Idaho. We have no extended meteorological records from these regions at hand, but it is more than probable that the years preceding the migrations of the locusts were exceptionally warm and dry, when the soil was parched with long sustained droughts, as we know that the corresponding species east of the Mississippi river abounds during dry summers following dry and warm springs. Given, then, the exceptional years of drought and heat and the great extent of territory, and we have as the result vast numbers of young hatched out. The year previous having perhaps been warm and dry, the locusts would abound, and more eggs than usual would be laid. These would with remarkably few exceptions hatch, and the young soon consume the buffalo grass and other herbage, and move about from one region to another, following often a determinate course in search of food. In this way large broods may migrate a long distance, from perhaps twenty to fifty miles. In about six or seven weeks they acquire wings. Experience shows that the western locust as soon as it is fledged rises up high in the air, sometimes a thousand feet or much higher. They have been seen to settle at night on the ground, eat during this time, and toward noon of the next day fill the air again with their glistening wings. As more and more become fledged, the vast swarm exhausts the supply of food, and when the hosts are finally marshaled, new swarms joining perhaps the original one, the whole swarm, possibly hundreds of miles in extent, begins to fly off, borne by the prevailing westerly and northwesterly winds, in a generally easterly and southeasterly course. (It should be remembered that prevailing winds from a given direction will deflect the flight of the locusts north or south, according to the intensity and continuance of the winds.—Editor.) Those plants the locusts do not like and which are usually

Manitoba.	Minnesota and Western Iowa.	Montana and Dakota.	Wyoming and Idaho.	Utah.	Colorado.	Nebraska, Kansas, and Western Missouri.	Indian Territory and Texas.	California.	Washington and Oregon.
1818	1818							1827 or 1828	
1819	1819							1834 or 1835	
	1820					1820 or 1821		1838	
			1845				1845		
						1846?		1846	
			1852	1852			18,9		1852
		1855?	1855?	1855	1855?	1855	1855	1855	1855
	1856			1856*			1856*	1856*	
1857	1857*			1857					
1864	1864	1864			1864				
	1865*				1865*				
				1866		1866	1866		
1867	1867			1867	1867	1867	1867		
1868				1868*	1868	1868*			
1869				1869		1869*			
1872				1870					
	1871			1871					
	slight.			1872					
	1873	1873	1873		1873			1873	
1874	1874	1874	1874		1874	1874	1874	Southern.	
1875	1875	1875	1875*		1875*	1875	1875	California.	
	1876	1876	1876	1876	1876	1876	1876		

cultivated are principally peas and other leguminous species, castor beans, sorghum, broomcorn, tomatoes, sweet potatoes, etc. Such wild plants to which the insects are particularly partial, as tansy, wild buckwheat, etc., might be periodically sprinkled with Paris Green water or powder, so as to kill the young locusts that feed upon them. Such plants might also be sown and encouraged around cultivated fields where the young insects are expected to hatch out. These young will also congregate on timothy in preference to other grasses or grain, and a strip of timothy around a corn or wheat field, to be poisoned in the same way, might save the latter. It is also currently supposed that the common larkspur (*Delphinium*) is poisonous to these insects, but how much truth there is in the statement we are unable to tell. Trapping can easily be accomplished, especially when the locusts are making their way from roads and hedges. The use of nets or seines, or long strips of muslin, calico, or similar materials, converging after the manner of quail nets, have proved very satisfactory. By digging pits or holes three or four feet deep, and then staking the two wings so that they converge toward them, large numbers may be secured in this way after the dew is off the ground, or they may be headed off when marching in a given direction. Much good can be accomplished by changing the position of the trap while the locusts are yet small and congregate in isolated or particular patches. Many machines have been made for trapping locusts. We illustrate the one invented by Dr. C. V. Riley, which will be found simple and effective. Irrigation is feasible in much of the country subject to locust ravages, especially in the mountain regions, where, except in unusually favorable locations, agriculture can be successfully carried on only by its aid, and where means are already extensively provided for the artificial irrigation of large areas. Where the ground is light and porous, prolonged and excessive moisture will cause most of the eggs to perish, and irrigation in autumn or in spring may prove beneficial. Yet, experiments prove that it is by no means as effectual as is generally believed, and as most writers have assumed to be the case. In pastures or in fields where hogs, cattle, or horses can be confined when the ground is not frozen, many if not most of the locust eggs will be destroyed by the rooting and tramping. The eggs are frequently placed where none of the above means of destroying them can be employed. In such cases they should be collected and destroyed by the inhabitants, and the State should offer some inducement in the way of bounty for such collection and destruction. Every bushel of eggs destroyed is equivalent to a hundred acres of corn saved, and when we consider the amount of destruction caused by the young, and that the ground is often known to be filled with eggs; that, in other words, the earth is sown with the seeds of future destruction, it is surprising that more legislation has not been had, looking to their extermination. One of the most rapid ways of collecting the eggs, especially where they are numerous and in light soils, is to slice off about an inch of the soil by a trowel or spade, and then cart the egg-laden earth to some sheltered place where it may be allowed to dry, when it may be sieved so as to separate the eggs and egg masses from the dirt. The eggs thus collected may easily be destroyed by burying them in deep pits, providing the ground be packed hard on the surface. In the thickly settled portions of Europe, where labor is abundant and cheap, this method may be adopted with some advantage,



THE RILEY LOCUST CATCHER.

but it will scarcely be employed in this country, except as a means of earning a bounty, when, in the more thickly settled sections, it will prove beneficial and give employment to young people and others who have nothing else to do. In relation to the destruction of the young or unfledged locusts, the commission say: It is with some degree of pride that we point to the fact that this part of the locust problem is solved. The experience of 1877 has added much to our knowledge of the practical and feasible ways of destroying the young locusts, and has firmly established the fact which we had previously maintained, that, with proper means, effort, and co-operation, the farmer, in the more fertile and settled portions of the country liable to their injury, may successfully cope with them; that, in short, he can protect his crops against them with about as little labor and expense as he must annually employ to protect most of these same crops from weeds. Farmers themselves were surprised at what could be accomplished by well-directed, intelligent effort; and it was the almost universal testimony that there need be, in future, no serious fear of the young insects, even where little effort has previously been made to destroy the eggs. In the destruction of the young, no methods that will not sweep them away in wholesale fashion have any value for our Western farmers, however valuable they may be to the owner of a small flower or truck garden. It is for this reason that we have been able to profit so little by European methods, and have had to invent means suitable to our broad Western fields and the extensive nature of our farming operations. The best that most European authors can advise is the killing of the insects with flattened implements or brush; while Gerstäcker and other writers devote page after page to prove the superiority over other methods of catching the insects with hand nets—a method which, while doubtless of some utility in dense German settlements, would prove absolutely futile on our large and scattered prairie-farms and against the excessive numbers of the pests which our farmers have to deal with. While, therefore, we shall mention all available means that have been or may be employed, we shall devote more especial attention to those which are useful in a broad and general way in the field. Experience has shown that the results of any particular measure will vary in different regions, dependent, to some extent, upon the nature of the soil, the condition of the crops, and the general characteristics of indigenous vegetation. Circumstances may also render some particular measure available and profitable to one farmer where it would be unprofitable to another. For convenience, the means of accomplishing the desired result may be classified into: Burning, crushing, trapping, catching, and use of destructive agents. Burning is, perhaps, the best in prairie and wheat-growing regions, which compose the larger part of the area subject to devastation by this locust. In such regions there is usually more or less old straw or hay which may be scattered over or around the field in heaps and windrows, and into which the locusts, for some time after they hatch, may be driven and burned. During cold or damp weather they congregate of their own accord under such shelter, when they may be destroyed by burning, without the necessity of previous driving. Much has been said for and against the beneficial results of burning the prairies in the spring. This is chiefly beneficial around cultivated fields or along the roadsides, from which the locusts may be driven, or from which they will of themselves pass for the shelter the prairie affords. Scarcely any eggs are laid in rank prairie, and the general impression that locusts are slaughtered by myriads in burning extensive areas is an erroneous one, at least in the Temporary region. In burning extensive prairies after the bulk of the locusts hatch, the nests and eggs of many game birds are destroyed; but as the birds themselves escape destruction on the wing, they may and do return and nest again, while, on the contrary, many injurious insects, like the chinch-bug, for instance, are killed, so that, even leaving the locust question out of consideration, the burning proves beneficial by exterminating other noxious insects, and has some advantages from an agricultural point of view. As locusts disperse more and more from their hatching-grounds into the prairie as they develop, burning the grass in spring is beneficial in proportion as it is delayed. Machines for burning have been used in several localities with considerable success. Mr. J. Hetzel, of Longmont, Col., has employed a machine drawn by horses. It is twelve feet long, from two to two and a half feet wide, made of iron, and set on runners four inches high. An open grate on the top of the runners is filled with pitch-pine wood, a metal sheet covering the grate to keep the heat directed downward. The grate is generally made with a net-work of heavy wire, such as telegraph wire. Two men and a team can readily burn from ten to twelve acres a day, and kill two-thirds of the insects, but for this it requires a hot fire. Hand-burners, consisting of any form of pan or grate, or wire sieves, with handle attached, to hold combustible material, will do excellent service in gardens and small inclosures. There is another method by which large numbers of locusts can be burned, consisting merely of a bundle of rags or tow, which, after being attached to long wire or iron rods and saturated with kerosene, can be ignited and carried over the field. This method has been quite satisfactorily used in Colorado. A stout wire, say forty feet long, is thoroughly enveloped in rags soaked in coal oil. A small wire is wound around the rags to keep them in place, and the simple device is complete. Two men carry this rope, after setting fire to the rags, across the field to and fro until the fuel is exhausted; and as it is not necessary to pass over the same ground more than once or twice, a large field of grain can be thus protected during the half hour or so that the rags burn. The effect is that of a miniature prairie fire. To destroy locusts satisfactorily by crushing, can only be advantageously accomplished where the ground is smooth and hard. Where the surface of the ground presents this character, heavy rolling can be successfully employed, especially in the mornings and evenings of the first eight or ten days after the newly-hatched young have made their appearance, as they are generally sluggish during those times, and huddle together until after sunrise. It is also advantageously employed during cold weather at any time of day, since the young when the temperature is low seek shelter under clods, etc. Harrowing in the autumn, or during dry, mild weather in early winter, will prove one of the most effectual modes of destroying the eggs and preventing future injury, wherever it is available. It should be enforced by legal enactment, whenever the soil in any region is known to be abundantly stocked with eggs. A revolving harrow or a cultivator will do excellent service in this way, not only in the field, but along roadways and other bare and uncultivated places. The object should be, not to stir deeply but to scarify and pulverize as much as possible the soil to about the depth of an inch. Where the cultivator is used, it would be well to pass over the ground again with a drag or a brush harrow for this purpose. Some of our correspondents have urged, and with some reason, that wherever land can conveniently be prepared to induce the females to oviposit in it, as by plowing and then rolling when the insects are beginning to breed, such preparations should be made. A subsequent harrowing will be the more easy. In practice, this method will not often be adopted, because it will pay only under exceptional circumstances. Next to harrowing, plowing is one of the most generally available means possessed by the farmer of dealing with locust eggs, and it is well to fully understand how it may be made most effectual in destroying them. As showing something of this, and the depth at which the locusts should be buried, the following series of experiments was made with eggs obtained at Manhattan, Kan., early in November, and similar in condition to those in the first series: Large tin cylindrical boxes, made of different depths, and varying from four to eight inches in diameter, were used; and in order to hasten the result they were kept indoors at the temperature already mentioned. The soil in all the boxes was finely comminuted and kept in uniform and moderately moist condition. It was gently pressed with the fingers, so as to approach in compactness the surface soil of a well-cultivated garden. In each instance the eggs were placed in the center of the box. A large number of eggs were buried at different depths outdoors where they were under natural conditions of soil pressure and temperature. The soil was a tolerably stiff yellow clay, and was pretty well compacted by many heavy rains, after the frost was thawed out. The results of the outdoor experiments comport with those made in the boxes. The eggs being placed at every depth from one to eighteen inches, and each batch covered with a wire screen, the result was accurately determined. All at one inch below the surface hatched; about one-third of those at two inches managed to escape, and none from any greater depth. Examined May 12, they had hatched down to a depth of twelve inches, and worked their way upward, and horizontally, seldom extending more than one inch in the former, or more than two inches in the latter direction. Most of those at greater depths were at that time unhatched. In looser soil they would doubtless have managed to push somewhat further.

LOCUSTA. The inflorescence resembling the spike, but occurring in grasses, the flowers having no calyces, but bracts only.

LOCUST TREE. Of the so called locust trees, there are two genera, first the common locust or false acacia, (*Robinia*). The common locust, *R. pseudacacia,* valuable for its timber and as an ornamental tree, when it escapes the Locust Borer unfortunately generally common through the West. It is, however, said to escape, comparatively well, this pest on limestone soils. Its handsome foliage, fragrant white flowers, and invaluable timber makes it a subject of regret that it should be so almost universally attacked in the West. It is hardy throughout the North and southward to Tennessee, and makes a noble timber tree. The Clammy locust, *R. viscosa,* is a smaller tree found in the latitude of Virginia and south. The twigs and leaf stalks clammy, flowers tinged rose-color, crowded in oblong racemes, pods glandular—vispid. The bristly or Rose-acacia, *R. vispida,* is an ornamental flowering shrub, a native of the mountains of southern Virginia and the South, growing from three to eight feet high. It is cultivated for ornament in the North but requires winter protection. The honey locust, (*Gleditschia,*) has two species, *G. triacanthos,* a large tree armed with stout, strong thorns in threes, but varying. The foliage is light and graceful, and the tree peculiar but handsome. It is much valued in the West as a hedge or barrier, hardy and effective where the Osage Orange will not stand. It grows in rich woods from Pennsylvania to Illinois and southwestward. The pods are from twelve to eighteen inches in length, flat, sometimes twisted, and containing a sickish sweet pulp between the seeds. The water locust, *G. monosperma,* is a western tree, found in swamps in Illinois and southwestward, with slender spines, mostly single, pods oval, one-sided and pulpless.

LODICULA. The two minute fleshy hypogynous scales beneath the ovary of grasses.

LOESS. Alluvial formations By the English it is often used for a yellow loam, with chalky concretions.

LOG. A portion of the trunk of a tree.

LOGWOOD. *Hæmatoxylon campechianum.* A small leguminous tree of Central America and the tropics. The central heart wood, deeply stained, from old trees is preferred; the logwood bath is of great service in the production of black dyes, browns, and reds.

LOLIUM. The generic name of rye grass. (See Grasses.)

LOMENTUM. An indehiscent pod resembling a legume, but divided by membranes between each seed.

LONG-EARED SYRIAN GOAT. (See Goats.)

LONG-HORNED CATTLE. A breed of neat cattle now nearly extinct, chiefly distinguished by the length of the horn, the thickness and firm texture of the hide, the length and closeness of the hair, the large size of the hoof, and the coarse, leathery thickness of the neck.

LONGICORNS, LONGICORNE. Coleopterous insects with long antennæ, often longer than the body; they are borers.

LONGIPALPS, LONGIPALPI. A family of short-winged beetles, with the maxillary feelers (*palpi*) almost as long as the head.

LOOPERS. Caterpillars of the family *Geometers.* (See Span-worms.)

LOOSESTRIFE. Small weeds of the genus *Lysimachia;* they are wholesome. The creeping loosestrife, or money wort (*L. nummularia,*) is said to be a good remedy against insects, when steeped in oil and sprinkled over the granary floor.

LORE. In ornithology, the space between the bill and the eye, which is bare in some birds, as the great crested grebe, but is generally covered with feathers. In entomology the term is applied to a corneous angular machine observable in the mouth of some insects, upon the intermediate angle of which the mentum sits, and on the lateral ones the cardines of the maxillare, and by means of which the trophi are pushed forth or retracted, as in the hymenopterous insects.

LOSS OF CUD. (See Cud, loss of.)

LOTION. An external wash: it may be evaporating (spirituous) or watery. Indolent sores require stimulating lotions; painful wounds, anodyne lotions, etc. Lotions are also used to discuss tumors and inflammations near the skin.

LOUSE. (See Lice.)

LOUSEWORT. *Pedicularis Canadensis.* An insignificant perennial, herbaceous weed; the rattle.

LOVAGE. *Ligusticum levisticum.* A perennial (biennial), herbaceous, disagreeable aromatic plant, of the family *Umbelliferæ*, the seeds of which are used as medicine in flatulence.

LOVE APPLE. Tomato.

LOVE GRASS. A small grass, ornamental, with pretty spikelets, *Eragrostis.*

LOW CLOVER. (See Clover.)

LUCAMA. A Chilian fruit resembling, in size and flavor, a peach.

LUCERNE. *Medicago.* There are several varieties of *Medicago* (medick) cultivated as *M. sativa*, or lucerne; *M. lupulina*, or black medick or nonsuch; *M. maculata*, or spotted medick; and *M. denticulata*, or denticulated medick. The first only is useful in the United States. Lucerne, called generally Alfalfa in the United States, is a most valuable forage plant for warm climates. It is extensively cultivated in California and should be in the South. It delights in a loose, deep, sandy soil, but also does well in dry, deep, loams, rooting deeply, and after being established stands any amount of drought. It will not thrive well in the climate of the North, but from Kentucky south it is a most valuable forage crop. Given rich, clean, and dry land, it will, after the first season, furnish an enormous amount of forage for farm stock, who learn to eat it with avidity. The roots are sought after by hogs who follow them to great depths. In climates that do not freeze severely, as in California and the South, it may be cut five or six times a year. When it begins to fail at the end of several years, it may be again renewed by plowing and harrowing the ground thoroughly, when it will immediately spring up from the deep roots. Of its culture South, Rev. C. S. Howard says: On many accounts, lucerne is one of the most bountiful gifts of Nature to the Southern planter. No grass or forage plant in cultivation at the North will yield nearly as much hay as lucerne at the South. In good seasons, and on land sufficiently rich, it can be cut four or five times during the year. An acre of good lucerne will afford hay and cut green food for five horses the whole year. Ten acres will supply fifty head of plantation horses. This can be cut down in a day with a mowing machine. How unwise in the planter, then, to damage his corn by pulling fodder—that most irksome and senseless work of the plantation. A few acres of lucerne would save him this labor, and the tedious time occupied in pulling fodder could be employed in the improvement of his land. It is useless to attempt the cultivation of lucerne on poor land. It will live, but it will not be profitable. There are certain indispensable requisites in the cultivation of lucerne. The ground must be good upland; it must be made very rich; it can not be made too rich. If the ground is as carefully prepared for it as an asparagus bed, the lucerne will spring almost with the rapidity (after cutting) of asparagus. It must be very clean. When the lucerne is young it is delicate, and may be smothered with the natural weeds and grasses of a foul soil. Land which has been in cotton, worked very late, if made sufficiently rich, is in a good state of preparation for lucerne. The manure put upon it must be free from the seeds of weeds; hence, a mixture of guano and phosphatic manures would be an excellent application. On this farm, land designed for lucerne is put in drilled turnips well manured and worked. The turnips are folded with live stock—that is, they are fed on the ground, which thus gets all the solid and liquid excrements of the animals, and becomes very rich, and is also very clean. Great depth of cultivation is necessary in preparation of the soil for lucerne. If the ground was broken up with a four-horse plow, and in the same furrow a two-horse subsoil plow was run, stirring it eighteen or twenty inches, it would be to the advantage of the subsequent crops of lucerne. Ten pounds of seed are required for an acre, sowed broadcast. Drilling is unnecessary if the ground be properly prepared and the lucerne is not pastured. If the preparation has been imperfect, and the lucerne is to be occasionally pastured, it is better to drill at such a distance as will allow a narrow plow to be passed between the rows when the surface requires stirring. Either early in autumn or early in February are good seasons for sowing lucerne. The seed should be lightly harrowed in, and then the surface should be rolled. Lucerne lasts a great number of years, the roots ultimately becoming as large as a small carrot. It should be top-dressed every third year with some manure free from the seeds of weeds. Ashes are very suitable for it. The lucerne field should be as near as possible to the stables, as work-horses, during the spring and summer, should be fed with it in a green or wilted state. As lucerne is much earlier than red clover, it will be found a useful adjunct in hog raising. Hogs are very fond of it, and will thrive on it in the spring, when it is cut green and thrown to them. This extended notice of lucerne is given because it is remarkably adapted to our soil and climate, and is, beyond all comparison, the most valuable plant for hay-making and soiling to the southern planter. It thrives in no part of Europe with greater vigor than it does in the Southern States. The following interesting statement by a gentleman of California, will be of interest: A freshet cut away the bank of a creek, exposing a section of an alfalfa-field. The roots of the plant had penetrated to a depth of from twelve to twenty feet, and were exposed by the washing away of the bank from the surface to the water-line. The diameter of the root at the crown on the surface varies from an eighth to half an inch. They taper gradually to the lower end, from which a cluster of roots or feeders put out. In the section exposed the roots were close together, but entirely disconnected, each one growing straight through the soil to the water, and producing on the surface a luxuriant branch of alfalfa, which keeps green the year round. A farmer near San José sowed three and a half acres with alfalfa in February, and in September it was producing feed enough to sustain six milch cows. Up to that time it had been cut twice. He thinks that ten cows may be supported when the grass has become fully established. A gentleman who has noted the cultivation of this plant in California for twenty years has in no instance seen it succeed without irrigation except upon alluvial soils, such as are found in the low flats along the margins of rivers. The conditions of successful cultivation are a friable, mellow, moist soil, easily penetrated by the long tap-roots, which should find a permanent supply of water at a depth of not more than six to eight, and not less than three feet; the land should be thoroughly plowed and the surface-crust well pulverized, and about fifteen pounds of clean seed sown per acre and brushed in, but not covered too deep. The sowing should be just before a rain-fall.

LUMBAR, LUMBALIS. Belonging to the loins.

LUMBER. Timber, especially in the rough state.

LUMBRICUS. The generic name of worms resembling the earthworm; some species infest the bodies of animals. The earth worms, when not too numerous, tend to improve the soil by their castings; when over numerous, they eat the roots of plants, and may be destroyed by a heavy salting (twenty bushels to the acre,) or liming, with a summer fallow.

LUNAR CAUSTIC. Nitrate of silver. Prepared nitrate of silver, sold in thin cylinders, and used as a caustic: it is one of the best caustics. A solution is valuable as a lotion in some forms of inflammation.

LUNATE, LUNULATE. Crescent-shaped.

LUNATION. The period from one new moon to another, the synodic revolution.

LUNG FEVER. (See Pleuro Pneumonia.)

LUNGS. The viscus in which air is received, and the blood changed by its presence. The lights, pulmonary apparatus. The substance of the lungs resembles a fine, regular sponge; they are so light as to float on water; the windpipe communicates with every cell throughout the viscus. Common air received is changed in the lungs by an absorption of four per cent. of oxygen, and the substitution of an equivalent of carbonic acid, derived from the blood. This oxygenation, or aëration of the blood, taking place in the lungs, is one of the great functions on which life depends, and can not be interrupted for a minute without injury or death. By this change, black venous blood is changed into the scarlet arterial fluid, which alone is capable of sustaining the wants of the body.

LUNGS, INFLAMMATION OF. (See Pleuro Pneumonia.)

LUNGWORT. *Pulmonaria officinalis.* An exotic, perennial, herbaceous plant. The whole genus are pretty, and readily propagated by seeds.

LUPINE. *Lupinus.* A flowering plant sometimes cultivated in gardens, and extensively cultivated as a forage crop in France, Germany, and the southern portions of Europe. The wild lupine of the United States, *L. perennis*, is common in sandy soils, in which all the varieties delight. The cultivated lupine is tender, and the attempts to introduce its cultivation in the South have not met with favor. The cultivated lupine is an annual, and hence the cost of cultivation will not pay in a country where perennial grasses thrive abundantly. The garden varieties are attractive, and of various colors, white, blue, yellow, and variegated and striped. *L. polyphyllus* is a perennial and nearly hardy. It is of two colors, white and blue.

LUPININE. A gummy matter of lupines. Lupinite, a bitter substance extracted from the leaves of the lupine.

LUPULINE. The yellowish resinous dust hanging about the scales of the hop, on which its flavor and value depend.

LURCHER. A coursing greyhound, with shaggy coat and pricked ears; swift and sagacious.

LURID, LURIDUS. A color of a pale-yellowish purple, frequently associated with poisonous properties in mushrooms and flowers.

LUSUS NATURÆ. A sport of nature. Unnatural form in animals.

LUTE. In chemistry, a pasty matter used to adapt two vessels, or coat their surfaces from fire. Clay, putty, dough, lime, white of eggs, and melted India rubber are variously used for this purpose.

LUTEOLINE. A yellow crystalline coloring matter of weld.

LUTESCENT. Yellowish.

LUXATION. A dislocation of a joint.

LYCOPERDON. The genus of puff-ball mushrooms.

LYCOPODIACEÆ. A family of cryptogamic plants, growing in moist places, and resembling ferns, but with a higher organization, approaching that of the *coniferæ*, or pine-trees; the club moss family. These are low growing plants, generally of moss-like appearance, with solid and often woody stems, thickly clothed with sessile, awl-shaped, or lanceolate, persistent and simple leaves, bearing the two to four-valved spore cases, sessile in their axils; they are represented only by two genera. These are Lycopodium or club moss, with the sporangia scattered in the axils of the ordinary and uniform leaves, which are dark green and shining, rigid about the eight ranked leaves. The other genus is Selaginella, with leaves all alike, equally imbricated, and those of the spike similar. Both the Lycopodiums and Selaginella contain handsome varieties, used in the conservatory and greenhouse. Among the Lycopodiums, native in the North, are the common ground pine, and the common club moss. Among the hardy Selaginellas are the delicate *S. Apers* growing in low, shady places, and resembling a moss or Jungermannia.

LYCOSA. A genus of spiders dwelling in holes on the ground, or in chinks, and pursuing their prey with great activity. The tarantula is of this kind.

LYE. A fluid saturated with potash or other salts.

LYMPH. The fluid of the lymphatic vessels. It is slightly milky, but becomes pink on exposure to air, and divides into a clot and fluid part. It is the surplus nutritious fluid returned from every part of the body to the blood through the thoracic duct.

IMPROVING THE FARM FROM THE PROFITS.

LYMPHANGITIS. This disease is variously known as Weed, and Shot of Grease, and is really an inflammation of the absorbent vessels commencing by inflammation of the lymphatics, or absorbent vessels of the hind legs, and when extending to the cellular tissues it becomes chronic, with swelling of the limb or limbs and permanent effusions. It is usually caused by high feeding and want of exercise, especially if the grooming and care of the stable be neglected Hence it is often prevalent in the stables of some farmers, and especially of horses of a gross habit, thick legged, and coarse porous bones. There will be heat, tenderness, and sometimes the swollen glands can be felt beneath the skin. As the swelling increases, abscesses form and discharge, and once the disorder becomes chronic, the horse will always be liable to a recurrence. In the early stages of the disease the horse should be warmly clothed, and a ball given composed of one drachm of calomel and four drachms of powdered aloes, with syrup and linseed meal sufficient to form the bolus. If the chills and shivering continue, give, as one dose one to two ounces of arnica in warm water as the indications may seem to require, as a stimulant to the skin and whole system. In the hot stage, foment the limb with cloths wrung out of hot water. Keep the bowels moderately loose, and allow an ounce of saltpetre two or three times a day in the water given to drink. Open the abscesses freely with a knife if they appear, and dress with cloths wet with carbolic acid solution, an ounce of acid to a pint of water. The horse having suffered with frequent attacks of Lymphangitis, has the leg permanently thickened. If so, give moderate diuretics and alteratives, as nitre and powdered resin, each one-half ounce, and ten drops of oil of juniper, given as a ball once a day. In connection with this rub the swollen leg with iodine ointment to reduce the swelling.

LYMPHATIC HAIRS. In botany, the transparent hairs on some leaves.

M

MACARONI. The dough of wheat flour drawn out into tubes.

MACE. The envelope of the nutmeg.

MACERATION. The softening of animal or vegetable bodies by immersion in fluids, either water, alcohol, ether, etc.

MACHICOLATED. With parapets projecting beyond the walls, and supported by arches springing from corbels or consoles.

MACULATE, MACULATUS. Spotted.

MADDER. This plant was formerly cultivated to some extent, in the middle portions of the United States, rich, dry, sandy bottom lands being best adapted to its growth, and the production of the roots. These were formerly extensively used for dyeing red, but they are now in a great degree superseded by petroleum dyes. The product is about 2,000 pounds per acre. It is hardly probable that the cultivation of madder will be profitable in the United States; it requires much hand work, and hence, our expensive labor can not compete with the cheap labor of France, Turkey, and India. Madder requires a comparatively mild climate for its growth such as may be found in the latitude of Cincinnati, and South and West. Its manner of cultivation in France is as follows: It is grown from seed in a chalky alluvial deposit, and is sown in beds five or six feet wide, with a space of eighteen inches between the beds. In November of the first year, the young plants are covered two or three inches with earth taken from between the beds. In the second and third years the beds are carefully weeded, and the foliage cut for forage when in flower. The roots are dug in August or September of the third year, and simply cleaned if the earth is dry, but washed if so damp as to adhere. In digging, the earth is loosened by a spade or fork, and the roots are drawn, piled, dried in the open air, and packed in bales. The seed should be perfectly dry and free from fermentation. A ridge of eight or nine inches wide and one inch and a half deep is made with a spade and sowed. At a distance of two inches another ridge, of the same size, is run, having care to cover the seed of the first ridge with the earth taken from the second, and so on to the completion of the third ridge. These three ridges form a platband about three feet wide, separated from each other by a space one and a half feet in width, left as a path for the laborer in weeding. From this path also is taken the earth to cover the plants in autumn, when the leaves are dead. For the sake of economy these paths are sometimes planted with potatoes, beets, etc., but each extra plant should be put far apart. If the earth is well pulverized, instead of the seed being sown, one had better plant roots of the preceding year's growth, as crops obtained from the plants display much finer roots than when raised directly from the seed. But if the ground is not friable, but hard and clayey, the plants would not grow well, and possibly would not take at all. In this case seed must be sown. An acre of madder produces seed sufficient for three or four acres of sowing. For the transplanting of roots, as indicated above, ridges, about three feet wide and three inches deep, are made, and the roots laid therein just free from each other; and between these ridges an uncultivated space is left, as in sowing. The seed is sown, or the roots transplanted, in March, and great care must be observed in keeping the land free from weeds; the paths, also, being attended to in this respect. When the land is dry, from drought, it will be necessary to water it by irrigating the intermediate paths, if possible. Slimy water is preferable to clear water for this purpose. In autumn, when the plants lose their verdure and turn to a grayish tint, they must be covered with one and a half or two inches of earth taken from the paths. In the following spring the clods must be broken with a rake. The madder cultivated in strong, dry soils may be removed in three years, and from wet lands in eighteen months. Thus the madder of the mountain requires three years to mature well, while the "paluds" may be dug in from one and a half to three years. The roots should not be extracted until the seed has been produced. Some cultivators, who are pressed for the moneyed results of their labors, do not wait for the seed; but the madder thus prematurely gathered is of an inferior quality. The ramifications of the stalk are first cut, dried, and threshed for the seed; the straw, or refuse, is saved as fodder for cattle. The roots are then dug with the spade or fork, and as their length will average one and a half feet, it can be seen that their removal leaves the land in a prepared state for some other crop. When dug they are spread on the "aire," usually a level, paved spot of ground, where they are dried by the action of the sun and air. When the larger roots may be easily broken, they should be heaped up, so that the smaller tips, (*pettis couts,*) may become thoroughly dry. Care must be taken that this place be free from dampness. When the roots are sufficiently dry they are embaled and sent to the manufacturers, where they are stored in a well ventilated granary. It is taken from the granary in proportion to each day's demand, and, having caused it to lose fifteen or sixteen per cent. of water in a drying oven, it is passed under a large mill-stone and ground to powder. The bolters keep the coarser portion for a second grinding.

MADEIRA CIDER. Mix new cider with honey until it bears an egg, boil in a copper kettle for one quarter of an hour, skim, cool, barrel, and, in March, bottle. It will be as strong as Madeira wine in six months.

MADEIRA NUT. A nut belonging to the walnut (*carya*) family.

MADIA. *Madia sativa.* Sometimes called Gold of Pleasure. A composite plant inhabiting South America, the seed of which yield an abundance of good table oil. It is extensively cultivated in Germany, is a summer crop, maturing in 127 days from seed.

FLOWERS OF MAGNOLIA SPECIOSA.

MAGGOT. The larva of dipterous and other insects. The fly in sheep.

MAGMA. A thick fluid, or mud. Thick, feculent matters from solutions.

MAGNESIA. One of the primitive earths having a metallic basis. It is an oxide of magnesium. It is sometimes found native, nearly in a state of purity; but it is generally prepared by calcining the common carbonate of magnesia. It is inodorous and insipid, in the form of a very light, white, soft powder, having a specific gravity of 2.3. It turns to green the more delicate vegetable blues, and requires for its solution 2,000 parts of water at 60°. It is found combined with carbonic and other acids in plants. It is a useful purgative in an acid state of the stomach; and taken daily, with short intervals intervening, it is a useful preventive of red gravel or lithic acid deposits in the kidneys.

MAGNESIUM. The metallic basis of magnesia; it is bright and white like silver.

MAGNESIAN LIMESTONE. Limestone rocks containing magnesia; they abound above the coal formation.

MAGNETIC NEEDLE. A small bar or needle of steel, fully magnetized, and suspended or supported so as to move freely over a card divided into the points of the compass. It is much used by surveyors to take down the bearing of the fences and other lines of a farm.

MAGNETISM. The electric fluid manifesting itself on a metallic body; iron, cobalt, and nickel are magnetic metals.

MAGNOLIA. The magnolia is one of the most magnificent of the flowering trees of the United States, being handsome in the tree and leaf, elegant in its bloom, and exceedingly fragrant. Unfortunately none but the more inconspicuous are hardy in the West, north of the latitude of Tennessee. In Nashville, Tenn., we have seen large trees of Magnolia Grandiflora, in the yards of citizens, the leaves scarcely browned by the winter. In the Gulf States, its native home, this splendid species is a common tree of the open forest. Even of those called hardy, none of them are so in the West, much north of the latitude of St. Louis. The Umbrella tree or magnolia, *M. umbrella;* the Cucumber tree, *M. acuminata,* and the small or Laural magnolia, *M. glauca,* are the most hardy. The Great-leaved magnolia, *M. macrophylla,* is a native of southeast Kentucky. The Ear-leaved magnolia, *M. Fraseri,* is found in Kentucky and Virginia, and south along the entire range of the Alleghanies. *M. cordata* is the great Cucumber tree of Georgia, and *M. Grandiflora,* the great Laural magnolia of the Gulf States, are the evergreen species There are many hybrid sorts that have been produced by florists, none, however, worthy of attention that are hardy in the North. As among the so called hardy varieties, we give a cut of the flowers of *magnolia speciosa,* a Chinese hybrid, called Showy-flowered magnolia, the flowers of quarter size. The flowers are handsome, late, and hold their bloom well, and the tree is one of the hardiest of the foreign varieties. Nevertheless, we should not advise the planting even of the hardy varieties north of 40°, except in peculiar situations, as for instance Rochester, N. Y., and the fruit region of the eastern shore of Lake Michigan.

MAGPIE. Nuttall, Bonaparte, and Swainson regard the magpie of America and Europe as identical, and Audubon approved their judgment. Its range is generally throughout Europe, but in this country it is restricted to the western and northern regions. It is stated by Dr. Richardson that it has not been seen nearer to the Atlantic on this continent than the head of Red River, in Louisiana. It dwells in the fur countries of the North in winter as well as in summer, and is a common resident of the interior of Texas, western Louisiana, Arkansas and Missouri. It suffers from the want of food, but not from cold, in high northern latitudes, where travelers have been almost unable to protect their galled horses from its assaults. Unlike the magpie of Europe, it then has little fear of man, the young especially coming to his encampment or habitations, and greedily devouring whatever food they can obtain, even from his hands. The raven is often its companion, but the crow is not found with it. In the central table-land of the Rocky mountains, the nests of the magpie may be seen, usually in low thick bushes, barricaded over and floored with interlaced twigs; and it is common near Monterey, in California. Its common call is pay, pay, and when approaching each other, they practice a low chatter, but utter a monotonous and gluttonous croak while eating. The accounts of the habits of the European magpie, given by Macgillivray, is recited by Audubon in treating of the American bird. He states that its food consists of testaceous mollusca, slugs, larvæ, worms, young birds, eggs, small quadrupeds, carrion, and sometimes grain and fruits of different kinds, in search of which it frequents the fields, hedges, thickets, and orchards; it occasionally visits the farm-yards, prowls among the stacks, and perches on the house-tops, whence it sallies to examine any attractive spot. It is probably unjustly accused of picking out the eyes of lambs and sickly sheep; but it eats eggs, or the young of chickens or ducks, when the old are not present to repel it. Its more wary character, in Europe, is the result of the persecution it experiences because of its depredations. The magpie walks like the crow, but often leaps in a sidelong manner. It is prompt to apprise its companions of the approach of danger, which it does by a chatter indicating its own fears. The eggs of this species are from three to six in number, and vary in form and color. In general they are regularly ovate, or a little pointed, more than one and a half inches in length, and nearly or quite an inch across. They are frequently pale-green, freckled all over with umber-brown and light purple, and sometimes pale blue, or bluish-white, or greenish-white, with smaller spots and dots of the same dark colors, so as very nearly to resemble the eggs of the jay, which, however are smaller.

MAHALEB. A species of cherry, used as a grafting stock; the fruit affords a violet dye.

MAIDEN HAIR. Ferns of the genus *Adiantum*, a beautiful race.

MAIZE. *Zea Mays.* Corn, Indian corn. To the American ear, the word corn signifies that important member of the grass family, denominated, outside the United States, among English speaking people, Indian corn, (the word corn in Great Britain being the term used to designate grain generally). It is a plant of prime value, rivaling rice and sugar cane, in its importance to the human family at large, and in the United States standing ahead even of wheat, in money value, and in the number of bushels produced yearly, exceeding wheat nearly four times. It is a very important article of consumption alike for man and beast and is, indeed, the staff of life to the poorer classes in the South, where it is in more general use as an element of human food than in any part of our country. Botanically the corn plant is a most interesting one. The staminate flowers, (tassel) are arranged at the summit of the plant where their pollen may fall upon the pistillate spikes, (ears) below; these are dense spikes covered with sheaths of abortive leaves, the husks, which often have their blade more or less developed. The silk of the ear is the elongated pistils, one of which proceeds from each ovary or kernel. The cob is the thick rachis, and the chaff which covers it the glumes and paleæ. From the lower nodes or joints aërial roots are often thrown out, imitating in an humble way the celebrated Banyan-tree. The juice of the stem, before the grain is perfected, contains a considerable amount of saccharine matter, and sugar has been obtained from it. The young ears of some varieties have much sugar, which is changed to starch as the grain ripens. In the varieties known as sugar corn much sugar remains unchanged and gum is also a constituent. Under the words corn and Indian corn, in this work, we have referred to the word maize as designating corn, and this to prevent confusion to others than American readers, and for reasons explained in this article. Maize is a native of South America, but before the discovery of America had become pretty generally distributed among the wandering tribes of Indians in the temperate regions of North America. Although a tropical plant and of course exceedingly sensitive to frost, even the late varieties will ripen where there is about five months of summer without frost, and the earlier varieties in 100 days. Cultivation and climate has broken this remarkable grain up into numerous varieties, of every color from dark purple through the reds and yellow to white, and varying remarkably in their constituents of starch, sugar, gum and oil, some, as the dent varieties of the West and South, producing large quantites of starch, others, as the flint varieties of the East having gum and oil notably. Those varieties denominated sweet corn, being especially rich in gum and sugar. The stalks of all the varieties are rich in saccharine when the grain is in milk. So much so that sugar in notable quantities has been produced therefrom, not however in quantities to warrant working it, since, in the South, the true sugar cane, and in the North the varieties of sorghum are more profitably worked. Indian corn may be properly divided into four distinct groups. The Flint corn of the sea coast States, the Dent corn of the West and South, the Sugar varieties containing gum, sugar, oil, and but little starch, and the Squaw or flour corn. The varieties being marked by their tenderness, the skin being filled with starch granules which readily break into powder, the flint varieties contain largely of gum and oil, and the dent varieties as largely of starch and oil. The analysis by M. Payen given below shows the amount of proximate principles of maize as compared with the other cereal grains:

100 parts of—	Starch.	Gluten and other azotized matter.	Dextrine, glucose, etc	Fatty matters.	Cellulose.	Mineral matter and salts.
Wheat	58.12	22.75	9.50	2.61	4.00	3.02
Rye	65.65	13.50	12.00	2.15	4.10	2.60
Barley	65.43	13.96	10.00	2.76	4.75	3.10
Oats	60.54	14.39	9.25	5.50	7.06	3.25
Maize	67.55	12.50	4.00	8.80	5.90	1.25
Rice	89.15	7.05	1.00	.80	3.00	.90

As showing the constancy of species in retaining characteristics for long ages under cultivation, where no especial means were used to change them by special cultivation, we give three illustrations. Fig. 1 shows a cob of Indian corn from a rock cave of Arizona; Fig. 2, the corn of the present time as cultivated by the Puebla Indians of Arizona; Fig. 3, an ear of corn found with a mummy of Ancient Peru, the date being so far distant that the age can not even be guessed at. To return to Indian corn of the present day, Dr. Emil Wolff, makes the plant, cut early, or just at the time of blossoming, to contain in 100 parts: water, 82.2; organic matter, 16.7; ashes, 1.1. Or, of nutriment containing nitrogen 1.1; nutriment not containing nitrogen, 10.9; woody fiber, 4.7; total nutriment, 12.0. Or, again, fat 0.5; phosphoric acid, 0.08; lime, 0.07. The total amount of nutritious matter exceeded that of Swedish clover, peas, vetches, oats and lucerne, cut when in flower, as it also did the leaves of cabbage, beets and carrots. As compared with the common English field turnip, the per centage of flesh forming nutriment is the same, of fat forming material nearly double, as between the maize plant, and turnips, while the amount of water in the green stalks and leaves is less than half as much, a curious and interesting comparison, considering that the turnip is the sheet anchor of English husbandry. Maize is the real fallow crop of the West. It was once, and should now be, the fallow crop of American husbandry, both North and South. From many analyses made by Mr. J. H. Salisbury, of New York, the following is the average, of the whole plant calculated without water, and just before the formation of the ear;

Sugar and extract	35.00
Matter obtained from fiber by a weak solution of potash	12.00
Dextrine or gum	6.04
Albumen and caseine	7.96
Woody fiber	39.00
Total	100.00

The analyist as to the value of maize as fodder, says, the plant during tasseling, owing to the very large per centage of sugar and extract, with the respectable quantity of albuminous matter and dextrine which the stalk, leaves, and sheaths contain, must form a very palatable and nutritious fodder. This has been well borne out since, by those who have drilled, cultivated, and fed Indian corn to dairy cows in the West. Those who have persisted in sowing the corn thickly—three to four bushels per acre—and feeding it half grown, blanched and watery, from overdue crowding, hold contrary opinions. If they will drill it, in rows two feet apart, at the rate of one bushel per acre, and cultivate it until it begins to shade the ground, and will feed it from the time the blossom begins to appear until the grain is half grown, it will be found a most valuable and economical forage plant to tide over the dry season in the West, from the middle of July to the middle of August, especially, if they avoid the mistaken idea of sowing the late varieties of Southern corn, and use instead early and more dwarf sorts, especially the medium early varieties of sweet corn. The insects and their larvæ, which infest maize, are rather numerous, and yet with the exception of Wire worms which attack the young plant under ground, the Heart worm which destroys the plant by boring into the heart of the stalk, and the Corn worm which attacks the young ears, they are not common enough to do serious injury. The range of Indian corn is most extensive, reaching from the torrid zone well up into Canada Far north the plant often does not reach four feet in height, the ears being not thicker than a man's thumb, or more than four inches in length. On the other hand, some of the Southern varieties sometimes reach the height of from fourteen to sixteen feet, with ears as many inches long. It is a curious fact, however, that the largest yields per acre are obtained in the middle region of cultivation, and with varieties neither dwarf nor yet of great height. The corn zone may be stated to lie from the middle latitude of Tennessee and Kentucky to that of central Michigan, southern Wisconsin and northern Iowa, The best climates being the latitudes of Ohio, Indiana, Illinois, southern Iowa, northern and central Missouri and Kansas. The center of corn production and also the center of wheat production since 1850 has moved gradually West, with each recurring decade, the center of wheat production, however, advancing West faster than corn. The center of corn production in 1877 was a line drawn north and south, near the center of Illinois. In another decade, we shall find the center of corn production removed to near the Mississippi river, and that of wheat undoubtedly beyond the Mississippi river. The center of corn production can not travel much further West, for the reason that the dryer climate of the far West is not suited to the production of maize. As showing the wonderful increase in production, we give a table below showing the progress of the production of maize in the last sixteen years, as gathered from the statistics of the United States. It must be remembered that the first three years were years of civil war, with decreased production and inflation of prices. The acreage in the first two years is low, and the price excessive. The year 1865 was a prolific one, with by far the largest average yield reached during the whole period, even in 1879, a year of great crops, giving less than thirty bushels per acre. The acreage of 1865 was nearly doubled in 1866, and nearly tripled in 1878. During the year last named our cornfields were nearly equal in area to the State of Kansas. The average product per acre was substantially the same throughout, amounting to 26.6 bushels during the latter eight years, against 26.8 bushels in the previous eight years. The four crops, 1875-1878, each exceeded considerably a billion and a quarter of bushels. As in the case of wheat, the supplies have grown faster than the population. During the first eight years the outturn averaged 21.40 bushels per capita, and during the latter eight years, 24.07 bushels; in 1875, it amounted to nearly thirty bushels. Our surplus in later years has found an increasing foreign outlet. During the first eight years we sent abroad but 1.20 per cent. of our product; during the latter eight years, 4.37 per cent.; of the crop of 1877, we shipped abroad six and one-half per cent., and of the crop of 1878 in about the same proportion. The average price obtained by the farmer has fallen off two-thirds in fifteen years, being 99.7 cents per bushel in 1864, and 31.8 cents in 1878. The last named crop, though greater by 46,000,000 bushels than

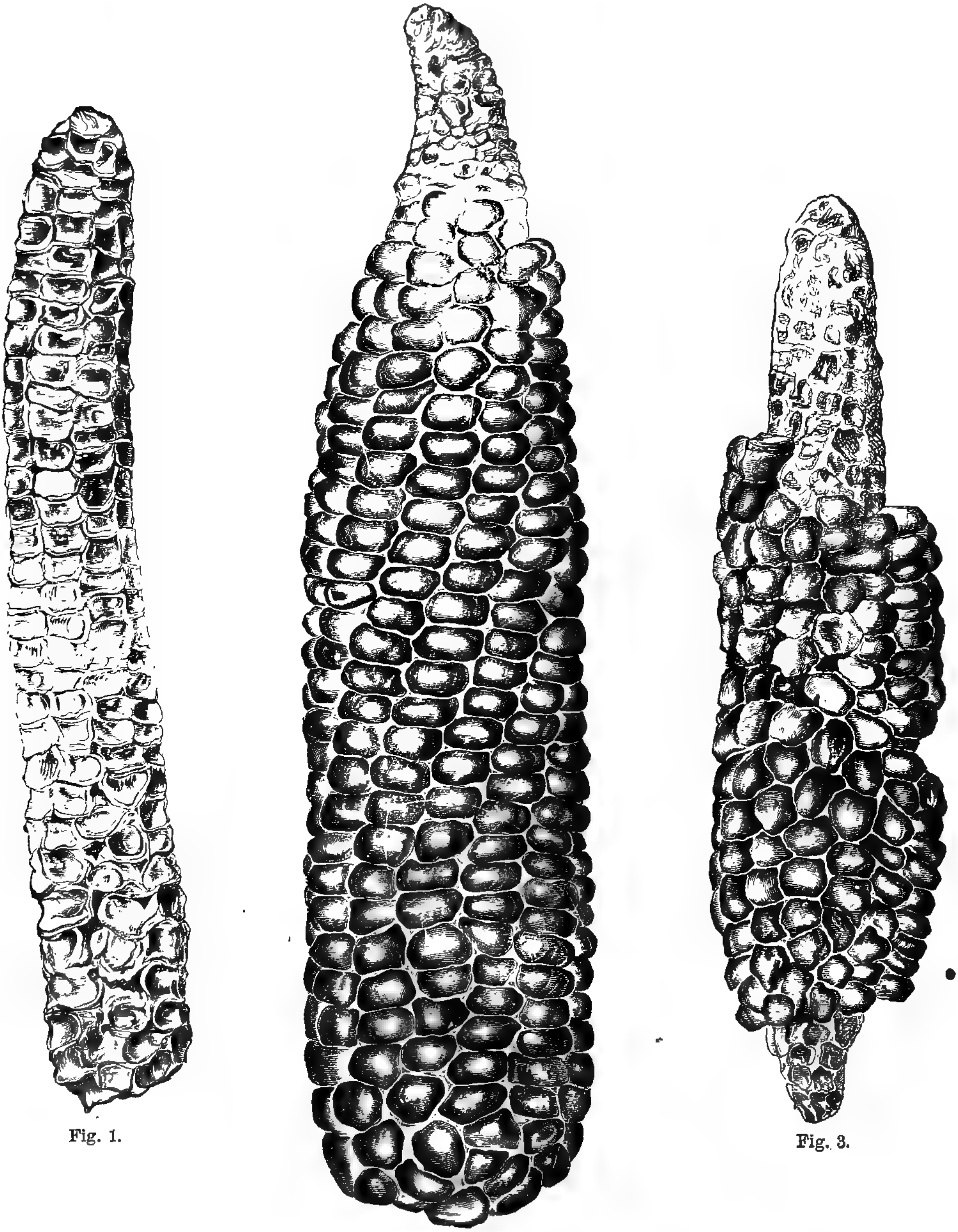


Fig. 1.

Fig. 2.

Fig. 3.

AZTEC INDIAN CORN — PAST AND PRESENT.

its predecessor, fell short of it $39,000,000 in aggregate value. The average value of each acre's yield has fallen to the unprecedented low figure of $8.55 in 1878; in 1864 it amounted to $30.64. The last named year, however, was one of extreme moneyed inflation. The table above will show the production for sixteen years The corn crop of 1879 aggregated 1,547,901,790 bushels, on 53,085,450 acres, of the value of $580,486,217, or within about $50,000,000 value of the wonderful wheat crop of that year. In 1880 the production of corn was 1,537,535,900 bushels; less than that of 1879. Now as the production of wheat in 1880 was 32,000,000 greater than in 1879, while corn was less, we may conclude, that wheat was more remunerative than corn. It is quite probable that we have already arrived at the maximum production which the country is capable of under an economical system of agriculture, even allowing which is true, that the corn crop is the great fallow crop of the West. It will be seen by the scale representing production and exports, given below, that the years 1875 to 1878 inclusive show an increasing export. Of the crop of 1878, over 100,000,000 bushels were exported, and of that of 1879 still more. One reason why the area of corn production has remained comparatively steady is, that the demand for export wheat has wonderfully increased for the last three years, owing to short crops in Europe. Hence the remarkable increase in wheat production since 1876, as shown in the wheat scale, which has steadily increased including the year 1880. On this page is another table showing the number of bushels, acreage and value of maize, by States, for the year 1878. It will be seen that the four States of Illinois, Iowa, Indiana and Ohio raise about one half the corn grown in the entire country. For the years 1879 and 1880 these figures would be largely increased. It should not be omitted in this article, that the stalks of Indian corn, at that period when they are fullest of elaborated sap will make sugar equal in every respect when refined to cane sugar. Yet it is hardly probable that the making of

Years.	Acreage.	Yield per acre.	Total product.	Price per bushel.	Total value of product.	Total value per acre.	Corn and corn meal exported in the fiscal year closing June 30, following.	Proportion of crops exported.
		Bush.	Bushels.				Bushels.	P. ct.
1863	15,312,441	25.98	397,839,212	$0.69.9	$278,089,609	$18 16	5,146,192	1.29
1864	17,438,752	30.42	530,451,403	99.5	527,718,183	30 26	3,610,402	.68
1865	18,990,180	37.09	704,427,853	46.0	324,168,698	17 07	14,465,751	2.05
1866	33,306,538	25.30	867,946,295	68.2	591,666,295	17 21	16,026,947	1.85
1867	32,520,249	23.63	768,320,000	79.5	610,948,390	18 49	12,493,522	1.62
1868	34,887,246	25.9	906,527,000	62.8	569,512,460	16 32	8,286,665	.91
1869	37,103,245	23.5	874,320,000	75.3	658,532,700	17 74	2,140,487	.24
1870	38,646,977	28.3	1,094,255,000	54.9	601,839,030	15 57	10,676,873	.98
1871	34,091,137	29.1	991,898,000	48.2	478,275,900	14 02	35,727,010	3.60
1872	35,526,836	30.7	1,092,719,000	39.8	435,149,290	12 24	40,154,274	3 68
1873	39,197,148	23.8	932,274,000	48.0	447,183,020	11 41	35,985,834	3.86
1874	41,036,918	20.7	850,148,500	64.7	550,043,080	13 40	30,025,036	3.53
1875	44,841,371	29.4	1,321,069,000	42.0	555,445,930	12 38	50,910,532	3.85
1876	49,033,364	26.1	1,283,827,000	37.0	475,491,210	9 69	72,652,610	5.66
1877	50,369,113	26.6	1,342,558,000	35.8	480,643,400	9 54	87,172,110	6.50
1878	51,585,000	26.9	1,388,218,750	31.8	441,153,405	8 55	....	.....
Average of whole period	35,930,407	26.7	959,174,938	52.3	501,616,287	13 96	....	.....
Average 1863-'70	28,650,703	26.8	768,010,845	67.7	520,309,421	18 16	....	.....
Average 1871-'78	43,210,111	26.6	1,150,341,531	42.0	482,923,154	11 18	....	.....

States.	Corn Crop 1878.		
	Bushels.	Acres.	Value.
Maine	2,180,000	54,500	$1,417,000
New Hampshire	2,207,400	56,600	1,346,514
Vermont	2,275,500	55,500	1,319,790
Massachusetts	1,260,000	35,000	781,200
Rhode Island	268,800	8,400	142,464
Connecticut	2,220,000	75,000	1,376,400
New York	25,020,000	695,000	12,510,000
New Jersey	9,792,000	274,000	4,406,400
Pennsylvania	44,065,000	1,259,000	21,151,200
Delaware	4,500,000	180,000	1,755,000
Maryland	11,209,500	477,000	5,044,275
Virginia	18,200,000	1,040,000	7,826,000
North Carolina	22,603,200	1,662,000	10,171,440
South Carolina	12,276,000	1,320,000	6,629,040
Georgia	24,398,000	2,218,000	14,882,780
Florida	2,124,000	236,000	1,550,520
Alabama	23,928,000	1,994,000	14,117,520
Mississippi	19,474,000	1,498,000	12,463,360
Louisiana	16,875,200	848,000	10,125,120
Texas	58,396,000	2,246,000	25,694,240
Arkansas	22,992,000	958,000	11,036,160
Tennessee	37,422,700	1,939,000	15,343,307
West Virginia	10,118,400	372,000	4,249,728
Kentucky	45,922,100	2,023,000	18,368,840
Ohio	108,643,700	3,113,000	35,852,421
Michigan	31,247,700	835,500	11,874,126
Indiana	138,252,000	4,215,000	37,328,040
Illinois	225,932,700	8,337,000	56,483,175
Wisconsin	36,900,000	984,000	10,701,000
Minnesota	17,106,900	449,000	4,961,001
Iowa	175,256,400	4,686,000	28,041,024
Missouri	93,062,400	3,552,000	24,193,224
Kansas	81,563,400	2,406,000	15,497,046
Nebraska	54,222,000	1,291,000	8,675,520
California	3,467,250	100,500	2,080,350
Oregon	166,500	5,000	153,180
Nevada, Colorado, and the Territories	2,670,000	89,000	1,602,000
Total	1,388,218,750	51,585,000	441,153,405

corn sugar will ever become a profitable industry in the United States, notwithstanding the assertions of enthusiasts. It will not supersede the true sugar cane in the gulf States, nor sorghum further north. Nevertheless, it is possible, that some early varieties, rich in saccharine, may be available in prolonging the season of sugar making in the North, by working corn before sorghum is ready for the mill.

MALACODERMS. A tribe of soft-skinned, serricorn beetles.

MALARIA. The poisonous exhalations of stagnant marshes and low new lands. It is most active at nightfall and during night.

MALE FLOWERS. Such as have stamens only, and no ovary or swelling under the petals.

MALIC ACID. The sour principle of apples, oranges, and numerous fruits; when pure, it is intensely sour and crystalline.

MALIGNANT. Rapidly fatal, poisonous.

MALIGNANT ANTHRAX. (See Blain.)

MALIGNANT PUSTULE. (See Murrain.)

MALLEABILITY. The property of being extended by hammering, as in the case of gold, copper, silver, platina, iron, etc.

MALLENDERS. This is a skin disease attacking horses above the feet, usually back of the knee in the hollow of the joint. If it occur in the hollow of the joint below the hock it is called Sallenders. Technically it is psoriasis of the carpus and tarsus, generally beginning with a moist tetter often difficult to cure. If attended with indigestion and constipation, these must be attended to. The animal should also have light, digestible food, and have an ounce of Fowler's solution of arsenic once a day in the drink. Touch the sore spots lightly with a stick of nitrate of silver, first thoroughly washing with castile soap suds, and drying; then cover with pure wood tar. If it do not heal kindly, cleanse thoroughly and use the following ointment: One drachm powdered camphor, one half drachm acetate of lead, and one ounce mercurial ointment.

MALLOW. *Malvaceæ.* The mallow family includes Althea (*A. officinalis*) being the well known and useful marsh mallow, and the common hollyhock of the garden. The mallow (*Malva*), an introduced weed; Sida, (*S. spinosa*) being an introduced weed from India, and quite common in the South; Abutilon, containing some handsome flowering plants, and the well known *A. avicennæ*, Indian mallow or velvet leaf of the West, a noxious weed in many places; Abelmoschus, of which okra (*A. esculentus*), produces the pods so much in repute South and West as an ingredient in gumbo, and other stews, requiring mucilage; Hibiscus, or rose mallow, to which the shrubby althea or Rose of Sharon, and other elegant flowering plants belong. The family also contains Gossypium, *G. herbaceum*, being the well known cotton of commerce. Cotton and okra are treated of under their separate names. The others may be regarded as weeds, with the exception of marsh mallow, which is a most valuable demulcent. The Indian mallow yields a most elegant fiber, and near Springfield, Ill., its manufacture was at one time actually carried on, but did not prove lucrative, and it was abandoned. The quality of the fiber was superior to hemp, being as strong as manilla, taking colors well, the fiber being valuable as warp for carpets, rugs, and other fabrics requiring color.

MALT. Barley which has been prepared or malted, by which sprouting is induced, and the grain becomes much sweeter.

MALUS. The generic name of the apple.

MALVACEÆ. A natural order of mucilaginous, exogenous plants, with polypetalous flowers and monadelphous stamens. The species are herbs, bushes, or trees, and are found all over the temperate and tropical parts of the world, especially the latter. Their flowers are in many cases large and handsome; but the order is chiefly interesting from the *Gossypium*, or true cotton plant, forming a part of it. Another species is the marsh mallow. Some yield a fiber fit for manufacture into cordage.

MAMMALIA. The study of animated nature with reference to agricultural economy is certainly of importance to the farmer, for thus he learns of those beneficial or noxious. The following will give the principal points relating to the subject, originally written by Mr. E. A. Samuels, of Massachusetts; and from which this is condensed. Taking our terrestrial animated nature, or fauna, and analyzing it we find it to consist of four great classes—mammals, birds, reptiles, and insects. The characteristics of each of these classes, are, of course, familiar to all; they may be described briefly as follows: Mammals are warm-blooded vertebrate animals that suckle their young. They are viviparous—that is, they bring forth their young alive. Birds are warm-blooded vertebrate animals clothed with feathers; they are invariably oviparous—that is, the young are hatched from eggs by the action of heat imparted from the body of the parent bird. Reptiles are cold-blooded vertebrate animals; they are oviparous, the young being hatched by the heat of the sun. Insects are those articulate animals which undergo changes, called metamorphoses, before the perfect animal is formed; these changes are three in number after the eggs are laid; first, the caterpillar stage; second, the pupa stage; and after these the imago or perfect insect stage. The study of the first class is called mammalogy; that of the second, ornithology; the third, herpetology; and that of insects entomology. The study of entomology is undoubtedly of the greatest importance to the agriculturist, but the present paper will not treat of it otherwise than in a general description of the characteristics of the different orders, and incidentally in the enumeration of destructive species which furnish food for some of the mammals and birds. Herpetology is of but little importance to the farmer, as we have but few species of reptiles, most of which are, however, beneficial. Beginning with the great class mammalia, we find it divided by naturalists into different classes called orders, each of which is distinguished by peculiarities in structure, habits, and food. Those orders indigenous to this country among the terrestrial mammalia of importance to the agriculturist, either as beneficial or injurious, are: Cheiroptera, the bats; Insectivora, the insect devouring animals; Carnivora, the flesh devouring animals; Rodentia gnawing animals; Marsupialia, pouched animals; and Ruminantia, animals which chew the cud. Of these animals the Cheiroptera, Insectivora, and Carnivora are beneficial; the Rodentia are generally injurious; and the Ruminantia are valuable only as food, and are, to a slight extent, injurious in the wild state. In the order Cheiroptera are included those animals known as the bats; there are several species in the United States, all of which can be properly included in the family *Vespertilionidæ*, the characteristics of which are an excessive prolongation of the fingers of the anterior extremities, which are connected together, and with the posterior extremities, which are connected with the tail by a thin, semi-transparent, generally naked membrane, which enables them to fly. Their food, which they almost always capture in the night, as the habits of the animals are strictly nocturnal, consists entirely of insects, chiefly nocturnal lepidoptera, which they seize while on the wing. The number of these noxious insects which they destroy is immense; and this fact, together with their harmless dispositions and habits, establishes them as valuable friends to the farmer, who should encourage them to take up their abode on his premises, and protect them as much as possible. At the approach of cold weather, the bats seek convenient quarters in caves, hollow trees, and buildings, where they remain torpid until spring, suspended by the sharp hooked claws of their feet. Of the large and important order, Insectivora, we have many representatives included in the two families, *Soricidæ*, (shrews), and *Talpidæ*, (moles). The shrews may readily be distinguished by their mouse-like form, long and pointed head, diminutive eyes, and attenuated muzzle, prolonged into a movable snout. In the true or typical shrews included in the genus *Sorex*, the body is rather slender, nearly cylindrical, and covered with a soft glossy fur; the ears are large, but nearly concealed by the fur of the head, the eyes are minute, but visible; and the snout is elongated, flexible and sensitive; the tail is variable in length, but generally is long; series of glands are placed along the flanks which secrete a fluid of disagreeable odor, in consequence of which they are seldom destroyed and eaten by the Carnivora. The animals of this family are small, some of them the most diminutive of mammals. Their habits are generally nocturnal, and none of the species hybernate, I believe, as individuals are often seen in winter busily engaged in searching for insects in their various forms, in and beneath piles of stones and rubbish. The shrews inhabit the woods, fields, and gardens, and being possessed of voracious appetites they are continually active in destroying numerous noxious insects, of which their food almost entirely consists; consequently they are all eminently beneficial to agriculture, and are certainly worthy the protection of the farmer. There are also in this country besides the genus *Sorex* or true shrew included in the *Soricidæ*, other genera, of which *Blarina* is the most important. In this genus are placed the mole-shrews or short-tailed shrews. These may be recognized by their stout body, short tail, and the other features of the genus *Sorex*. The family *Talpidæ* (or moles) is represented in this country by several species, in all of which the body is short and strong, the snout flexible and very sensitive, and the head is long and tapering. The external ear is wanting, and the eye is so small as to be hardly visible, or is completely covered with the skin of the head. The limbs are short and strong, (the forward ones which are provided with strong claws for digging,) exceedingly so. These peculiarities of form are all adapted to the subterranean habits of these animals. Their food consists of insects and worms; these, which they destroy in great quantities, are all, or nearly so, captured beneath the surface of the ground. They are almost constantly employed in searching for food in consequence of their voracious appetites, and their labors are valuable in destroying these insects. In reviewing the habits of the different animals that subsist entirely upon insects, we find them to be generally nocturnal in character. This seems to be a wise provision of nature, whereby the birds (generally diurnal in habits) which destroy great numbers of insects, and even in a great many species, subsist entirely upon them, are continually assisted in keeping reduced this formidable and destructive element. Another interesting and valuable fact is, that these animals to make their work the more sure, hunt in different circles: The *Vespertilionidæ* destroying great numbers of insects in the air; the *Soricidæ* on the surface of the earth, and the *Talpidæ* beneath the surface. In studying these beautiful laws, so nicely calculated for so desirable an end, we admire and wonder. Appreciating them, and noting their efficacy, we learn to respect and even love the instruments by which they are executed. The Carnivora, a great order, generally diffused over the entire globe, is represented in this country by the following families: *Felidæ*, (the cats;) *Canidæ*, (the dogs;) *Viveridæ*, (the civet cats;) *Mustelidæ*, (the weasels, skunks, etc.;) and *Ursidæ*, (bears.) The external characteristics of the *Felidæ* are—a rounded head, light, elastic, muscular body, strong limbs and sharp retractile claws on all the toes, which are five in number on the anterior feet, and four on the posterior. In this family are included our panthers, lynxes, and wildcats. The habits of these animals are both nocturnal and diurnal, but generally the former. In capturing their prey they always spring suddenly upon it from some concealed station, and if they fail in their first attack they seldom repeat it. By nature they are cowardly and cruel; they are gifted with acute senses of sight and hearing; they are only beneficial in destroying many of the injurious herbivorous mammals; and it is a doubt whether or not the damage they inflict by destroying great numbers of beneficial birds and valuable ruminants, does not more than balance the little good they do. At any rate the hatred all farmers have for them is so great that they lose no opportunity to destroy them, and, probably, this one of their prejudices is founded on reason. In the family *Canidæ*, are included our wolves and foxes; the same remarks will apply to them as to the cats regarding their usefulness. The family *Viveridæ* has no importance to our agriculturists. The family *Mustelidæ*, in which are placed our martins, weasels, otters, badgers, and skunks, is the most important of the Carnivora to agriculture. Its characteristics are based principally on peculiarities of the teeth, of which these animals have six incisors in each jaw; two canines; six or eight pre-molars; two molars in the upper, and two or four in the lower jaw. Their bodies are generally long and slender; legs short; feet, five-toed, provided with long sharp claws; the tail is generally long, and sometimes bushy, as with the skunks. These animals generally have glands at the root of the tail which secrete a liquid of offensive odor. With the skunks this secretion is used as a weapon of defense; its offensive odor exceeds anything in nature. The weasels and skunks are the most important members of this family; they are continually active in destroying the mice and rats; the form of the weasels being peculiarly adapted to following them to their most secret haunts. Insects also form no inconsiderable portion of the food of skunks and weasels. Birds and their eggs, and young, are often destroyed by them, but not to an extent at all balancing the benefit they do; nor is the injury caused by an occasional raid into the poultry-yard at all comparable to the immense benefit we receive from their unceasing nightly labors in the destruction of rats, mice, and insects. The otters and badgers are of no importance to agriculture. The *Ursidæ*, in which are included our raccoons and bears, are omnivorous in nature, although they are placed by the naturalists in the Carnivora. In consequence of thier depredations in the cornfields and sheepfolds they are in ill favor with the farmers, who improve every opportunity to destroy them. But little can be said of their benefit to agriculture. In closing the order Carnivora it would be proper to say that these animals are slow to multiply. If this were not the case, they would, in consequence of their voracity, exterminate the other animals on which they subsist, (and which are also valuable as food for man,) and thus defeat the object for which they were created. A knowledge of the characteristics and habits of the animals of the order Rodentia is of great importance to the agriculturist, from the fact that these animals constitute one of the most destructive elements with which he has to contend. To properly understand these characteristics, it will be necessary to enter into a more careful and less general examination of the animals, and trust less to external peculiarities than we have thus far done; and we will, as far as possible, simplify these examinations, that they may be brought within the comprehension of all who have not already made the subject a study. The animals of this order are all of small size, the beaver and marmots being among the largest. The species are all very prolific and numerous, and all are destructive, some exceedingly so. The prominent characteristics of these animals is the peculiar formation of the teeth. These are of two kinds, incisors and molars; the canines are wanting; the incisors are generally two in number in each jaw; they are large and powerful, and provided with sharp, cutting, chisel-shaped edges adapted to gnawing. The constant severe action to which they are subjected would in time destroy them were they not continually growing, or being replaced by a pulpy secretion at their bases. The molars vary in number from twelve in the upper and ten in the lower, to but two in each jaw; these, like the incisors, are composed of two substances; an external layer of hard enamel, and a softer material in the interior; their surfaces are irregular or tuberculated, adapted for grinding vegetable substances. These teeth are replaced in the same manner as the incisors. The forms and habits of the animals in this order are of a great variety. They will be discussed in the descriptions of the different families, of which we have in this country five. They constitute each a natural group, with generally familiar representatives. They are called the *Sciuridæ*, (the squirrels), *Saccomyidæ*, (the pouched rats and gophers); *Muridæ*, (rats and mice); *Hystricidæ*, (porcupines); and *Leporidæ*, (rabbits and hares). The detailed peculiarities of these families can not be, in the present paper, discussed at great length, but those most prominent will be mentioned sufficiently to have them understood. The *Sciuridæ* of the United States are included in the two natural divisions or subfamilies *Sciurniæ*, (squirrels and woodchucks); and *Castorinæ*, (beavers). The subfamily *Sciurinæ*, in which are placed the squirrels, both ground and arboreal, the woodchucks and spermophiles, is very numerous in this country, and the members of it are generally injurious, from the fact that the great bulk of their food, of which they generally secure large quantities for their winter subsistence, consists principally of the various seeds, nuts, and grains which are valuable as a means of subsistence to man and the domestic animals. These animals also consume great quantities of cultivated fruits, and even vegetables, to an extent, in some districts, involving to the farmer considerable pecuniary loss. Woodchucks, especially, are very mischievous, not only in what they eat, but to the crops of clover, grass, and grains, which are destroyed by numerous trails or paths leading from their burrows. This family is of small value, either for food or for their fur. The *Castorinæ*, or beavers, are of no great importance, economically speaking, to agriculture. They are valuable for their fur, which always commands a ready sale at a high price. These animals are rapidly becoming extinct, and are only found in the wildest and most retired districts of the country. In the family *Saccomyidæ* are included all the gophers and pouched rats. They may be readily distinguished by their large cheek pouches. These animals, are all eminently injurious. They burrow in the earth in grain fields and grass lands, and often do considerable mischief by visiting the gardens, orchards and nurseries, where they eat the roots of the plants and gnaw the bark from the trees. In this manner large numbers of fruit trees are destroyed yearly. The cheek pouches are used in conveying food to their burrows. This food consists of roots, grains, grasses, seeds, fruits and nuts. Of these they devour great quantities. Various methods have been devised for their destruction, the most successful being by poison. Great numbers are destroyed by the carnivorous animals and birds, and were it not for these they would, in consequence of their numbers and rapid increase, be a serious pest. These are, however, not found in New England. The great family *Muridæ* is, economically speaking, the most important in our indigenous *Rodentia*. In it are included the rats and mice, all of which are injurious, in some genera, seriously so. These animals have characteristics in common, but they naturally fall into several groups, which possess peculiarities sufficiently marked to rank them as subfamilies. They are called the *Dipodinæ*, (jumping mice); *Murinæ*, (rats and mice proper); and *Arvicolinæ*, (short-tailed field mice). In the subfamily *Dipodinæ* we have but one genus, (*Jaculus*), in this country. These animals are readily distinguished from the field mice by their very long posterior limbs and tail, and their progression by long leaps. This genus is not a large one, and consists in this country of but one or two species. They are not abundant in any districts, and can hardly, from their retiring habits, and the nature of their food, which consists largely of the seeds of wild plants, be called greatly injurious. Their number will probably be kept reduced by the *Carnivora* and reptiles. The subfamily *Murinæ* is largely and widely distributed. It is characterized by a robust body, moderately short limbs, strong and fully developed clavicle, and the tibia and fibula are united below. The anterior feet are four-toed, with a wart-like tuberole supplying the place of a thumb; the posterior feet are five-toed; the tail is generally long, and covered more or less thickly with scales, which are arrayed in whorls; and between which spring scanty hairs which partially conceal them. In this subfamily are included our common rat, *Mus decumanus*, (Pallas); black rat, *M. rattus*, (Linn.); common mouse, *M. Musculus*, (Linn.); the field mice, (*Reithrodon*); the white-footed mice (*Hesperomys*); the bush rats, (*Neotomia*); and the cotton rats, (*Sigmodon*). These animals are all injurious generally in the highest degree. In the fields and gardens, in the grain houses and hay ricks, their depredations are innumerable, and the farmer has to pay for their support a large share of his produce. These species are all prolific and numerous, and their rapidly increasing numbers are already a serious evil. They should be destroyed at every opportunity. The farmer will find that he will have abie and willing assistance in their destruction in one or two small terriers if he keeps them about his premises. They are as natural enemies to the rat tribe as the cats are, and as constantly and successfully on the alert for them. In conclusion, we can say that, with the exception of the *Arvicolinæ*, to be treated of next, they are the most injurious of all mammals. The animals included in the subfamily *Arvicolinæ* are certainly the most injurious of all farm pests, excepting the insects. They are divided into three genera, *Arvicola*, (field mice); *Fiber*, (muskrats); and *Myodes*, (Lemmings). Of these, the last mentioned are not of much consequence agriculturally. Muskrats are very mischievous among crops which lie near their haunts. They ought to be exterminated by every means in the farmer's power, on account of the immense and unceasing injury in cutting through dams and embankments, breaking the banks of ditches, and burrowing in, through, and across drains, opened and covered. It is the animals in the genus *Arvicola* that constitute one of the greatest of farm nuisances. They are characterized, and may be readily distinguished, by a rat-like, but rather stout, form; short ears, nearly concealed in the fur; large head and short tail. They are known in different sections by the names, field mice, short-tailed field mice, bull-head mice and bear mice. These animals are numerous, in some districts extremely so, and prolific to an alarming degree, and exceedingly voracious. In summer they live in the cultivated fields and meadows. In this season they eat the different grains by cutting down the stalks to get at the ears. They also eat the roots and seeds of the different grasses and clover, and devour carrots, turnips, and other vegetables. In the barns and hay ricks they spoil the hay by cutting it into fragments and filling it with their peculiar odor, thus rendering it unacceptable to the cattle. The late lamented Robert Kennicott, who obtained a rich fund of knowledge of the habits of these animals, wrote a valuable report on them, in which he says: Few if any escape their depredations, though the full amount of damage done by them is but little known, and they are usually thought unworthy of consideration. Such farmers as cut their corn and leave it standing in shocks for some time in the field, usually done in the West, will find upon examination that in many, if not in every one of the shocks, there may be found one or more pair of meadow mice, which have dug for themselves burrows in the ground beneath, and have often carried thither a store of corn; while in these, or ensconced in the protecting cornstalks above, they have built themselves a nest, in which they can lead a very comfortable sort of life, regaling themselves when hungry upon the corn. Now, a pair of mice will not, it is true, eat enough corn to alarm a farmer for the safety of his crop; but let any one examine a large field of corn thus cut and left standing on the ground a month or two where these mice abound, and carefully estimate the average amount of corn destroyed in each shock, observing that which has been buried in the burrow, and then multiply that by the number of shocks inhabited by these pests, and it will be often found that they have consumed or destroyed a large amount. In meadows they do much injury by devouring the roots and stems of timothy, clover, and other plants used for hay. In a nursery, where apple seeds were planted in autumn, I have observed that, during fall and spring, so many of the seeds were dug up by these mice as to leave long gaps in the rows of seedlings, the empty shells of the seeds being found lying about the rows from which they had been taken. They congregate in stacks of hay and grain, sometimes in exceedingly great numbers, destroying all the lower parts by cutting galleries through them in every direction. The greatest mischief done by meadow mice is the gnawing of bark from fruit trees. The complaints are constant and grievous, throughout the Northern States, of the destruction of orchard and nursery trees by the various species of *arvicolæ*. The entire damage done by them in this way may be estimated, perhaps, at millions of dollars. If any think this too large an estimate, let them inquire, even in a small neighborhood, where much attention is paid to fruit-growing, and it will be found that, wherever they abound, the injuries committed by these pests are frequently among the most serious difficulties encountered by the pomologist. This is especially the case at the West, where no care is taken to protect the trees against them, careless orchardists allowing grass to grow about the roots of their fruit trees, and thus kindly furnishing the *arvicolæ* with excellent nesting places in winter, and rendering the trees doubly liable to be girdled. Thousands of fruit trees, as well as evergreens and other ornamental trees and shrubs, are at times thus killed in a nursery in one winter. The mice are most mischievous in winters of deep snow. It is usually thought that they only gnaw bark when no other food is to be obtained; but it is more probable that this is palatable to them at all times. Confined specimens, while abundantly supplied with food of all kinds, ate the bark from twigs placed in their cage. One reason why fruit trees are most girdled in times of deep snow is, that the meadow mice can then best move about at a distance from their burrows, being protected by the snow, under which they construct numerous pathways, and are thus enabled to travel comfortably in search of food, always to be obtained in abundance where there is any kind of perennial grass or the seeds of annual plants Aided by the snow, too, they climb up at the sides of the trees to gnaw the bark at a considerable height from the ground. Rabbits are often accused of gnawing the bark from trees, when the mischief has really been done by meadow mice. If the *Arvicolinæ* had not numerous enemies they would soon become unbearably numerous, for they are all very prolific, rearing several litters of from five to seven in each, yearly. They are destroyed by all the carnivora and rapacious birds. Indeed, some species subsist almost entirely upon them. The animals most efficiently active against them are the *Mustelidæ* and some of the large snakes. These, if protected by the farmer, and they should be, would do much to keep these pests reduced in numbers. They can readily enter the burrows of the mice, and, possessing voracious appetites, destroy great numbers. But the farmer, the moment he sees a snake, no matter if it is perfectly harmless, (and but few are venomous,) kills it, thus destroying one of his greatest benefactors, living as it does on insects principally, but often catching these mice. Domestic cats are also extremely fond of them, and destroy great numbers. In spite of all this destruction *Arvicolinæ* are still abundant. Many farmers kill small birds of prey with a zeal that would be highly commendable if exhibited in a better cause, while the man is rarely found who does not kill the harmless mouse and insect-eating snakes, with as much eagerness as he would destroy the really objectionable rattlesnake, which is the only venomous reptile on the prairie region of the Western States. Let one of our prairie farmers, who regards these pests as inoffensive little mice that only steal a few kernels of corn, investigate their habits carefully for a year, and he will be very apt to conclude that meadow mice are a kind of farm stock that are hardy and excellent breeders, but rather expensive to keep. It may be, he will think it best to forbid killing, too, on his farm the prairie hawks, owls, and shrikes, as well as harmless snakes. Before dismissing the destructive family *Muridæ*, it will be proper perhaps to mention some of the methods that have been adopted on the farm for their destruction, or to prevent their ravages. Numerous traps have been devised, some of them ingenious and effective. Of these, the best we have seen—one for barns and granaries, and another for the fields—are as follows: Place a barrel half full of water beneath a trap-door in the floor of buildings infested with these animals, so that the top of the barrel will be just on a level with the floor; around this scatter grain or meal at night, and by morning numbers will have fallen in and been drowned. In the fields and nurseries where they abound, a trap made on the favorite Scotch plan is very effective. Dig in the earth, at the beginning of cold weather, short trenches four feet wide at the bottom, and three feet wide at the top, and about four feet deep; the ends inclined at the same angle as the sides. The earth walls of these trenches, after becoming frozen, are impassable to mice that have fallen in, as they will in great numbers. It is stated by a Scotch gardener, that he has killed upwards of nine thousand in one winter in this manner. Different poisonous preparations have been used with effect on these vermin. The following are among the best: Two ounces of carbonate of barytes mixed with one pound of suet or tallow; place portions of this within their holes and about their haunts. It is greedily eaten, produces great thirst, and death ensues after drinking. This is a very effective poison, as it is both tasteless and odorless. Mix one ounce of finely powdered arsenic and one ounce of lard with meal into a stiff dough; put it about the haunts of the rats; they will eat it greedily, and it makes them so thirsty that they will die near the water, of which they drink until they burst. Other effective poisons are composed as follows: Make a paste of one ounce of flour, one-half gill of water, one drachm of phosphorus; or, two ounces of lard, half a drachm of phosphorus, and one ounce of flour; or, one ounce of flour, two ounces of powdered cheese-crumbs, and one-half a drachm of phosphorus; add to each of these mixtures, if convenient of access, a few drops of oil of rhodium; mix into a paste or pills, and scatter about the fields and nurseries; or, two ounces of finely powdered arsenic, two ounces of lard, ten drops of oil of rhodium, mixed with flour or meal into a thick dough, and pills of it scattered about the orchards and nurseries, In the family *Hystricidæ*, are comprehended the porcupines, etc. Of these we have but two species included in the genus *Erethizon;* they are the white-haired or Canada porcupine, *E. dorsatus*, (Cuv.,) and the yellow-haired porcupine, *E. epixanthus*, (Brandt.) These animals are not numerous or troublesome; they are injurious only in destroying trees, of which they eat the bark and leaves. Sometimes these trees are found stripped almost entirely of bark, and it is said that a single porcupine will thus denude a hundred trees in a season. They also eat fruits and vegetables, but not to any great extent. In the family *Leporidæ* are included our rabbits and hares. Their characteristics are: long and erect ears; large and prominent eyes; four incisors in the upper, and two in the lower jaw; the two middle ones in the upper jaw much the largest; posterior limbs long and strong, adapted to leaping; anterior feet five-toed; posterior feet four-toed; tail short or wanting. Some of the animals in this family are injurious in gardens and nurseries to an extent hardly appreciated. I have known acres of peas to be destroyed in a few weeks when situated near small swampy woods, in which these animals for the most part reside. Fruit trees are often injured by them, sometimes seriously, by their eating the bark in winter from the trunk; cabbage fields are also visited in the summer, and great damage done. Fields of clover, of which they are fond, are trampled and cut up, if they are near woods, to an extent only known by the enraged farmer. I have seen many of these fields with well-beaten paths running in all directions made by the rabbits and woodchucks. The *Leporidæ* are very prolific; were they not they would soon be exterminated, for they furnish food for man, and are destroyed in great numbers by the carnivorous animals, (especially lynxes, weasels, and foxes,) rapacious birds, and reptiles. The animals of the order Ruminantia have peculiarities that constitute this a very natural group. They have in all the families the following common characteristics: No incisors in the upper jaw, their place being supplied by a calloused gum; eight incisors in the lower jaw; generally twelve molars in each jaw; feet bifurcate. These animals, as their name indicates, chew the cud; that is, they masticate their food a second time. The manner in which this is done is as follows: Their stomach is compound, being composed of four different compartments. The food, which is always vegetable in nature, is but little chewed when passed into the first or largest compartment called the paunch. From this it passes into the second compartment, from which it returns to the mouth where it is completely masticated, and then passed to the third stomach, from that to the fourth, and thence to the intestines. In this order are found two of our most valuable domestic animals—horned cattle and sheep. These animals, in their order indigenous to this country, are included in but two families; *Cervidæ* in which are placed our moose, elk, and deer, and *Cavicornia* which includes the goats and bison. The *Cervidæ* are distinguished by solid deciduous horns; the *Cavicornia* by permanent hollow horns. These animals are all valuable for food, and for their hides, of which different kinds of leather are made. They are generally wild and retiring in their habits, seldom approaching human habitations. The deer in some districts are injurious by visiting corn and grain fields, which they eat and destroy, sometimes to a considerable amount. They also injure young fruit trees in nurseries by biting off the twigs and gnawing the bark. The thoroughness with which they have been hunted has driven them into the most retired and thinly settled districts, and the time is not far distant when they will be extinct in all but the unsettled territories of the continent. In the curious order, Marsupiata, are included those animals, the young of which are brought forth prematurely, and received, in most instances, into a peculiar pouch situated on the lower part of the abdomen of the female. This order is represented in this country by the opossums, which are confined to the Southern, Western, and Middle States. The following account of the common American opossum as given by Goodrich, will suffice: It has a pointed head; wide gape, numerous sharp teeth, a rough tongue, ears large and naked, small eyes, the tail long, tapering, flexible and prehensile; the toes are armed with sharp, strong, curved claws. Its size is nearly that of a cat, but the form is low and squat; the color is a grayish-white; the face near the snout pure white; the ears black. In its habits it is mostly nocturnal and arboreal, feeding alike upon insects, eggs, small birds, and fruit. It sometimes invades the barn-yards and destroys the poultry, it is said, for their blood. It is a good deal hunted, and manifests much dexterity in escaping by creeping away amid the grass, and sometimes pretending to be dead. In defending itself it bites severely. It is sluggish in its movements, and will sometimes lie on its back for hours. It often suspends itself from the branch of a tree by its tail. It is very prolific, producing from six to fifteen at a birth. The young at this period are well-formed, and weigh from three to four grains each. As soon as produced they are shoved into the pouch by the mother with her snout, and pushed near the nipples, which they find and grasp by instinct. Their growth is very rapid; at a week old they weigh thirty grains. They remain in the pouch attached to the nipples till they are able to move about. In winter, if the climate is cold, they become sluggish, but not torpid like the woodchucks.

MAMMARY. Relating to the breast.

MAMMILLARY. In minerals, covered with rounded knobs like small teats.

MAMMITIS. (See Garget.)

MANDIBLE, MANDIBULA. In zoology, this term is applied to the lower jaw of mammals, and to both jaws of birds (except by Illiger, who restricts its application to the lower jaw in this class also.) In insects, it is applied to the upper or anterior pair of jaws.

MANDIBULATES, MANDIBULATA. The name of a section of insects, including all those which preserve their organs of mastication in their last or perfect state.

MANDREL. A revolving shank to which turners affix their work in the lathe.

MANEGE. The management of horses.

MANGANESE. A black mineral. Peroxide of manganese. The metal is gray, brittle, and hard. The protoxide of manganese forms numerous salts some of which are occasionally present in the ashes of plants.

MANGE. The cause of mange is the presence of a minute insect which live on, or burrows under the skin, various animals having their peculiar parasites. First wash the parts well with soap and water to break up and remove crusts or scabs; dry, and apply the following for the horse. Two pounds flowers of sulphur, and one pound quicklime, boiled with two gallons of water, stirring until the ingredients are fully combined. Bathe with this several times a day. Or, take two ounces each of tobacco and white hellebore; boil in three pints of water, strain, and when cold, add a pint of fresh lime water. Bathe with as heretofore directed. Scab, mange or itch in sheep, are caused by three different parasites. It is not prevalent in the United States. When sheep are found affected, make the following dip: One pound each of tobacco leaves and of sulphur, to each five gallons of water. Boil the tobacco in water until the strength is exhausted, and add the sulphur. Dip the sheep in this solution as hot as they can bear it, holding them in about four minutes, and occasionally thrusting the head under, being careful that it does not enter the nose and mouth. Repeat in a week if necessary. For mange in swine, scrub well with soft soap and warm water, and then after drying, rub with the following mixture: One pint of train oil and two drachms each of oil of tar, and oil of turpentine. To this add one drachm of petroleum, and mix with flowers of sulphur enough to make a thick paste. Rub on well and let it remain for three or four days, then wash off with strong suds of soft soap, change the bedding, and wash the floors and sides of the pen with soap suds in which has been dissolved a little carbolic acid, also give in the feed every day for ten days, one-half ounce flowers of sulphur and one drachm nitrate or potash.

MANGEL WURZEL. A variety of beet, producing heavy and sure crops in the West, where the turnip can not be successfully grown, and valuable as producing a succulent food adapted to the winter feeding of cattle and sheep. The yield may be stated at from fifteen to fifty tons per acre, according to richness of the soil and cultivation. On good corn land, sown in rows thirty inches apart, twenty-five tons per acre may easily be raised, costing for labor, including harvesting and pitting, not more than two dollars per ton. In the cultivation of any root crop, the soil should be brought into the finest possible tilth. If manure is used, plow it in deeply in the fall. In the spring, plow lightly when the soil is dry. Sow about four pounds per acre, and at the first weeding thin the plants to a distance of about six inches apart. if the rows are thirty inches apart. In cultivation, be careful not to break the leaves; since this will materially injure the crop. They must be gathered before the ground freezes, since they will not stand actual freezing. In pulling, lay them so the tops of two rows may point together, when they are quickly topped with a sharp spade. In pitting them, they should have ventilation until they undergo their sweat, and then covered so they will not actually freeze. Mangel wurzels are better if kept until the 1st of January before feeding, since they then loose an acrid principle they contain.

MANGER. A trough or crib in the stable, in which corn or cut provender for the horse is placed. The usual method is to have them the whole breadth of the stall; but this is unnecessary, as, if eighteen or twenty inches in length, and fourteen or sixteen in breadth, they will be sufficient for every useful purpose. In the fixing of them, they should be so contrived as to admit of being removed for the purpose of being cleaned. This could, however, never be done in the old method of fixing them, but by a little contrivance may be easily effected. It is, in many cases, a convenient plan to have them in the corners or angles at the heads of the stalls.

MANGO. It is a very large fruit tree, inhabiting the tropical parts of Asia, throughout all which it is as extensively cultivated as the apple in more temperate climates. Old specimens have been seen with a trunk from ten to fifteen feet in circumference. The fruit is something like a nectarine, but more compressed, longer, and more curved. It contains a large stone, covered with coarse fibers, which lose themselves in the succulent flesh. The wild and inferior varieties of this fruit taste so strongly of turpentine as to be wholly unfit for use by Europeans; but in the fine varieties this flavor is replaced by a rich sugary quality. The fruit of the *Mangifera indica*, is also called mango.

MANGOSTEEN. The fruit of the *Garcinia mangostana*, growing in Java and the Molucca Islands; it is of the size of an orange, and of a delicious flavor.

MANGROVE. Small trees of the genus *Rhizophora*, inhabiting the rivers and coasts of the tropical world.

MANHADEN. *Clupea manhaden.* A migratory fish, resembling the herring, taken in immense quantities off the eastern and northern coasts for manure; they should be made into a compost with earth or peat; some apply them naked to the land.

MANIOC. The Indian name of the starchy, nutritious matter obtained from the shrub *Jatropa manihot*, from which cassava and tapioca are made.

MANIPULATION. The operations of the laboratory.

MANITRUNK, MANITRUNCUS. The anterior segment of the trunk of insects, on which the head is placed.

MANNA. The concrete juice of the *Fraxinus ornus*, a species of ash growing in the south of Europe. The juice exudes spontaneously in warm, dry weather, and concretes into whitish tears; but the greater part of the manna of commerce is obtained by making incisions in the tree, and gathering the juice in baskets, where it forms irregular masses of a reddish or brownish color, often full of impurities. Manna consists of two parts: one a saccharine, crystallizable principle, named mannil, closely resembling sugar; the other is an acrid, uncrystallizable principle, which is the purgative agent in the manna.

MANTEL. In building, the wood, stone, etc., lying from one jamb to the other of the chimney.

MANTIS. A genus of orthopterous insects, with an exposed head, long and narrow body, and wings plaited longitudinally.

MANURE. Any substance which contains the elements of fertility, to the soil is manure. The composition and characteristics of various manures has come to be an important study wherever land has become so worn as to be infertile, and the best manner of sowing and applying to various crops, has attracted attention from the earliest times and in all countries. The ancients understood the value of manuring both, by plowing under green manure and the carting on of manure made by the feeding of animals. In modern agriculture, heavy manuring and thorough cultivation, is, the first the sheet anchor, and the second the cable which holds profitable agriculture safely. Manures may properly be divided into three classes: Barn-yard manure, either solid or liquid, commercial manures, and green crops plowed under. Barn-yard manure, is made of every waste substance about the farm, and is either applied, fresh or green, half rotted, in the form of compost, or as liquid manure, according to the nature of the soil, and the contingencies of the case. Where mechanical as well as chemical action is desirable, as on stiff soils, it is better that it be applied and plowed under fresh. For crops requiring its immediate effects, and especially to root crops, it should be given half rotted, or as compost. For special crops it is applied often in its liquid state. As to the question of sheltered as against unsheltered manure, the whole matter must be resolved by the question of cost of shelter, and the price of the products reaped. There is no doubt of the advantage of sheltering manure, if it be kept moist, from strong heating, and consequently from fire fanging. An experiment by Lord Kinnaird, of Scotland, will show this. The soil was a rich loam, lying on trap, and the field was planted in potatoes. One acre treated with sheltered manure yielded eleven tons, seventeen cwt., fifty-six pounds of potatoes, and another acre fertilized with like manure, twelve tons, twelve cwt., twenty-six pounds of potatoes; average of two acres, twelve tons, four cwt., ninety-seven pounds. One acre dressed with unsheltered manure yielded seven tons, six cwt., eight pounds of potatoes, and another, treated in like manner, yielded seven tons, eighteen cwt., ninety-nine pounds; average of two acres, seven tons, twelve cwt., fifty-three and one-half pounds. Gain in product of potatoes per acre, from application of sheltered manure, four tons, twelve cwt., forty-three and one-half pounds. A similar trial was made on wheat the next year. But the season was characterized by wet weather, and the grain was soft and not in very good order. Two acres dressed with unsheltered manure yielded, of wheat, weighing sixty-one and one-half pounds per bushel, respectively, forty-one bushels, nineteen pounds, and forty-two bushels, thirty-eight pounds. Two acres dressed with sheltered manure yielded, of wheat, weighing sixty-one pounds per bushel, respectively, fifty-five bushels, and five pounds, and, fifty-three bushels, forty-seven pounds. Average excess of product of wheat per acre, from the application of sheltered manure, twelve and one-third bushels of sixty pounds. Average of straw per acre from sheltered manure, 2.36 tons; from unsheltered manure, 1.72 tons, showing an excess of .64 ton from the former application. Some persons suppose that sheltered manure gains nitrogen from the air. This, however, is not true. In recent experiments by M. Boussingault on the nitrification of a vegetable mold in confined, unrenewed, stagnant air, it was shown that under such conditions the nitrogen of the atmosphere takes no part in the nitrification, which is accomplished with loss of nitrogenous organic matter. The composition of manure is an important subject. It is now generally admitted, what has long been known to intelligent investigators, that the value of manure depends upon the food of the animal. Prof. Goessman, of Massachusetts, states the following, partly made up from German experiments: Some of the material is the fruit of recent German experiments. At a temperature of 100° centigrade, the dry substance of the entire fresh solid and liquid excretions of cattle, sheep, and horses amounts, on an average, to fifty per cent. in weight of the dry substance of the food consumed. Prof. Wolff thus states the percentage of the dry substance of the food of cattle found in the excrements:

There were found	Cows.	Oxen.	Sheep.	Horses.	Aver'ge
In the urine....	9.1	5.8	6.6	3.6	....
In the fæces ...	38.0	45.4	46.9	42.0	....
Total	47.1	51.2	53.5	45.6	49.4

On an average, the weight of dry straw required for absorption reaches one-quarter of the weight of the dry substance consumed as food. Putting the composition of stable manure as twenty-five parts dry substance and seventy-five parts water in 100, it follows that for every 100 pounds of dry-food substance consumed 300 pounds of stable manure will be produced. Placing the daily amount of dry fodder consumed at twenty-four pounds for 1,000 pounds of live weight of the animal, and allowing six pounds of straw for bedding, the product of manure, in stable feeding, of an animal of the stated weight, will amount to seventy-two pounds daily, or 26,280 pounds per year. But considerable variation exists between the different classes of animals as regards the amount of straw required for bedding; the daily requirement of wheat straw being estimated at six pounds for a horse, eight pounds for a cow, four pounds for a pig, and 0.6 pound for a sheep. In general farming, if the farm-stock has been well fed, 1,000 pounds of the manure will contain 4.5 pounds to 5.8 pounds of nitrogen. The commercial value of stable manure may be approximately represented by allowing for every ton of manure ten pounds of potassa, eight pounds of nitrogen, and four pounds of phosphoric acid. On account of the highly beneficial action of stable manure on the physical condition of the soil, its agricultural value, as a rule, stands higher than that of any commercial artificial fertilizer giving the same proportions of the named constituents. But a good concentrated fertilizer may, under certain circumstances, be a valuable assistant of stable manure. It has been customary on large estates to calculate the nitrogen afforded by the excretions of the entire number of farm animals at seventy-five per cent. of the nitrogen of the food consumed, allowing twenty-five per cent. for nitrogen carried off in milk, animal texture, etc. Taking cows and oxen, which require 6.5 ounces to seven ounces of nitrogen in their daily food for each 1,000 pounds of live weight, their annual consumption of nitrogen per 1,000 pounds of live weight would range from 148 pounds to 171 pounds A deduction of twenty-five per cent. being made, there would remain in the fresh excrement 111 pounds to 128 pounds of nitrogen; as much as would be found in 750 to 800 pounds of best Chincha Island guano, or in 3,200 pounds of bone meal, or in 25,000 pounds of half-rotted barn-yard manure. But the efficiency of the excrements depends greatly on the preservation of the entire amount of liquids and solids. The following table, from Prof. Wolff, shows the proportion in which the nitrogen of the food is distributed in the animal excretions. The figures exhibit the number of parts for 100 parts of nitrogen contained in the food:

Amount found in food.	Cows	Oxen.	Sheep.	Horses.	Aver'ge
Nitrogen in solid excretions.....	45.5	51.0	43.7	56.1	49.1
Nitrogen in liquid excretions	18.3	38.0	51.8	27.3	33.9

But the excretions of high-fed oxen often contain two and a half times as much nitrogen, and three and a half times as much phosphoric acid as those of cows or young cattle, whose milk or growth carries off a large amount of the named elements. We now come to compost. A compost of barn-yard manure, is simply whatever may be collected about the farm, piled together in a compact heap, kept moist, and turned over often enough to keep it from heating strongly enough to discharge its gases, and used when it decomposes into a homogeneous mass. To facilitate this it may be mixed with swamp muck, old sods or whatever earthy material may be procured. Neither ashes nor lime should be mixed with fresh manure; but ashes at the rate of four or five bushels to each load of peat or swamp muck, makes an excellent compost for special crops, as potatoes or other root crops. As a special fertilizer, compost acts immediately and hence its value for any drill, hill crops, or garden vegetables. As to the changes which take place in barn-yard and other manurial substances in the process of decomposition, the laborious experiments of Dr. Voelcker, made upon large quantities of manure, treated in various manners, for the purpose of noting results from careful analyses from time to time are interesting. It was shown that the great loss occurring to barnyard manure in the process of rotting is not the escape of ammonia into the air, for it was found that this was light, but the principal loss is in the washing out of the soluble portions by the rain. In the climate of England where evaporation is slow, and rain falls often, this would take place to a greater extent than here, since we must use means to keep it moist enough during summer while in England, they have to guard against leaching. The idea is to keep the whole mass moist, but not dripping. The following table gives the composition in pounds of an experimental heap of manure at four different periods, showing the changes that occurred:

	Nov. 3.	Apr. 30.	Aug. 23.	Nov. 15.
Weight of manure in lbs.	2,838	2,026	1,994	1,974
Water	1877.9	1336.1	1505.3	1466.5
Dry matter	960.1	689.9	488.7	507.5
Soluble organic matters	70.38	86.51	58.83	54.04
Soluble inorganic matters	43.71	57.88	39.16	36.89
Insoluble organic matters	731.07	389.74	243.22	214.92
Insoluble inorganic matters	114.94	155.77	147.49	201.65
	960.1	689.9	488.7	507.5
Total nitrogen	18.23	18.14	13.14	13.03
Equal to ammonia	22.14	22.02	15.96	15.75

It is to be observed that during the first six months, although the weight of the manure largely diminished, the loss was almost exclusively confined to the insoluble organic matters; while soluble matters had increased, and the ammonia remained undiminished. But during the hot summer weather all the most valuable matters had undergone diminution. The conclusions to which they lead are these: Farm-yard manure, in its fresh state, contains but a small quantity of ammonia, most of its nitrogen being there as insoluble nitrogenous matters. But as the decomposition advances the ammonia increases, and a quantity of organic matter becomes soluble. For this reason the manure should be preserved in such a manner as to prevent the escape of the soluble portions which are the most valuable. This can be effected by keeping it in water tight pits, or under cover; but in the latter case the manure, particularly if it contain a large proportion of litter, is not sufficiently moist to admit of its ready fermentation, and water must be added in sufficient quantity to promote that change. The worst of all modes of keeping manure is to pile it in heaps in the corners of the fields, for under such circumstances it is most liable to loss; and if the manure must be carted out, it is better to spread it upon the soil at once, because when this is done fermentation is stopped; and as there is very little free ammonia the loss is small, and the soluble matters are uniformly washed into the soil by the rain. Dr Voelcker is of opinion that the most advantageous mode of applying the manure would be in all cases to leave it on the surface to be washed into the soil, by which means its distribution is more uniform than if it be plowed in. The most disadvantageous mode of making manure is to produce it by cattle in open yards, for in this way at least two-thirds of the valuable matters are lost after a year's exposure. Liquid manures are the soluble portions of any substance containing plant food in combination with water. Thus, the drainings of the barn yard into any depression that becomes puddled so as to retain water, is liquid manure, but the proper way to obtain it is to prepare a tank into which it may leach without waste. Dr. Voelcker, made extensive experiments on the changes which liquid manure undergoes in soils of known composition. The following were the conclusions arrived at:

> Liquid manure, in contact with soil, undergoes a number of chemical changes.
>
> These changes are greater in the case of clay and calcareous soils, than in the case of sandy soils.
>
> Passed through clay, loamy, and calcareous soils, liquid manure leaves a considerable quantity of ammonia in the soil.
>
> Under the same circumstances, liquid manure parts likewise with potash and phosphoric acid.
>
> Sandy soils remove from liquid manure but little ammonia, and likewise not much potash.
>
> With the exception of purely sandy soils, liquid manure, as used in practice, leaves the greater portion of all the most valuable fertilizing matters in the generality of soils.
>
> The comparative power of different soils to remove ammonia, potash, and phosphoric acid from liquid manure, differs greatly.
>
> Liquid manure passed through sandy soils rich in soluble silica takes up soluble silica.
>
> Soils that absorbed much ammonia also absorbed much potash, and the soils which absorbed little ammonia also absorbed little potash.
>
> Soda salts (common salt) are either not at all removed by liquid manure, or only to a small extent.
>
> Chlorine, and generally sulphuric acid, remain unaltered in quantity in liquid manure passed through different soils.
>
> In most cases liquid manure left in contact with different soils becomes richer in lime.
>
> The proportion of lime which liquid manure takes up from the soils with which it is brought in contact does not altogether correspond with the relative proportions of lime in the different soils.
>
> Liquid manure passed through a sandy soil greatly deficient in lime became poorer in lime; thus showing that the property of soils, of storing up food for plants, is not confined to ammonia, potash, or phosphoric acid, but that it is a property which manifests itself in a variety of ways. Thus soils rich in lime yield this substance to liquid manure. Again, potash usually is removed from liquid manure left in contact with soils; but in particular cases liquid manure may even become richer in potash after filtration through soil.
>
> Very soluble saline fertilizing compounds are probably injurious to vegetation when supplied too abundantly to the land.
>
> All moderately fertile soils have the power of rendering the more important soluble fertilizing matters much less soluble; but in none of the experiments were ammonia, potash, phosphoric acid and other compounds that enter into the composition of the ashes of our cultivated crops, rendered perfectly insoluble.
>
> It does not appear probable that plants take up mineral food from the soil in the shape of totally insoluble combinations.

In surface manuring, not always practicable, but when so, always effective and economical, since fresh manure may be used, as in the case of fallows, meadows, pastures, orchards, etc., we save the elements of strength in the manure and really get the benefits of liquid manuring. In relation to this matter, Mr. Bright, a well known horticulturist, and writing on manuring from a horticultural stand point, says: The practice of top-dressing, or of surface-manuring, has long been the favorite method employed by all intelligent gardeners within the circle of my acquaintance. We have long ago learned that masses of rich, nitrogenous manures are not what plants require about their roots, but that manures are applied much more successfully (and less injuriously) by top-dressing, either in solid or liquid form. Nature never manures her plants with crude masses of concentrated fertilizing substances, but imparts her stimulating and mineral food in a state of the most minute division—almost infinitesimal—chiefly from the surface of the earth. No wonder so many fruit trees have been killed, so many grape vines destroyed or rendered barren by excess of wood, in consequence of the heavy manuring at the roots so universally recommended by writers on gardening and horticulture. The great objection to surface-manuring is founded upon the probable loss of ammonia, caused by the exposure of decaying manures upon the surface of the earth. But this loss has been shown, by sound reasoning, and by facts deduced from practical experience, to be much less than is commonly apprehended; while the benefits arising from surface-manuring in other respects, more than counterbalance any p ssible loss of ammonia from this practice. In the first place, when manures are exposed upon the surface of the earth, even in hot weather, decomposition no longer goes on so rapidly as when the same manures are kept in a heap, and the ammonia that is produced is gradually carried into the soil by rains. The other soluble substances, as potash, lime, the phosphates, etc., are of course not lost, because they are not volatile. Nor are these soluble and valuable substances lost to plants by being carried into the soil before they are needed by growing plants. It has been conclusively shown by eminent scientific authorities that any good soil, containing a fair proportion of clay and carbon, is capable of taking up and retaining effectually ammonia, lime, potash, soda, etc., in a soluble form, so that little, if any, passes off in the under-drainage water of such soils. These substances, it is true, may wash from the surface, but they can not pass through a good soil and go off in the drainage water. By surface-manuring we mulch the ground, and render it cooler in summer and warmer in winter. More shade is an important element in culture—so important that some writers have thought shade alone to be equivalent to manure. A piece of soil heavily shaded by surface-manuring actually decomposes like a manure heap—that is, it undergoes a sort of putrefaction or chemical change, which sets free its chemical constituents, unlocks, as it were, its locked-up manurial treasures, and fits its natural elements to become the food of plants. Darkness, moisture and air are the conditions required for vegetable and mineral decomposition, for under these conditions decay is quick. These conditions are produced in the soil by surface-manuring. Then, again, when the surface-manure decomposes, its elements are washed into the soil in a state of solution precisely fitted to meet the wants of plants, and they become active agents in promoting further decomposition and chemical changes in the body of the soil. Manure, then, chiefly upon the surface. Do not waste your manures by mixing them deeply with the soil. Plant shallow. Keep roots of all trees, plants, and vines as near the surface as possible. There are weighty reasons for the position assumed in preceding sentence, says our authority, and he reiterates most forcibly, plant then shallow. Let your soil be deep and dry, but plant near the surface as much as possible. Top-dress your grass, after mowing in July or August, under a burning summer sun; top-dress in the fall, before and during the autumn rains; manure the surface while snow is on the ground, while the March winds blow, and while the April rains fall. Manure your grass, instead of your corn and wheat, broadcast at any time when you have manure and leisure, and you will be abundantly satisfied with the result. In the application of farm-yard manures, critically carried out in the United States, there have been but comparatively few well digested experiments. In Europe the case is different. There they have experimented largely and with barnyard and commercial manures. The Superintendent of the Kansas Agricultural College farm made the following experiment, to determine the value of green manure both, as against yield on poor land with manure and as against yield upon naturally rich soil, and also, as between manure and no manure on homogeneous and fertile soil with the following results, illustrating its decisive value even on the more fertile of western soils: One half of field No. 7 of the Kansas State Agricultural College farm is a badly washed hill-side, washed to the underlying red and yellow clay. The other half of the field is second bottom; the soil a deep alluvium, rich and black. A sharper contrast in one field could hardly be imagined. This contrast furnished an opportunity for testing the relative merits of manure, an opportunity that was gladly improved. Early in May the clay hill-side was dressed with green stable manure, at about the rate of thirty tons per acre, which was immediately plowed under to the depth of five or six inches, the nature of the soil not permitting a deeper furrow. Even at this shallow depth the soil rolled up after the plow in hard, sticky masses, upon which harrow and roller had but little effect. Many who saw the field at this time expressed the opinion that the hill-side would not produce even corn nubbins. After plowing, the clay hill-side was top-dressed with a compost of rotted manure, ashes, and old mortar, at the rate of fifteen two-horse loads per acre, after which the whole surface was repeatedly harrowed and rolled. As soon as this was finished the whole field, the lower half having been plowed to the depth of eight inches and thoroughly harrowed in the mean time, was marked off and planted with corn, the Milton or Mammoth Dent. No manure was used upon the lower part of the field. Both parts were cultivated alike. The land was new, this being the second crop from the sod. The crop was harvested the last of November, and returned forty-five bushels per acre from the lower land and sixty-five bushels per acre from the manured clay hill-side, an advance of forty-five per centum in favor of the washed hill-side, and attributable alone to the effect of the manure. In the earlier part of the season this field was frequently trespassed upon by cattle, and probably one-third of the crop was thus destroyed. As the two parts of the field suffered alike, the result pro rata is the same, and we have in contrast the poorest and best of our Kansas soils. The poorer, treated with manure at the cost of $11 per acre, exceeding by forty-five per centum the yield of the better soil without manure. It would be difficult to more strongly illustrate the effect of home-made fertilizers upon Kansas clays. The contrast in this single instance, however, may be too well defined for general application. Fields Nos. 5 and 6 of the College farm present no such contrast, being identical in soil and situation, the division being entirely arbitrary, and only indicated by a narrow drive. These two fields are a fair representation of prairie loam, conforming essentially to the soil of the second bottom of field No. 7. Field No. 5 received an application of green stable-manure, at the rate of forty tons per acre. No. 6 received no manure. Cultivation essentially the same. Result: the yield of sound corn upon field No. 5 was 100.1 bushels per acre, as ascertained by actual measurement by a committee of disinterested persons. The return from No. 6 was between sixty and sixty-five bushels per acre, or an increase of fifty-eight and one-third to sixty-six and two-thirds per centum per acre, due solely to the use of manure. At the Michigan Agricultural College the following results were obtained: One acre of very light sandy soil was selected from a clover field, the second year from seeding and mowed once in 1867. This acre was equally divided into sixteen plots, and manures were applied to every alternate plot, as follows: The two composts of muck and ashes, and the two of muck and lime, having been carefully mixed, under shelter, in February 1868, and shoveled over from time to time, till properly incorporated. On plot 1, one load of muck and leached ashes, mixed in the proportion of five loads of muck to two loads of ashes; on plot 3, one load of muck mixed with quicklime slaked with water, in the proportion of five loads of muck to ten bushels of lime; on plot 5, one load of muck and quicklime slaked with a saturated solution of common salt, in the proportion of five loads of muck to ten bushels of lime; on plot 7, one load of muck and wood ashes, in the proportion of five loads of muck to one load of ashes; on plot 9, one load of muck; on plot 11, one-half bushel of ashes and one-eighth bushel of gypsum; on plot 13, one-half bushel of ashes; on plot 15, one-eighth bushel of gypsum. The following table exhibits results in pounds:

Lots.	Manures applied.	First crop.	Second crop.	Total.	Gain.	Gain per acre.
1	Muck and leached ashes.....	265	149	414	116	1,856
2	No manure.....	200	98	298	....	....
3	Muck and lime slaked with water.......	200	78	278	47	752
4	No manure.....	125	39	164	....	....
5	Muck and Lime slaked with brine.........	128	30	158	Loss 11	Loss 176
6	No manure.....	134	40	174	....	....
7	Muck and ashes	204	90	294	72	1,152
8	No manure.....	188	82	270	......	....
9	Muck	224	102	326	46	736
10	No manure.....	211	89	300	....	....
11	Ashes and Gypsum	204	67	271	23	368
12	No manure.....	154	43	197	....	....
13	Ashes	169	49	218	15	240
14	No manure.....	164	46	210	.....	....
15	Gypsum..	218	92	310	88	1,408
16	No manure.....	190	45	235	....	....

According to this exhibit, the total products of the unmanured plots, respectively considered, ranged from one and one-sixth ton to two and one-seventh tons of hay, reckoning 2,240 pounds to the ton. It will be seen, by reference to the widely-ranging products of the unmanured plots, that the soil was, in the first place, quite unequal in productiveness. Caution is, therefore, required in drawing conclusions from these results. The statement of gain arising from each applied manure is estimated by comparison with the yield of adjoining unmanured plots. The prominent points of the exhibit are these: The muck and leached ashes, the gypsum, and the muck

	DESCRIPTION OF MANURES.	Per cent. of ammonia, (nitrogen equivalent to —)	Amount of manure per acre.	Price of manure per ton.	Grain per acre.	Weight per bushel.	Value of grain per acre.	Total value of grain, straw, and chaff, per acre.	Net profit of manured over unmanured.	Loss.
	Experiments on wheat.		Tons.	£ s. d.	Bush.	Lbs	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	Dung from open cattle yard..........	.60	11 2-3	0 6 0	31	59	10 15 2	14 1 2	1 3 0½	....
2	Dung from covered cattle yard......	.77	11 2-3	0 6 0	35	59	11 14 7	14 8 11½	1 10 10	....
3	Shoddy, (factory waste manipulated)	7.72	1 1-6	3 0 0	34 3-4	60	11 19 11½	15 0 4	2 2 2½	....
9	Peruvian guano....	10.96	7-27	13 10 0	31 1-2	60	11 0 0	13 3 6	0 5 4½	.. ....
10	Unmanured	....	....	....	22 1-2	59	7 12 6	9 8 1½	. ...	....
11	Sulphate of ammonia....	24.50	7-40	20 0 0	38 1-2	61	13 7 5	16 4 9½	3 6 8	....
12	Nitrate of soda, (applied in autumn).	19.50	7-37	18 10 0	32	60	11 1 2	13 1 8	0 3 6½	....
13	Ground rape cake.........	5.08	1-2	7 0 0	31 3-4	60	10 19 5½	13 0 4	0 2 2½	....
14	Superphosphate of lime.	....	7-10	5 0 0	25 1-2	59	8 10 1¾	10 0 10¾	....	2 17 2⅔
15	" "	....	7-9	4 10 0	26 2-3	60	9 4 8	10 19 11	....	1 18 2½
16	Patent ammonia......................	14.90	7-24	12 0 0	38 1-2	60	13 4 5	16 2 2	3 4 0½	... .
17	Nitrate of soda, (applied in spring).	19.50	7-37	18 10 0	39 1-5	59	13 6 1	16 9 5½	3 11 4	....
	Experiments on barley.									
18	Dung from open cattle yard..........	.46	11 2-3	0 6 0	38 1-4	54	9 11 3	11 6 6	....	1 19 8
19	Dung from covered cattle yard.......	.77	11 2-3	0 6 0	43 1-4	54	10 18 2	12 15 2	....	0 11 0
22	Unmanured	....	....	....	37 1-2	52	9 4 2	11 6 2	.....	... .
23	Nitrate of soda	19.50	7-37	18 10 0	48 2.3	53	12 7 10½	15 1 1½	1 14 11½	....

and wood ashes gave the largest products; the ashes and gypsum were less effective than the gypsum alone; a loss resulted from the applied mixture of muck and lime slaked with brine. The following results will be interesting as showing experiments in England with manures of various kinds, both domestic and commercial: The first is a selection from a report of experiments made by Messrs. H. F. and A. Harwood, of Ipswich, England, in 1872, on light land which had been cropped in 1870 with wheat, manured with ten tons of farm-yard dung per acre, and in 1871 with barley, manured with five cwt. of mixed artificial manures per acre. This barley crop having been removed, equal plots were measured off, various manures applied, at a cost of £3 10s. per acre, in each case, and wheat sown. Other plots were marked off for barley. The table, on page 627 gives the descriptions of manures and the quantities applied per acre, and the results obtained. The superphosphate received by wheat plots 14 and 15 contained, respectively, twenty-eight per cent. and seventeen per cent. of soluble phosphates. In addition to the merchantable grain represented in the column of yield, there was a small amount of refuse grain, the value of which is included in the statements of total values of the crops. Applications of this exhibit to American practice will, of course, be modified by prices of manures and values of grain and straw in different localities. English experimentalists have found that in general not one-half of the nitrogen of such manures as guano, ammonia salts, and nitrate of soda, is recovered in the increase of the crop to which they are applied. As to the residue, a portion may remain comparatively inactive in the soil, and a considerable portion may, under conditions favorable to drainage, be carried away and lost. With a view to these points, experiments were commenced at Rothamsted, England, in 1871, to determine whether any economical advantage can be gained by applying such manures in comparatively small quantities near the seed, instead of larger amounts broadcast and harrowed in. In the following tabulated experiment with wheat, the plots measured one-quarter of an acre each, and the amount of seed in each case was one bushel per acre. The fertilizers in this and the barley experiment were intimately mixed with ashes of burned clay before application. The 146 pounds sulphate of ammonia applied on plot two contained nitrogen equal to that contained in fifteen bushels of wheat, with straw in proportion, and the imperfect recovery of the nitrogen is indicated by the fact that the yield on this plot was only seven and three-fourths bushels per acre in excess of that of the unmanured plot. That the soil can not be expected to return any large additional percentage of the nitrogen in seasons subsequent to that of the application has been already shown by experiments at Rothamsted. In his report for 1864, Mr. Lawes says that the unexhausted residue of nitrogen supplied in ammonia salts was but very partially and very slowly recovered in increase of crop in succeeding years, even with liberal applications of such mineral manures as were very effective to crops when used in conjunction with newly applied ammonia salts. The subjoined is a tabulation of experiments on barley. The plots were one-half of an acre each; amount of seed, three bushels per acre, except on plot five, which received one and a half bushels of seed per acre.

Plots.	Manures per acre, etc.	Wheat per acre.	Weight per bushel.	Straw per acre.
		Bush.	Lbs.	Cwt.
1	Unmanured(seed dibbled six inches apart in the rows)...............	23¾	59.3	24½
2	146 pounds sulphate ammonia(holes dibbled six inches apart, in rows,) manure put in, and seed above...	31½	59.1	36¼
3	292 pounds sulphate ammonia, (broadcast, seed dibbled six inches apart in rows).............	28¾	58.3	35⅝

Plots.	Manures per acre, etc.	Barley per acre.	Weight per bushel.	Straw per acre.
		Bush.	Lbs.	Cwt.
1	Unmanured; seed drilled..	40½	53.9	24⅝
2	100 pounds superphosphate; 100 pounds nitrate soda; manure broadcast; seed drilled.........	49⅞	53.3	30½
3	100 pounds superphosphate; 100 pounds nitrate soda; manures drilled; seed above..............	49½	53.4	28½
4	100 pounds superphosphate; 100 pounds nitrate soda; manures (with clay-ashes as usual) and seed mixed and drilled together.	51	53.0	30⅜
5	100 pounds superphosphate; 100 pounds nitrate soda; holes dibbled six inches apart, in rows; manures put in, and seed above.	51¼	53.3	28¼
6	200 pounds superphosphate; 200 pounds nitrate soda; manures broadcast; seed drilled....	56¼	51.6	32⅞

The following is a summary of the experimental statement of Mr. J. B. Lawes on the effect of different fertilizers on oats grown on the same land during the three years from 1869 to 1871, inclusive, at Rothamsted, England: The previous croppings were 1847 and 1848, clover dressed with different manures; 1849 to 1859, beans with different manures; 1860, fallow; 1861 and 1862, wheat, unmanured; 1863, fallow; 1864, beans, dunged, 1865, wheat, unmanured; 1866, beans, unmanured; 1867 and 1868, wheat, unmanured. The area of the experiment was three-quarters of an acre, which was divided into six plots. As to applications per acre, plot one was not manured; plot two received 200 pounds sulphate of potash, 100 pounds sulphate of soda, 100 pounds sulphate of magnesia, and three and one-half cwt. superposphate of lime made from 200 pounds bone-ash, 150 pounds sulphuric acid of 1.7 specific gravity, and water; plot three received 400 pounds ammonia salts, composed of sulphate and muriate of ammonia of commerce in equal parts; plot four received 400 pounds ammonia salts, 200 pounds sulphate of potash, 100 pounds sulphate of soda, 100 pounds sulphate of magnesia, three and one-half cwt. superphosphate; plot five received 550 pounds nitrate of soda, (containing the same amount of nitrogen as 400 pounds ammonia salts;) plot six received 550 pounds nitrate of soda, 200 pounds sulphate of potash, 100 pounds sulphate of soda, 100 pounds sulphate of magnesia, three and one-half cwt. superphosphate. The table page 629 gives results.

Plots.	1869.			1870.			1871.			Average for three years.		
	Oats per acre—bushels.	Weight per bushel—pounds.	Straw per acre—cwt.	Oats per acre—bushels.	Weight per bushel—pounds.	Straw per acre—cwt.	Oats per acre—bushels.	Weight per bushel—pounds.	Straw per acre—cwt.	Oats per acre—bushels.	Weight per bushel—pounds.	Straw per acre—cwt.
1	36⅝	36¾	19¼	16⅜	35	9⅛	20½	33½	11¼	24½	35	10⅞
2	45	38½	24½	19⅛	35⅛	9⅝	22	35¼	13½	28¾	36¼	15⅞
3	56⅛	37½	36⅞	30	34⅞	17¼	57⅛	36⅜	40⅝	47¾	36¼	31⅝
4	75¼	39¼	54	50⅝	36	28⅝	58⅝	35⅜	50	61½	36⅞	44¼
5	62¼	38½	42¾	36½	35¼	23	55	36⅝	34¾	51¼	36¾	33½
6	69⅜	38½	49⅞	50	35¾	28¾	60¼	33¾	48⅜	59⅞	36	42½

The following is an abstract of a report of private experiments made in Scotland: The soil was a good clay loam of very even quality, in very moderate agricultural condition, the subsoil a light sandy loam. The field was divided into sixteen plots of one-eighth of an acre each. Furrows were laid out twenty-seven inches apart, the manures were placed in the bottom of these furrows, and potatoes of the regent variety were dropped thereon, ten inches apart, May 1, 1871; the potatoes were then covered by running the plow through the ridge made between the furrows and throwing back the earth, according to the current practice of the region. The after cultivation consisted of hand and horse hoeing, and finally earthing up. The potatoes were dug November 2; were sorted over a one and five-eighths inch riddle and the large and small were separately weighed and pitted. At this time no diseased tubers were observed. On the 15th of March they were taken from the pits, the diseased tubers thrown out and the sound ones weighed. The diseased tubers amounted to about one-third of the whole crop, the proportion not varying greatly between the different plots, but being somewhat greater in the plots which received dung than in those which received artificial manure alone. The table shows the manures applied and the results obtained per acre, and given substantially in the order of largest yield, as it occurred. The left hand column indicates the relative locality of each plot. The sulphate of ammonia contained twenty-four per cent. of ammonia; the dissolved coprolites, twenty-six per cent. of soluble and five per cent. of insoluble phosphate; and the kainit, or potash salt, twenty-four per cent. of sulphate of potash. As to the sources of manure it is stated as follows: Carbonaceous matter is derived from the natural decay or chemical decomposition of vegetables. Vegetables collected into masses, as leaves, wood, grasses, straw, the stalks and stems of all plants, fruits, grains, roots, etc., under favorable conditions of temperature and moisture, rapidly undergo, first, the fermentation; and, secondly, the putrefaction process. Where there is too much or too little heat, or too much or too little moisture, fermentation will not go on. The fibers of vegetables thus collected in masses, under favorable circumstances, soften and swell, and become permeable to air and water. Their salts, starch, gum sugar, gluten, and extractive matter are dissolved, their carbon combines with oxygen, and carbonic acid is

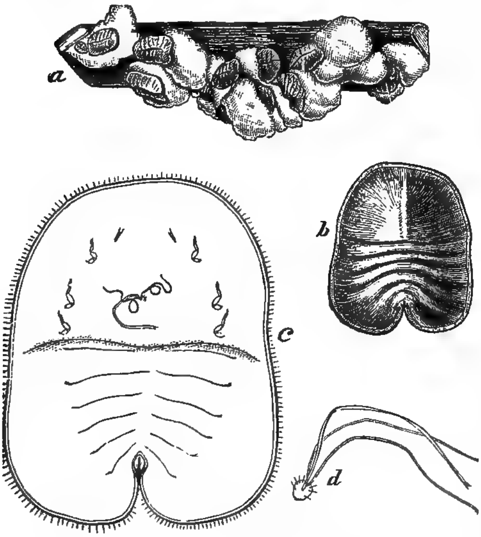
Plots.	Manure per acre.	Large potatoes per acre.				Total of large and small potatoes per acre.			
		Tons.	Hundred-weight.	Quarters.	Pounds.	Tons.	Hundred-weight.	Quarters.	Pounds.
5	400 pounds sulphate of ammonia, 400 pounds dissolved coprolites	9	19	0	8	12	3	1	12
4	200 pounds sulphate ammonia, 400 pounds dissolved coprolites, 200 pounds kainit	7	15	1	12	10	0	0	8
9	200 pounds sulphate ammonia, 400 pounds dissolved coprolites	7	7	2	8	9	9	0	16
16	16 loads dung, 200 pounds sulphate ammonia, 300 pounds dissolved coprolites, 200 pounds kainit	7	9	1	4	9	6	0	16
1	Ditto	7	4	3	12	9	5	3	20
10	400 pounds sulphate of ammonia	7	2	2	0	8	18	3	4
8	400 pounds sulphate ammonia, 400 pounds kainit	6	6	2	24	7	18	0	16
15	16 loads dung	5	6	2	16	6	14	1	20
2	Ditto	5	5	3	12	6	11	2	8
6	400 pounds dissolved coprolites, 400 pounds kainit	4	18	0	8	6	6	2	16
13	400 pounds kainit	4	0	1	12	5	5	3	12
14	No manure	4	0	3	4	5	4	2	16
7	Ditto	3	19	2	24	5	4	2	0
3	Ditto	3	18	1	12	5	0	2	24
11	Ditto	3	15	0	0	5	3	3	20
12	400 pounds dissolved coprolites	3	16	1	4	5	6	2	10

formed and penetrates the whole mass. This acid combines with the alkalies that are present, as potash, lime, soda, magnesia, and ammonia, and carbonates of potash, lime, etc., are formed. Certain elements in the mass soon take on the action of putrefaction. This process is owing chiefly to the presence of elements containing nitrogen, as gluten and other matters of animal origin. All animal substances pass rapidly into the process of putrefaction, and the larger the proportion of such substances mingled with the vegetable masses, the more rapidly putrefaction proceeds. Hence the addition of animal manures to vegetable composts facilitates putrefaction. By the process of putrefaction hydrogen also is rapidly developed, and combines with phosphorus and sulphur when these are present, forming sulphuretted and phosphoretted hydrogen. When the surfaces of these putrefying masses are exposed freely to the atmosphere, these gases, which are very volatile, are rapidly dissipated. To prevent this, substances should be applied which have the power of absorbing and retaining them. Carbon, when nearly pure and dry, has a strong affinity for them. The addition of dry charcoal, or of peat, will absorb large quantities of them. When these gases are thus absorbed their presence ceases to be indicated by their peculiar odors. The sulphates of lime, iron, and zinc have a similar power, hence their value as deodorizers. These sulphates have also the power of decomposing carbonate of ammonia, displacing the carbonic acid, and forming sulphate of ammonia, which is not volatile. Chloric and nitric acids will also decompose carbonate of ammonia, forming with it chlorates and nitrates of ammonia, which are soluble in water, as are also salts which they form with the other alkalies. Vegetable compost, then, when the decomposition is complete, consists chiefly of carbonaceous matter combined with gases and salts. By a process in many respects similar to that above described, vegetable substances are decomposed in the digestive organs of animals. The fibers are comminuted by the teeth, and fitted to be pervaded and softened by the fluids contained in the stomach and intestines. A large portion of the starch, gum, sugar, gluten, and salts is dissolved out, and taken up by the lacteal vessels of the animal, and serve the purposes of nutrition, while the remainder, mixed with the juices of the animal, containing various salts, is ejected. This process is accomplished much more rapidly than the ordinary process of vegetable decay, and the substance resulting is mixed with a large amount of animal matter, which fits it for rapid putrefaction. When the necessary conditions are present, this animal matter, which pervades the mass like leaven, sets up the process of putrefaction at once. These two processes, vegetable composting and the feeding of animals with vegetables, are the sources from which carbonaceous manures are chiefly derived. Vegetables reduced by the process of digestion, although they have parted with a large portion of their nutritive elements, yet, in consequence of the condition to which they are brought, and the additions which they have received, are more valuable as manures than when, without serving the purposes of nutrition, they are reduced by the ordinary process of decay. But the slow decomposition of vegetables is always going on in nature, and thus one generation of plants affords nutriment to those that come after it. The carbonaceous matter resulting from the decay of vegetables is not all taken up as it is formed. Masses of it have accumulated in swamps, basins, and meadows. These accumulations, mingled with more or less of insoluble earths constitute muck or peat, and furnish an almost unlimited amount of carbonaceous material fitted for the immediate use of the cultivator. The difference which is found in different accumulations of this material is owing in part to the difference in the vegetables from which it has been formed, and in part to the difference of the soils upon which it rests and by which it is surrounded. In some deposits the matter is almost purely carbonaceous; in some the composition is complete; in others but partial. But the most essential difference in different deposits of muck is, that some contain acids, or acids combined with minerals, while others are nearly or quite free from them. These acids are the carbonic, humic, crenic, and apocrenic. When deposits of muck are underlaid by clay, or receive the wash of clay beds in their vicinity, and iron is present, which it often is in the form of bog ore, the sulphate of alumina, which is the basis of clay, is decomposed, and the sulphuric acid combines with the iron and forms sulphuret of iron, or pyrites, which is often found in muck in sufficient quantity to impair its value as a fertilizer. When any of these acids abound in muck it is unfit to be used in a simple state. Alkalies are the proper correctives, and of these lime seems to be the best adapted to remedy the evil. Quicklime, mixed with peat, has the effect of rapidly rendering it pulverulent and light. Its influence seems to extend through the whole mass, like that of yeast through the whole mass of dough, while at the same time it combines with the acids and decomposes the salts of iron, forming salts of lime, which themselves are essential to the growth of many plants. Muck, when free or nearly free from acids, may be used by itself with great benefit on light, sandy soils, or on any soils from which the vegetable matter is exhausted; or it may be composted with stable manure, ashes, guano, or animal matters, with peculiar advantage, since it has, as we have already observed, the power of absorbing and condensing the gases arising from the putrefaction of these substances. Such composts are adapted to nearly all the uses of the garden and field. No substance is so well adapted to composting with night soil and urine as dry muck, since it deodorizes these manures and retains all their valuable elements, and renders them manageable and easy of application, affording at the same time the dilution which is necessary for the safe application of concentrated manures. Composted with putrefying fish, muck forms an exceedingly valuable manure. The best mode of preparing muck for use is to throw it from its bed in the autumn, and leave it exposed to the action of the frosts of the succeeding winter. If it is to be composted with lime or ashes it may be used the following spring. But if it is to be composted with stable manure, night soil, or animal matters, it is better to let it remain in the heap until the following autumn, when it should be deposited in the barn-yard or cellar, and mixed, from time to time, with the drippings of the animals. It is evident that it should be provided in sufficient quantity to be used freely as a deodorizer about the premises whenever or wherever it may be wanted. It will thus become charged with gases and salts, and be converted into a highly valuable manure, which for a garden and for fruit culture has perhaps no equal. Many skillful farmers consider a compost of one-half good muck and one-half stable manure fully equal for corn culture to pure stable manure. Vegetable composts, animal excrements, and muck are then the chief sources of carbonaceous manures. With these, as we have seen, are combined various gases and salts which are essential to vegetable growth, either as elements of nutrition or as stimulants. These may also be found in more concentrated forms and in smaller bulk, capable of more easy and direct application to growing plants. Variously combined and condensed, these fertilizing elements constitute the numerous articles known in commerce as artificial manures. All plants during their growth take from the soil more or less mineral matters. Some require them in large quantities. Such plants are said to exhaust the soil on which they grow. The small grains, which appropriate in their culms and seeds much silex, lime, and potash, are instances of this class. The elements of which we are now speaking are all soluble, and are washed out of the soil—and the better the soil is worked and the finer the tilth, the more rapidly does this take place—and, unless they are frequently renewed, the cultivated soil is soon exhausted of them. Owing to their small bulk they are easily applied. Nitrogenous manures are Peruvian guano, night-soil, poudrette, urine, hair, wool-waste, fish manures, and animal substances generally. The phosphates are bone-meal, superphosphate of lime, and Mexican guano. All these are combined with mineral earths and alkalies, and it is to these that is due whatever permanent value such manures possess, the other elements being so soluble and volatile that their effects are immediate and temporary. In this connection we may mention the saltpetres or nitrates, a class of manures to which little attention has been paid in this country. Earth containing nitrate of potash is often found in caverns, where it has been accumulating for ages, protected from the weather. Large quantities of it are imported from Chili. The nitrates may be manufactured artificially by means of nitre beds. These are formed by means of earth and animal manures mixed with potash, lime, and soda. They are protected from the rain by roofs open on all sides to the air. The mixture is kept at the proper degree of moisture, and frequently stirred to expose new surfaces to the atmosphere. Nitrates of lime, potash, and soda are formed, and the whole mass becomes impregnated with them.

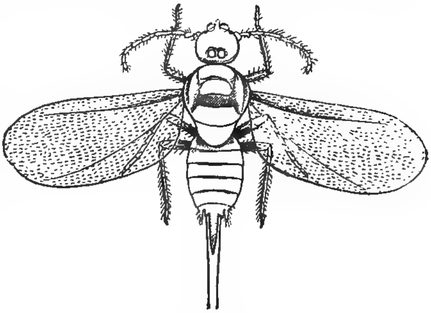
MANURING. (See Manure.)

MAPLE. *Acer.* The maple family is an important one to the United States, both from the value of its timber, and for the saccharine juices which some of the species yield. These are notably the Sugar maple, or Rock maple, *A. saccharinum,* and the variety, *A. nigrum,* or Black maple. The Sugar maple is the variety that produces the Bird's-eye maple. The Red or Swamp maple, *A. rubrum,* and the Ash-leaved maple or Box elder, *Acer negundo,* or more properly, *negundo aceroides,* are also rich in saccharine juice. The other species are the White or Silver maple, *A. Dasycarpum;* Mountain maple, *A. spicatum,* a tall shrub, growing in clumps in rich, moist woods, and the Striped maple, *A. Pennsylvanicum,* known also as Striped maple and Moose-wood, a tree, small, slender, and with light green bark, striped with dark lines. The Norway maple, *A. platanoides,* is a foreign tree, a native of Europe, and, as an ornamental tree, finer in some respects than our own, with fine, abundant foliage, which continues green much later than our native maples. The great maple, *A pseudo-platanus,* is also an European tree introduced into the United States, and sometimes planted. This and the Plane tree (*Platanus*) is sometimes called Sycamore. The true sycamore is, however, a species of fig, *Ficus sycamorus.* We should not advise the planting of either of the foreign named; our own Sugar or Rock maple, the Red or Swamp maple, and the White or Silver maple, are preferable. None can be finer than the Sugar maple in summer; and all, both the Sugar and the Swamp maple, are magnificent in their varying foliage, after the frost has touched the leaves in the autumn. The Ash-leaved maple is among the fastest growing of any of the family, a most ornamental tree, and every way worthy of planting when a quick effect is desired. The seeds of the Silver maple ripen soon after the leaves have become fully grown, and should be sown immediately. The seeds of the other maples, including the Ash-leaved variety, ripen in September and October. If the seeds are not sown immediately, they should be kept over winter in sand, just moist, and as cool as possible, even down to the freezing point. (See article Acer.)

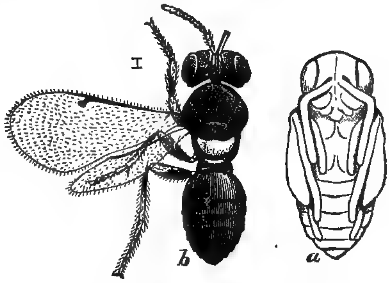
MAPLE BARK LOUSE. *Pulvinaria Innumerabilis.* Miss Emily A. Smith, of Illinois, one of the most accomplished entomologists of the West, says of this insect: Although the soft maple (*Acer dasycarpum*) is generally one of the first trees attacked, yet they soon spread to the other species. The insects live by puncturing the bark, and the females soon become clothed with a white, cottony substance, proceeding from the posterior parts. In this the eggs are deposited. The cut of the insects, highly magnified, shows the female, and also their work on the bark; *a,* bark with insects at work; *b,* dorsal view; *c,* ventral view; *d,* beak. In the natural condition, the young insect settles down upon the leaves of the maple almost immediately after hatching, the preference being given the under side and near the midrib, although they are found upon the upper side to some extent; this is entirely owing to the number of insects upon the tree. When in a state of rest, the young lice draw the antennæ under and parallel with the last joint of the fore pair of legs, the two remaining pair extending backward. During the summer the young insects increase in size, and continually grow darker. They molt several times during their growth, and do so by shreds of skin peeling off and not cast off entire, as in the usual way. Although they seldom leave the position first assumed, during the summer, they have full use of their legs, since when the leaf is detached from the tree, the young lice will withdraw their beaks and move quite actively about in search of fresh food. When young, the males and females can not be distinguished one from the other, but in a few weeks the males cease growing and change into the pupa state. The male scale is lighter than the growing females, and becomes longer and narrow. As the transformation progresses, two anal stylets project from the posterior end, and soon after the end is slightly raised and the male comes forth, leaving behind on the leaf the whitish larval scale. These are found scattered about among the females, on both upper and under sides of the leaf. The male louse is very different from the female. During the pupa state he has acquired wings for the new sphere into which he is about to enter, and, although he still retains the legs and antennæ, the beak and mouth organs are wanting, since, in the short existence granted him, there will be no need of food. The males generally appear the latter part of the month of July, and continue some two weeks. They are very active, flying about the leaves with great rapidity. At this time, impregnation takes place, the males dying shortly after, while the females remain on the leaves and continue to develop. We find that this louse is single brooded, the females living a few weeks over one year, the eggs deposited the latter part of May, and the young lice appearing three weeks and a half after. That they settle down at once upon the leaves of the tree and remain until autumn, when they return to the under side of the leaves, remaining in this assumed position the remainder of their lives. The males appear in eight weeks after the young have hatched, and the females are then fully developed; in two or three weeks the males disappear entirely, while the females remain dormant on the limbs six months and a half of the entire year. It is well known that the varied temperature has great effect upon the length of time the insects remain in their several stages of growth. The manner in which this insect is conveyed from place to place is undoubtedly through the transportation of the trees, the scales of the female adhering to the limbs when transplanted. The insects spread from tree to tree by the aid of the wind when in the egg state, the waxy mass becoming detached from the tree in very stormy weather, and, being light, it is easily blown about. Many flies, wasps and bees are attracted to the trees by the sweet substance in the waxy mass, and the young lice, when crawling about, before settling down upon the leaves, will become attached to the legs of these insects and thus conveyed to other trees. Nature has made violent efforts to assist in destroying the *Pulvinaria innumerabilis,* and one of the most successful ways of combating with this destructive insect is by cultivating and protecting the natural enemies. To the lady birds we are the most indebted for services in this direction, since, unlike many kinds of insects, they continue their work of destruction throughout their entire active life, the larva and imago subsisting upon the same kind of food. Three kinds of lady birds are very often found upon the infested trees during the summer months. The female maple louse has one true parasite, (*Coccophagus Lecanii,* Smith), which is double-brooded, and lives in the body of the female. The insect is small, having a black body and four membraneous wings. The perfect insect and the pupa are shown at *a*, and *b*, the hair lines denoting the natural size. When the imago is about to emerge, the dorsal part of the louse becomes very black and presents a rounder appearance; later the parasite makes a small circular opening, from which it takes flight. The first brood occurs in early spring, the second in August. Remedies: The fact that the young lice settle upon the under side of the leaf and limb, renders the use of fire extinguishers charged with liquid solutions possible and to good effect. When the lice are first hatched they are very small and delicate. A wash containing an alkaline solution applied at this time is sufficient to destroy them. By attaching a wire bag to a



MAPLE BARK LOUSE.



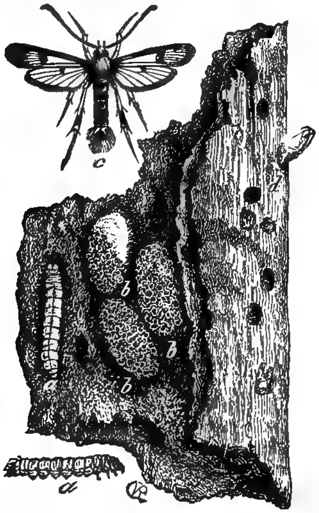
MALE MAPLE LOUSE.



CHALCIS PARASITE.

common sprinkling hose, filling the bag with soft soap and turning on the water, a soap-suds will be formed which will at once kill the insects. The scarcity of the water system in small cities renders this plan impracticable, however, and experiments led to a plan, easily attained by all, and which has proved successful the two seasons past. The plan recommended is as follows: Charge a fire extinguisher, in the usual manner, with bicarbonate of soda and sulphuric acid; add to the water one spoonful of crude carbolic acid to every eight gallons of water. Apply this to the tree; the force from the extinguisher will convey the fluid to all parts of the tree alike; the disposition of the insects to settle upon the lower surface of the leaf and limb serve to further this plan. Two applications should be made upon the same tree; the first, three weeks after the first deposition of eggs, and the second, four weeks from the first application. If the work is delayed, the insects become strong and the strength of the solution must be increased, which would be liable to injure the tree itself. The actual cost is not exceeding twenty cents an application, which is trifling compared to the cost of replacing the tree.

MAPLE BORER. Legged Maple Borer. (*Ægeria Acerni.*) This insect of late years has done extensive damage especially to shade maples in the West. Dr. C. V. Riley, in his sixth Missouri Report, says of this insect, that, vieing with the Flat-headed Borer in destructiveness, but generally following in its trail and rendering more conspicuous the damage which that species does to our shade maples, the insect under consideration deserves notice. It may be called the Legged Maple borer, because the possession of sixteen legs, at once distinguishes it from the Flat-headed Borer. It is, indeed, in structure similar to, and belongs to the same family as the common Peach-tree Borer, and the more common Current-stem Borer (*Æ. tipuliformis*, Linn.). The cut shows that the worm burrows under the bark of our soft maples, feeding on the inner bark and sap-wood and never penetrating deeply into the more solid heart-wood. It is so numerous at times that it completely girdles, and thus kills outright, trees of considerable size; while smaller trees are weakened, and rendered liable to be broken by wind, even where the worms are less numerous. The burrowings of the worm are filled with dark brown pellets of excrement, and cause the bark to crack open and loosen. The cocoon is loosely formed of white silk, and covered with the same brown excrement, and when about to give forth the moth, the chrysalis works its way partly out of the bark through a passage which, as larva, it has providently prepared, having left but the thin epidermis, which the chrysalis easily pushes through. The moth is a very pretty species, particularly distinguished by the large anal tuft of bright orange-red hairs. It appears to be very generally distributed over the country; though, as none of the older eastern writers on economic entomology refer to its injuries, we may infer that it does not attract the same attention in the Atlantic as it does in the Middle States. The moths begin to issue from the trees the latter part of May, and continue to issue throughout the summer. The worms are also found of all sizes, during this time, and throughout the winter. I have always found the worms in such trees as have been injured, either by the work of the Flat-headed Borer, the rubbing of the tree against a post or board, or in some other way. Where the bark is kept smooth, they never seem to trouble it, the parent evidently preferring to consign her eggs to cracked or roughened parts. For this reason the worm is not found in the smoother branches, but solely in the main trunk. Whether the soap application will prevent the moth from depositing her eggs, is not known; judging from analogy, probably not. Yet it will tend to keep the bark smoother, and, in being used to shield the tree from the other borer, it will indirectly shield it from this one. Mr. Gennadius recommends whitewashing the trunks, and filling up all holes and fissures with mortar, so as to render the bark as smooth as possible.



LEGGED MAPLE BORER.

MAPLE-LEAF CHENOPODIUM. (See Goosefoot.)

MAPLE SUGAR. In the article Sorghum, will be found matter relating to sugar making, from the best data except that of making sugar from the true sugar cane, and making maple sugar. So far as condensing the sap of the maple is concerned and converting it into sugar the ideas expressed in the article Sorghum will apply. The tapping of the trees and gathering the sap, when there is a considerable sugar orchard, must be carried out systematically, and, when proper implements are to be obtained, it is cheaper that the best quality of these be bought. Yet, in many localities, it is difficult to procure modern utensils, especially in the settlement of a new country. Thus, we will suppose that one of the early settlers, a farmer, is going to engage in making maple sugar, he would commence operations in something like the following manner: The first thing to be done is to procure something in which to catch the sap, and just before the season for making sugar arrives, he takes his axe, goes into the woods where the work is to be done, and proceeds to make a sufficient quantity of troughs. These are generally made out of soft timber, such as will split freely and work easily; trees of about one foot in diameter are selected and cut into lengths of from two and a half to three feet;

these are split through the center, and the blocks thus made are dug out with the axe, and made large enough to hold from one to two pails of sap. He next wants some spouts to conduct the sap from the tree to the trough; these are made of some timber that splits well, and are made by cutting or sawing blocks one foot in length, and splitting them into thin, narrow staves. If a crooked frow can be obtained to split them with, they are of the desired form; but if they have to be split with an axe, as is frequently the case, then a shallow groove has to be cut on one side for the sap to run in; one end of the spout is sharpened to correspond with the shape of the tapping iron. This instrument is about one foot in length, and made of iron in the shape of a carpenter's gouge, the cutting end being about two inches wide and usually made of steel. When the sap will run, the trees are tapped by making two incisions on the body of the tree, near the ground, or as near as the snow will admit; these incisions are made in the form of the letter V; just below the point of these cuts, another is made with the tapping iron by driving it into the tree with the axe, and into this the sharpened end of the spout is driven, and under this spout a trough is placed to catch the sap. Previous to tapping the trees, a place is prepared to boil the sap; this is done by felling a large hard wood tree; from the butt end two logs are cut, the length of these depending on the number of kettles to be used. If only two are used, they would be about six feet long. These logs are placed on the ground parallel with each other, with a space between them wide enough to hang the kettles. At each end of the logs a crotched stick is set into the ground, and across these a pole is laid; from this pole the kettles are suspended. These are generally iron, and hold from twelve to fifteen gallons. In boiling the sap, when the logs are burned up, others are cut from the same tree and rolled up to supply their places If the tree did not supply logs enough for the season, and others could not be brought conveniently to the fire, a tree was cut in another place and the boiling place removed. It was usually the custom, however, when it was desirable to have a permanent boiling place, to go in the fall or winter previous and cut and pile logs enough near the boiling place to last through the season; sometimes wood was cut and piled ready for use, but generally the wood used was green, and cut from day to day as it was wanted. The sap was gathered and carried to the boiling place in buckets or pails suspended from the ends of a wooden yoke, made to fit the shoulders of the person who gathered the sap. In gathering sap when the snow was deep, unless paths were made to go in, it was necessary to use snow-shoes to go around on the snow. Generally a rude shanty was erected near the boiling place, under which the tools that were used and sometimes a little dry wood were placed, and into which the man himself could also go when occasion required. Our fathers had but limited means for storing the sap when gathered; and during a good run much of it would be wasted, and during stormy weather much snow and rain would get into the sap. In boiling sap in kettles hung between logs, the wood to make the fire with had to be set endwise between the logs and kettles, and as the lower ends burned off, the tops of the small sticks would frequently fall into the kettles: leaves and ashes would occasionally be blown in by the wind, and when the sap was nearly boiled down to syrup it would burn on the sides of the kettles, thus giving the contents of the kettles an additional color. In some instances the syrup was strained through hemlock boughs, and then boiled down to sugar, if a mixture made by boiling such a compound together could be called by that name. Those who wished to make a nice article would strain the syrup through a linen strainer, then clarify it with milk or eggs, then strain it again and boil it to sugar. In this way a much better article of sugar was made than one would suppose. At the close of the season the troughs were turned bottom upwards by the tree, or set endwise against it, where they were ready for use next spring. The spouts were taken from the trees, and with the kettles and other tools, carried to the dwelling-house of the owner for future use. After a series of years wooden buckets began to be used in the place of troughs, and instead of tapping the tree with the axe and tapping iron, an auger was used. The trees were tapped by boring a hole into the tree from one to two inches in depth, and short, round spouts driven into the holes; an iron spike was driven into the tree a few inches below the spouts on which the bucket was hung by means of a hole bored through one of the staves near the top. A cauldron kettle was substituted for boiling the sap, and this large kettle was hung up to one end of a long pole resting on a crotched stick set in the ground; this pole was so balanced that when the kettle was filled with sap, the other end of the pole would rise and let the kettle down to the fire; but when the sap was boiled down low, the kettle would rise out of the way of the fire. The advantage of having it hung in this way was, that much less of foreign substances got into the sap while it was boiling; and if the person who was boiling the sap should be absent from the fire for some time, and the sap get low, it would swing up from the fire, and thus prevent it from being burned. After this, those who had cauldron kettles began to set them in arches made of stone, and these arches were generally protected from the storm by a shelter of some kind, at the same time the wood for boiling the sap was cut the season before it was wanted for use, so that it would be dry when wanted. Those persons having sugar lots near their dwelling-houses, accessible to a team, and having conveniences at their dwellings for boiling sap, drew it and boiled it there; the sap was gathered and put in barrels, and drawn on sleds to the boiling place. Soon after this, as there began to be a market for maple sugar, those engaged in the business began to build permanent houses and enlarge their accommodations and facilities for manufacturing. These sugar houses are generally built on the sugar lot, and were made large enough to contain not only boiling fixtures, but the storage for sap, the sap buckets when not in use, and generally the wood to be used These improvements in the manufacture of maple sugar which have been mentioned would bring us down to about thirty years ago, at which time considerable attention had been given to the business, both in the manufacture of the sugar and the preparation of it for market. About this time sheet iron pans began to be used for boiling sap, and from thence a new era seems to have commenced in the business. It was soon ascertained that those who used these pans for making sugar obtained a much better article than those who used iron kettles, and that those who made the best sugar sold it for the highest price; and that while there were generally plenty of customers for a good article, it was often difficult to dispose of an inferior one at paying prices. These considerations, with the increasing demand for maple sugar have stimulated those engaged in the manufacture to make all the improvements that were possible, so as to produce a superior article at the least expense and with the least labor. The most approved way of building sugar houses now is to locate them so that the ground on one side of the house will be several feet higher than on the opposite side. The general plan of the house and fixtures for boiling and storing the sap is as follows: The house is made large enough to enclose the arch and store-tubs at one end, with the wood in the other end, and the sap buckets in the upper part. The arch is built near one side of the house, and on the opposite side is built a platform on which the store-tubs are placed. These tubs are so arranged that the sap can be drawn by means of a faucet in the bottom of the tubs into a spout, and run into the heater or pans. On the outside of the building the ground is fitted at such a height that the sap can be drawn from the bottom of the gathering tubs and run into the tops of the store-tubs. With this arrangement all the labor of lifting the sap after it is placed in the gathering-tubs or buckets and brought to the house is avoided; the only force used after this until the sap is in the pans is that of gravitation. In the sides of the building are doors, so calculated as to afford means for the steam from the boiling sap to pass off. The arches are generally built of brick, though where suitable stone can be obtained it is sometimes used. The arch is usually made wide enough to set on one pan and long enough to place one or two pans, as may be required, and a heater. The pans to be set first from the mouth of the arch, and the heater between the pan and chimney. The mouth of the arch is fitted with a cast iron frame and door. About eight inches from the bottom of the arch is a bed on which the fire is made; this floor is generally made of narrow, flat stones, with sufficient space between them for the coals and ashes to fall through into the lower part, and thus prevent the fire-place from getting clogged up, as it would do in boiling any length of time without the floor. In this arrangement of the floor, the draft of air passes under and up through the fire, throwing the flame and heat of the fire against the bottom of the pans. The pans are generally set directly on the top of the arch, which is made level and smooth for that purpose. The ends of the pans rest on iron castings made for that purpose. On the end of the arch where the heater is placed is fitted a cast iron frame, in which the heater sets. The pans for boiling the sap are made of Russia sheet iron, and are of different sizes, holding from one to four barrels. The size of a pan holding one barrel is two feet three inches long, and two feet wide on the bottom; a two-barrel pan, five feet five inches long and two feet wide: a three-barrel pan, five feet four inches long, three feet three inches wide, a one and a half barrel pan, four feet four inches long, and two feet wide. The depth of the pans is seven and a half inches. The sides of the pans usually flare about three inches on a side, which would make the top of the pan six inches wider than the bottom. Handles are placed on the sides of the pans near the top. The cost of the pans will vary with the price of iron and also the quality of the stock. The sap-heater is a modern improvement. Experience in the process of boiling sap has shown that whatever vessel is used, the larger the surface exposed to the fire the faster will evaporation take place, and that evaporation will proceed faster in shallow vessels than in deep ones; and on this principle the sheet-iron pan has been constructed. In the construction of the sap-heater the idea was to make a vessel in which a much larger surface of the vessel, and consequently the sap, would be exposed to the fire than was in the pan then in use. To accomplish this it was proposed to incorporate into a sap-pan the principle, and as far as practicable, the form of a high-pressure steam engine. The plan adopted was to make a pan, with a box or pit extending down from the bottom of the pan. Into this box were placed a number of tubes: the ends of tubes made tight to the sides of the the pit, and holes cut through the sides of the pit against the ends of the tubes. In making the pit the holes are first made in the sides; then the tubes fitted in. When the pan was placed on the arch the pit of tubes would be placed in such a position that the heat and smoke of the fire should pass through these tubes, thus exposing a very large surface to the action of the fire, and, consequently, when the vacant places between the tubes were filled with sap, a very rapid evaporation must take place. Another consideration in the use of the heater is, that no additional fuel or heat is required; the heater, being placed in the arch behind the pans, receives the heat from the fire after it passes from the pans, so that all that is accomplished in boiling with the heater is a clear gain in time and fuel. In using the heater it was found necessary to have the top part of it made high, to prevent the sap running over when boiling; for when the fires are hot the heater is filled with foaming sap. Even with the high top it is necessary to have one or two tubes or spouts in the side near the top, to let the boiling sap into the pan before it, and also to make the system of boiling arrangements complete, which will be examined hereafter. The sap heater is made of the best quality of tin; the usual size is as follows: The upper part is nineteen and three-quarters by thirteen and one-quarter inches wide on the sides at the bottom, and eighteen inches high; the sides flare about two inches, so that the top is about four inches wider than the bottom. The pit is twelve and one-half inches deep. The tubes are thirteen and one-half inches long, and one and three-quarters inches in diameter. A pit of this size will contain thirty-five tubes, placed in five rows, seven tubes in a row. Near the top of the heater, on the side next to the pan, one or two tubes are placed to carry the sap from the heater to the pan. On the sides of the heater, at the top, are handles for taking it off. The cost of the heater is from eight to fourteen dollars, according to the size. The method of taking off the heater is to have a windlass directly over it. When the heater is not in use in boiling sap, a piece of sheet or cast iron, is used to cover the place in which it sets. To remove the pans from the arch when they contain hot sap or syrup various ways are used. The simplest and safest way is to have a strip of board nailed to the studs on the side of the house, the top edge of the board level with the top of the arch; then have two strips of board just long enough to reach from the side of the house to the bottom of the pan on the arch; have the upper side of the ends of the boards next to the pan beveled off to an edge; place these near the ends of the pans. After the greater part of the syrup has been dipped out of the pan, stand at the side of the arch between these boards; take hold of the handles of the pan and draw it upon the boards where it can be emptied of the rest of the syrup. The plan for boiling sap in the arrangement just described is, after the sap has commenced boiling, to have a stream of sap running into the heater, and from the heater into the pan before it, in which it is boiled down to syrup. If two pans are used, the sap is dipped from one to the other. The quantity of sap which can be boiled in a given time depends on many circumstances. Sap will boil much faster on a clear day than on a cloudy or stormy one, and weak sap will boil away faster than that which is stronger. With a three-barrel pan and a heater, with good wood and favorable weather, sap enough for eighty pounds of sugar can be boiled in a day as an average day's work. The kind of wood used may be either hard or soft, though it is now thought that equal parts of both kinds, mixed together, are the most economical. With one pan and heater the wood should not be cut over three feet long; some think two feet long enough. If the wood is too long it will clog up the back part of the arch with coals, so that the heater will not work as well. One cord of wood, (running measure,) two feet long, will boil as much sap as a cord four feet long. One cord of wood two or three feet long, is calculated to make one hundred pounds of sugar. The buckets used to catch the sap are made both of wood and tin, the wooden ones being generally used. These are made of pine lumber, hooped with iron, and painted with oil paint on both sides; at the top of the bucket, on the outside, is an ear made of sheet iron, through which is a hole large enough for the spike to pass on which it is hung. The spouts used for conveying the sap from the tree to the bucket are principally made of wood, although metallic ones are used to some extent. The wooden spouts are made of hard wood, birch making the best. They are made by taking inch boards, sawing them into strips one inch wide, then cut into pieces the length of the spout, which is about six inches; these are then put into a lathe and turned round and smooth, one end of which is tapered down to a little less than half an inch in diameter; a hole about one-fourth of an inch is then bored through the entire length, and the spout is ready for use. The spikes for hanging the bucket on the tree are made of wrought iron, and are about two inches in length, with the head on one side of the nail, to prevent the bucket from slipping off. A common half-inch bit is used for tapping the tree, though many use one seven-sixteenths of an inch for that purpose, and a one-half inch bit for boring the second time. In all sugar lots where the surface of the land will admit of a team being used, the sap is drawn from the different parts of the lot to the sugar house, on sleds. For this purpose a gathering-tub, holding three or four barrels, is used. This tub is made with a head in both ends, the diameter of the bottom being much larger than the top, to prevent it from tipping when filled. In the top of the tub a hole is cut large enough to turn in the sap; a lid is made to fit this hole, so that when the tub is full it can be closed tight, to prevent the sap from being wasted in going to the house. The tub is fastened on the sled with stakes or chains. The tubs in the house for storing are usually about the size of the gathering tubs; they have but one head, and the tops of these are the largest. Both the gathering and storing tubs are made of spruce or pine planks, hooped with iron, and usually painted on the outside. The storing-tubs should be painted on the inside like the buckets, to prevent them from becoming sour and discolored with mildew. Whenever storing tubs or buckets become sour, they should be immediately washed clean before putting more sap in them. In those lots where a team can not be used to draw the sap, a hand sled can be frequently used with advantage. Many of the sugar lots are located on the sides of hills so steep that neither teams nor hand-sleds can be used to draw the sap. In these lots leading spouts or pipes can be used in a way to save much severe labor. By having the sugar house located at the lowest part of the lot, lines of leading spouts can be put up from the house to different parts of the lot, and in these spouts the sap can be run from those places to the house. Spouts can not be used when it snows, as the snow that falls into them will choke up the passage of the sap, so that it will run over and waste. In rainy weather considerable water will collect in the spouts if the line of spouts is a long one. At the upper end of the line a store-tub is placed; by means of a faucet the sap is drawn into the spouts, and the size of the stream gauged to their capacity. Pipes are a great improvement on the wooden spout. It can be used as well in stormy as in pleasant weather. The size of the tube generally made is one-half inch; one end of these spouts is made a little larger than the other, so that the ends will fit tight in putting them up. The quantity of sap which different trees produce varies largely; some will produce as many pailsful as others do quarts. As a general rule, second-growth trees that have the most top will produce the most sap; with first-growth trees the difference is not as great. Trees standing in open land will produce much more sap than those growing where the timber is thick. Sap varies much in saccharine strength. Trees growing in open fields, or in exposed places produce a sweeter sap than those growing in the forest. Some years the sap will produce much more sugar than in others. Taking one year with another, eight pounds of sugar to a barrel of sap is a good average yield. Sap requires to be reduced to about one-twentieth of its bulk, to form good syrup. In making maple sugar or molasses, one thing is indispensably necessary in order to make a good article; that is, cleanliness in every process from the time the sap is collected till it is made into sugar. Great care should be taken that all the implements used to hold the sap or syrup should be kept clean and sweet. The same care should be taken to prevent all foreign substances, such as bark, leaves and dirt, from getting into the sap, and also to remove them as soon as possible, whenever they do get in, as everything of this nature has a tendency to impart a dark color and also an unpleasant flavor to the sugar. Sap usually runs best in pleasant weather, when the air is clear and wind west—an easterly wind dries up the sap—but at this season of the year, changes of weather and storms are frequent, and if it can be avoided, sap should not remain out to be exposed to the storm, as water from any source injures the quality of the sugar. Experience has shown that the sooner the sap is converted into sugar after it leaves the tree, the better; and especially is this the case when the weather grows warm; for the sap is liable to sour in the buckets, and also in the store-tubs. When the weather is quite warm—as it sometimes is for a day or two—sap will sour in twenty-four hours. At such times the boiling should be forced to the utmost extent, night and day, if necessary. At no time should much sap be allowed to accumulate on hand, if it can possibly be avoided. After the sap has been gathered, if there is dirt in it without ice, it may be strained as it runs into the pans. After the boiling has commenced, it should be kept up without cessation until it is reduced to syrup. Twelve hours is long enough to boil at one time for syruping off. The syrup should be boiled down as thick as it can be strained when taken from the fire. Whatever dirt and scum arises on the surface of the sap when boiling should be removed with a skimmer. As soon as the syrup is taken from the fire, it should be strained into a tub used for that purpose, and allowed to settle. The best strainers are made of home-made flannel—one thickness of cloth answering for a strainer. After the syrup has settled, it should be made into sugar. Pour off that part which is clear into the pan or kettle to be used in boiling it, leaving the sediment in the tub. By turning some hot sap into this it can be settled again, and either boiled down by itself or with the next lot of syrup. It was formerly the practice to clarify the syrup with milk or eggs, to remove the impurities; but if the syrup be well settled it needs none, for the simple reason that there are no impurities to remove. After the syrup is placed on the fire it should be kept boiling with a steady fire until it is done. Sometimes, while boiling, it is inclined to run over. To prevent this, put a piece of butter the size of a marble into it, and sometimes it may be necessary to put in a second or third piece before it will settle. A very good way is to take a stick long enough to reach across the vessel; lay this stick across the top of it, and from the stick suspend a piece of fat pork; when the syrup rises against the pork, it has the same effect as the butter. If neither of these methods will prevent the syrup from running over, the heat of the fire must be reduced until it boils steadily. The degree of hardness to which the sugar needs to be boiled depends on the subsequent treatment. If it is to be put into tubs and drained, it should be boiled only enough to have it granulate readily; if it is to be put into cakes, it should be done so hard that it will not drain at all; it is necessary to boil it as long as it can and not burn. There are various ways of telling when the sugar is boiled enough. A convenient and good way is, when snow can be obtained, to have a dish of snow, and when some of the hot sugar is put on the snow, if it does not run into the snow, but cools in the form of wax on the surface of the snow, it is done enough to put into tubs to drain. But when it is to be caked or stirred, it should be boiled until, when it is cooled on the snow, it will break like ice or glass. When snow can not be obtained, stir some of the sugar in a dish, and as soon as it will granulate, it is done enough to drain; when it will form bubbles, feathers, or ribbons, on being blown, it is done enough to cake or stir. To try it in this way, take a small wire or stick and form one end into a loop; dip this loop into the sugar and blow through it to produce the forms described. When the sugar is done it should be taken from the fire immediately, and cooled. It is then ready to be put up in any way that may be wanted. In large places, or where large quantities of sugar are made and the syrup is sugared off at the sugar house, a one-barrel pan fitted to a small arch is used to make the sugar in; but when the sugaring-off is done on the stoves of the dwelling-houses, as large quantities of it are, smaller pans or brass kettles are used. These pans are made of sheet iron, tin and copper; a convenient size is one of twenty-two inches long by thirteen wide on the bottom, and thirteen inches high, with handles on the ends. From forty to fifty pounds of sugar can be made in a pan of this description. The general method of putting up maple sugar for family use is to place it in tubs and drain it. When put up in this way, the sugar should stand long enough after it is taken from the fire to become well crystallized before it is put into the tubs. The best tubs for this purpose are those holding from one to two hundred pounds, made flaring, largest at the top, and having two bottoms. There should be a space of several inches between the bottoms, to contain the molasses which drains from the sugar. The upper bottom should be fitted loose, so that it can be taken out when the tub is empty. In this bottom one or more holes should be made for the molasses to drain through. When the tubs are to be filled with sugar this hole should be stopped with a stick long enough to reach above the top of the tub. After the first batch of sugar put into the tub has become hard, the stick should be loosened and raised a little, and this process continued until the tub is filled. The molasses will drain through this hole into the receptacle below the sugar, where it is secure from dust and insects, and when wanted for use it can be drawn out by means of a faucet in the side of the tub. Many families are in the habit of stirring a portion of their sugar, as in this form it retains its flavor better than when it is drained, and is in a more convenient form for use. When the sugar is to be stirred it should be boiled hard enough to cake. When it is done, take it from the fire, set the pan in a cool place, and with a wooden paddle commence stirring it briskly, and continue to do so until the sugar is grained and dry, or of the consistency of the brown cane sugars. If it is then put into tight boxes or tubs and thus kept, it will retain the fresh maple flavor for some length of time. When the sugar is to be caked, it should be allowed to stand after it is taken from the fire until it is partially grained, when it should be run into the moulds. Care should be taken not to let it get too cold before it is put into the moulds, for it hardens so fast at this stage that it must be handled quickly in order to cake in good form. If it is desirable to have the sugar of a coarse grain, it should not be stirred while it is crystallizing; but if a finer grain is wanted by stirring it moderately, while cooling, any desired grain can be obtained. Both wooden and tin moulds are used to cake sugar in, and these are made of different forms and sizes—the weight of the cakes varying from two ounces to several pounds. The general form of the cake is a square, as this is the most convenient one for packing in boxes, in which form it is put up for market. Previous to putting the sugar into moulds, they should be wet with water as this prevents the cakes from sticking. After the sugar is removed from the moulds, they should be washed before they are filled again. In draining sugar most of the coloring matter can be taken out and a white sugar obtained; but in this process much of the maple flavor is lost. The method is to cover the top of the sugar with wet cloths, flannel generally being used. These cloths should be wet and also washed daily in cold water until they are removed from the sugar.

MARASMUS. Leanness, wasting away.

MARBLE. Limestones with a granular and crystalline appearance; they are for the most part primary or transition. The colors and variegations are adventitious, depending upon the presence of other minerals. Good marble being entirely carbonate of lime, yields fifty-six per cent. of lime when well burned.

MARC. The matter which remains after the pressure of fruit; or any substance which yields oil; or, in fact, any fluid matter for the separation of which the action of the press is required. What remains in the press is the marc.

MARCESCENT. In botany, a term applied to leaves, etc., which are permanent, and when withered do not fall off.

MARE. The mature female of the horse. (See Horse.)

MARE'S TAIL. *Hippuris vulgaris.* A curious indigenous aquatic, growing in marshy situations, and in ditches, pools, and the borders of slow streams.

MARGARIC ACID. An acid obtained from animal fat. It derives its name from its resemblance to pearl. Its appearance and properties very much resemble those of stearic acid, another product of animal fat, the chief difference being in the greater fusibility of the margaric, which melts at 140° Fahr.

MARGARINE. The solid white fat of oils. A margarate of glycerine.

MARGARITIC ACID. One of those fat oils peculiar to castor oil.

MARGARONE. A product of the distillation of margaric and stearic acids; a white, pearly mass.

MARIGOLD. *Calendula.* A genus of showy plants, among which is the old and well known common marigold (*C. officinalis*). This species was formerly used in soups and broths, but is now little regarded. Some of the newer varieties are beautiful.

MARINE ACID. Muriatic acid.

MARINE SALT. Common sea salt.

MARJORAM. *Origanum.* A genus of well known, pungent, and gratefully aromatic herbs. The plants are all of easy cultivation; the shrubby kinds are increased by cuttings or slips; the herbaceous species by dividing at the roots. The species generally cultivated are the common or pot marjoram (*O. vulgare*), and sweet or summer marjoram (*O. majorana*), and bastard or winter marjoram (*O. heracleoticum.*) A light, dry, and moderately fertile soil is required for their healthy growth; and if it is one that has not been cropped for a considerable time, it is the more favorable for them. If the soil is wet or rich, they are deficient in their essential qualities, and the perennials are unable to withstand severe weather. The sowing is performed either in drills, six inches apart, or broadcast; in either case the seed being buried not more than half an inch deep. The tops and leaves of all the species are gathered when green, in summer and autumn, for use in soups, etc.; and dried in July or August, just before the flowers open, for winter's supply.

MARKETING CROPS. The marketing of crops is not the least important of the various divisions of agriculture. Here the farmer becomes the salesman, and as much tact, combined with strict integrity, is necessary here as in selling any product whatever. In the city or village, certain individuals become known for their produce being precisely as represented. In this case the buyer of grain takes it, the price being fixed according to the sample shown. If the farmer understands the ruling value of the commodity, but little trouble is experienced in selling in any market where there is competition. If there is no competition so much more the necessity that the seller knows the precise money value of the article to be sold. In the case of grain, he must understand the various grades, and prices. If live stock, the price according to fatness. If wool, the grade, whether it be fine, coarse, middle, or combing wool, and the price according to cleanness, and uniformity in packing. If butter, cheese, eggs, or other minor products of the farm, the seller must be competent to state the quality exactly, and then he can always fix a price anywhere in reason. The buyer is never deceived in the goods he examines, but may be in the statement of the seller, if he relies on his word. The buyer is an expert, or should be. So should be the farmer. Thus neither party will be deceived by misrepresentations of the other. In the case, where articles are to be consigned to a commission man in some distant city, a statement should be sent, detailing articles, quality, number of packages, weights, gross, tare and net, or number of bushels, or count, including bill of lading—is especially important in the case of butter, cheese, eggs, vegetables, fruits, berries, etc. If grain, samples should be forwarded by express, in case it is to be sold to arrive. In the case of perishable articles, as vegetables, etc., that are delivered from teams from day to day, these products should be carefully gathered, washed, when necessary, and tied in bunches, packed in uniform packages, of a bushel or integral parts of a bushel, unless sold by the bushel from the measure. The marketman soon learns to display his products in the most inviting manner, consistent with close packing in the wagon. As to market systems, all large cities are provided necessarily with market laws more or less stringent. In New York the market system includes fourteen or more principal market houses, and the firms of butchers and grocers, distributed over the city, who deal in vegetables and fruit. In St. Louis the regular market houses do the principal part of the trade. In Chicago, certain streets, as portions of Water and Market streets are occupied by marketmen, who sell the products consigned to them to butchers and grocers who supply the families direct. It is well understood, however, that in our great cities the inhabitants can not depend upon getting their supplies at regular market houses, directly from hucksters. This has been found to be the case in Boston and New York, and the evils of this system has tended to prevention of this system in the newer cities of the West. Philadelphia has probably the most perfect system of market houses in the country. Philadelphia has for generations been noted for the excellence of its market system. The law provides that vegetables, provisions, or fruits, exposed for sale shall not have been previously purchased within the limits of the city. When the city erects a market house, one-half of the building remains free for the use of the country people attending the market; and no fees, tolls, or perquisites are to be exacted from them for the use thereof. Persons who send or carry the produce of their farms to market, may sell beef, mutton, etc., slaughtered on their farms; and persons so selling such meats, etc., are not liable to any fine for selling in less quantities than one quarter; provided that farmers using the stalls in the market houses for such purposes shall pay a rent or compensation for each stall not exceeding $20 per annum. The select and common council annually elect a commissioner of market houses. No person is allowed to sell or expose for sale, elsewhere within the market limits than in the stands specially provided therefor, any fruits, vegetables, or other provisions (except fresh fish, meat, or flour) which have been before purchased within the city of Philadelphia. No person exercising the trade of a butcher is permitted to occupy a stand or station without the market house free of rent; and no person is allowed to offer for sale any veal, beef, lamb, etc., unless the same is the produce of his or her own farm, upon any of the streets authorized for the stands for market wagons, under a penalty of $20. The stalls and stands within the public market houses, and places for the use of which rent may be lawfully charged, are let annually. No person is allowed to use steelyards or spring-balances within the market houses. No person, except farmers bringing the produce of their farms to market, is allowed to sell or expose for sale any butcher's meat in any streets or other highways of the city south of Lehigh Avenue, east of the river Schuylkill, or north of Morris street, in any cart, wagon, etc., nor carry about the same for sale. The execution of these regulations provides better marketing than some towns of one-fifth her population. On Wednesdays and Saturdays, in the afternoon, thousands of pounds of butter, poultry, meat, and sausages are sold to consumers by farmers from all the counties within thirty miles of the city. The drawback to this system is that the poor are required to go considerable distances daily for their marketing. Nevertheless, prices should be enough cheaper to make it up, when the produce is sold direct from the producer to the consumer. In Chicago, the market business is all done through middlemen who receive the fruits, vegetables, etc., from the producer, and sell to those who supply the families. The commission man receives from five to ten per cent., and the retailer from ten to twenty-five per cent. Nevertheless, but little complaint is heard, except from fruit growers who have to pay a heavy additional tax in the shape of freights, sometimes carried several hundred miles. Chicago is the greatest fruit distributing market in the country, and in no market are fruits and vegetables cheaper or more abundant.

MARKET GARDENING. (See Gardening.)

MARL. A mixture of earths containing a large amount of mild lime. It is clayey or argillaceous when it has the mechanical characters and touch of clay, sandy when silicious, and calcareous when almost entirely composed of mild lime; it is also shelly when full of fossil shells. There is one feature common to all true marls, viz., effervescence with acids. Marl may be derived from ancient formations, more especially the upper red sandstone but is for the most part of tertiary origin, or modern, being produced in ponds and rivers flowing in limestone countries. The richest shell kinds are best, as they contain bone earth. The value of marls is precisely as the amount of lime they contain. When very rich, they may be burned for quicklime, which much increases their activity and value. Marls seldom contain more than twenty per cent. of carbonate of lime associated with sands or clay. They are applied at the rate of fifteen to thirty loads to the acre, and do much good by altering the texture of some soils, as when a clay marl is applied to sandy lands. In some cases one hundred loads have been applied. They are chiefly indicated where the soil lacks lime, or may be improved mechanically; but being, for the most part, mineral composts, marls are usually serviceable, and often extremely beneficial, especially to poor, sandy lands. Shell and coral sands are of the nature of silicious marls, but more active, from containing organic matter.

MARMORATUM. In building, a cement of pounded marble with lime.

MARSH-MALLOW. *Althæa.* This is a genus of tall, free-flowering plants. The biennial and annual kinds should be sown in the open border in spring, and transplanted when sufficiently strong. The herbaceous kinds may be increased by dividing the roots or by seeds. *A. rosea*, the parent of the many beautiful varieties of hollyhock, yields a blue coloring matter equal to indigo. The common marsh-mallow (*A. officinalis*) is in England an indigenous perennial, growing abundantly in marshes, especially toward the sea. The root is perennial, tap-shaped, rather woody. Bees are very fond of its melliferous flowers. The whole plant, especially the root, yields in decoction a plentiful, tasteless, colorless mucilage, besides a fatty oil, uncrystallizable sugar, starch, and phosphate of lime. It is emollient, and salutary in cases of internal irritation. A syrup made with the root, as well as the decoction, is an officinal preparation used in the coughs of children.

MARSH-MARIGOLD. *Caltha.* The species of this genus are showy, and do best in a moist situation, but will grow and flower in a common border. They may be increased by seeds or divisions. The British indigenous species are two in number, viz: The common marsh-marigold (*C. palustris*) which grows in marshy meadows, and about the margins of ponds, rivers, and brooks, almost everywhere. It is perennial in habit, blooming in March and April. The root is thick and somewhat tuberous, with many simple fibers. Stem twelve or eighteen inches high, round, hollow, leafy, branched, furrowed. Leaves variously heart-shaped, rounded. Flowers from three to five, large, bright, yellow, on alternate solitary stalks. The flower-buds, pickled, serve for capers, which they resemble, except in having numerous germens. A double variety is frequent in gardens. Creeping marsh-marigold (*C. radicans*). This species is found by the sides of lakes and rivulets in Scotland, and is scarcely half the size of the common *C. palustris*. A double variety of this is cultivated near London.

MARSH MIASM. The pestilential effluvia from marshes, producing agues and intermittent fevers.

MARSUPIALS. Quadrupeds with an abdominal pouch, in which their young reside, as the opossum, kangaroo.

MARTINGAL. An attachment of the bridle fastened by a strap to the girth and furnished with two straps carrying rings, through which the reins pass. It prevents the horse from tossing his head.

MARUM. Bitter. In botany, the term is used to signify an herb with a strong smell.

MASCAGNIN. Native sulphate of ammonia, found in volcanic districts.

MASH. A soft diet occasionally given to horses. It is prepared by pouring boiling water upon a small quantity of ground malt, bran, or other similar substance, in a pail, so as just to wet it well. After this has been done, it should be well stirred about, till it is thoroughly mixed and sweetish to the taste, when, after becoming lukewarm, it is in a proper state to be given to the animal. It is frequently used after purges to increase their operation, as well as after hard labor, and in the time of disease. Mashes are very useful for restoring animals in these circumstances.

MASONRY. The art of building, especially with stone.

MASSETER. The muscle which moves the lower jaw.

MASSICOT. Yellow oxide of lead.

MAST. The nuts or seeds of the beech, oak, chestnut, and other nut trees. (See Acorn.)

MASTIC. The resin of the *Pistacia lentiscus*, extensively used in making varnishes; also a cement used in plastering walls.

MASTIFF. The largest of watchdogs. He has small drooping ears, smooth skin; is variously colored, hanging lips, large jaw, and is strong, and sometimes savage.

MASTOID. Small knots or elevations on bones, etc.

MATERIA MEDICA. The collection of drugs used in medicine, farriery, etc.

MATRASS. A chemical flask, with a long neck, used for heating or boiling fluids.

MATRIX. A womb. A place where anything is formed. The mineral in which metallic ores or choice crystals are imbedded.

MATTER. Anything that has weight or sensible properties, as divisibility, impenetrability, extension. It is organized or inorganic, elementary or compound.

MATTOCK. The pickaxe. The ends may be pointed or of the figure of a chisel.

MATURATION. Ripening. The formation of pus in abscesses.

MAT WEED. The sea reed.

MAUL. A large mallet, or beetle, to split wood.

MAW. The stomach. Maw skin, the prepared stomach for rennet.

MAWBOUND. (See Gastritis).

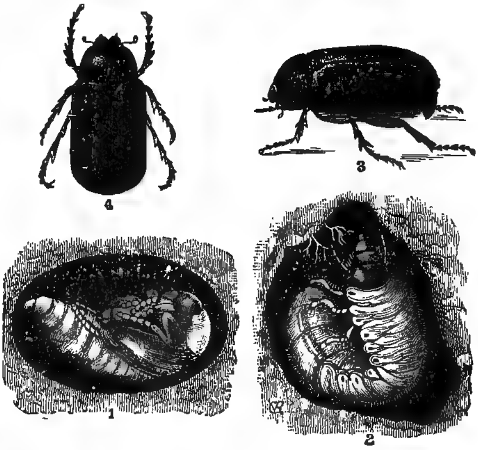
MAW SEED. The small Poppy, which see.

MAXILLA. The jaw. In zoology, it means the upper jaw; in entomology, the inferior pair of jaws.

MAXILLARY. Related to the jaws, as the maxillary glands, arteries.

MAY APPLE. *Podophyllum peltatum.* Wild mandrake. An herbaceous perennial, growing in moist woods, bearing one stem with two leaves; the roots are cathartic; the yellow fruit, often two and a half inches long, is acid and pleasant; it is worthy of cultivation.

MAY BEETLE, JUNE BEETLE. *Lachnosterna fusca.* This is one of the greatest pests of meadows, and occasionally of pastures. Pastures, however, are not so liable to be severely injured when fully fed down, since the continued tramping of stock is not favorable to either the egg or the future growth of the insect. Cereal crops also suffer sometimes to a fearful extent, and once the grubs are found in numbers it is better that the land be plowed and summer fallowed, since the grub requires to live three years in the larval state before transforming to the perfect bettle. We have seen large tracts of meadows, so completely eaten off about an inch under the surface that the sod could be rolled up like a carpet, and, of course, the field as a meadow was rendered worthless. A heavy sowing of salt will kill the grub, but to be effective, it must be heavy enough to kill vegetation. Hogs are persistent hunters of these grubs, and if turned into a field infested will soon rid it of these pests, but, of course, also at the expense of the crop. The cut shows the insect in its several stages, as at 1, the pupa; 2, full grown larva; 3, beetle side view; 4, the same, back view. In relation to the



MAY BEETLE.

application of nostrums, as salt, ashes, lime, etc , to kill these insects, it must be remembered that the first year of their lives they do comparatively little injury. The second year, unless in great numbers, the damage is not always particularly noticed. The third and last year of their life the farmer resolves to destroy them in earnest, and applies liberally the so-called specifics. The succeeding year they are not found, and he rejoices in the efficacy of the doses, but if he be an observing man, he will find the May Bugs (beetles) flying in great numbers. Here is the time to destroy them by killing them wherever found. Among the most effective means, the beetles being nocturnal, is to place torches, fed with kerosene or petroleum, in the fields. The beetles will fly to the light, and their wings being scorched, they are incapable of further mischief.

MAY TREE. The hawthorn.

MAY WEED. *Matricaria chamomilla*, and other plants. Perennial rooted, composite herbs, overrunning rich cultivated lands; they should be mowed before flowering, and exterminated by cultivating hoed crops.

MEAD. A wine made by fermenting one part honey boiled in three parts water, or so the liquid will bear out an egg the size of a ten-cent piece; and flavored with various aromatic herbs, according to the taste.

MEADOWS. Lands seeded down to grass to be cut for hay are termed meadows. Those used exclusively for grazing are pastures. Nevertheless, a meadow does not become a pasture simply because the aftermath is eaten off on the ground. The seeding of meadows is for an entirely different purpose than that of pasturage. In meadows the idea is to select such grasses as will furnish the heaviest swarth of palatable and nutritious hay, and which shall ripen together. The principal hay grasses in the United States are, North, Kentucky blue grass, orchard grass, fowl meadow grass, smooth stalked meadow grass, tall fescue, timothy, and red top. When Kentucky blue grass ripens in June the other grasses will ripen as follows: orchard grass, June; fowl meadow grass, July and August; smooth stalked meadow grass, July; tall fescue, June; timothy, July; red top, July and August. In seeding meadows more or less clover is generally sown. If with timothy and red top as the basis, the clover must be allowed to get pretty ripe in order that the timothy may be cut when the seeds are half formed. Then the red top will be in its prime, and the clover will have thickened at the bottom. Blue grass, orchard grass, tall fescue and clover ripen nearly enough together, so they may form the meadow; fowl meadow grass and red top ripen nearly enough together so they may be fit for hay at the same time. Clover, timothy, blue grass and orchard grass like a strong, rather dry soil, red top will grow in moist soil, so will fowl meadow grass. Timothy should not be cut close, since the bulb at the top of the ground will be injured. Clover, red top, fowl meadow, smooth stalked meadow grass, and blue grass make excellent hay for cattle and sheep. For horses, timothy, orchard grass, and blue grass make superior hay, since the hay is clean and generally free from dust. In the South, clover, blue grass, orchard grass, timothy and red top do fairly, but in the Gulf States the main dependence seems to be on crab, crowfoot, Bermuda and gama grass, which are extensively sown. What is necessary, North and South, is careful experiments with various grasses both for meadow and pasture. If a meadow is to be pastured it should not be a timothy meadow, that is intended for seed. The bulb is injured, the seeds of other grasses come in and the timothy is ruined as a seed crop. For shipping, clean timothy sells better than any other hay, especially in city stables. At the stock yards, mixed hay is not objected to if well cured. In the seeding of meadows plenty of seed should be used. It gives a better stand, and finer hay. All the grasses may be sown in the latter part of summer. If the grass miss, sow again in the spring. Clover should only be sown in the spring, and that as early as possible. (See article Grasses.)

MEASLES. This is a parasitic disease of swine producing peculiar small cysts, scattered through the muscular and other tissues. These cysts contain the form that produces the tape worm in the intestines of the human family. If the flesh is cooked most thoroughly, these bladder worms as they are called are destroyed, but it is better not to eat it. A hog with the measles, will have a cough, a discharge from the nose, running from the eyes, weakness of the hind parts, general debility, and there will be small pustules on the skin. Small doses of sulphur and saltpetre is recommended, daily for several weeks. Still there is little evidence that this or any other medicine will kill the worms. Once encysted they cause the animal very little further trouble.

MEASURES. Measure is of length, breadth, and thickness, estimated by known lengths, or compared by other known quantities: Thus there are 12x12x12=1728 cubic inches in a cubic foot; and 3x3x3=27 cubic feet in a cubic yard. The following collated from the Library of Reference, will show at a glance, the measures of capacity, weight, length, and time, both ancient and modern. Measures of capacity are:

The Imperial gallon is 277,274 cubic inches. A gill, or quarter of a pint, is 8⅔ inches.

The Imperial gallon contains 10 pounds avoirdupois of distilled water, weighed in air, at 62°, with the barometer at 30 inches. Two gallons a peck, eight a bushel, and eight bushels a quarter.

One English wine gallon is equal to .0833111 Imperial gallons.

One ale gallon=1.017045 Imperial.
One corn bushel=0.96943 Imperial.
One Imperial gallon=1.20032 wine gallon.
One Imperial gallon=0.933241 ale gallon.
One Imperial gallon=1.03152 corn gallon.

An Imperial gallon is 4.843452 litres.

Heaped measure, per bushel, is 2815¼ cubic inches clear.

The standard bushel kept at Guildhall contains 2145.6 cubic inches of water, weighing 1131 ounces and 14 pennyweights.

The Winchester bushel is 18½ inches diameter and 8 inches deep, containing 2150.42 cubic inches.

A quarter of corn is the fourth of a ton, and eight bushels, or two sacks.

A strike is four pecks.

1000 ounces of rain water are equal to about 7½ gallons wine measure, or to a cubic foot.

7 pounds avoirdupois is a gallon of flour.

A chaldron of coals is 58⅔ cubic feet.

Twelve wine gallons of distilled water weigh 100 pounds avoirdupois.

Nineteen cubic inches of distilled water, at 50°, weigh 10 ounces, Troy.

A cubic inch of distilled water at 62°, in a vacuum, is 252.724 grains.

The Imperial measure for heaped goods contains 80 pounds avoirdupois of distilled water, and is 19½ inches from outside to outside at the bottom; the heap to be in a cone at least six inches high from the outside; three making a sack and twelve sacks a chaldron, which ought to weigh 28 hundredweight.

The Imperial dry bushel, when not heaped, is 2218.192 cubic inches; the peck 554.548; gallon 277.274, and quart 69.3185. The bushel is 8 inches deep, and 18.8 wide; with a heap 6 inches high.

A tun is 2 pipes, 4 hogsheads, 3 puncheons, 8 barrels, or 252 gallons. A pipe of port is 138 gallons; of Lisbon 140; Madeira 110: and sherry 120. The hogshead of claret is 57 gallons, and the aum of Hock 36 gallons; Teneriffe 120, and Cape 20.

A tun of wine is 2 pipes, and each pipe 2 hogsheads of 63 gallons.

A tun of beer is two butts, and each butt 2 hogsheads of 54 gallons.

A bushel of wheat is 60 pounds, rye 53, barley 47, oats 38, peas 64, beans 63, clover seed 68, rape 48 pounds.

53 hundred weight is a chaldron at Newcastle, England. A keel of 8 Newcastle chaldrons is 15½ London chaldrons.

The Imperial corn bushel of 2218.192 cubic inches, is to the Winchester of 2150 42, as 32 to 31.

The Imperial coal bushel of 2816.459 inches is 1½ inches more than the old coal bushel of 2814.9.

The Imperial wine measure is to the old measure as 6 to 5; 5 Imperial gallons being 6 wine gallons and one forty-five hundredth over.

The new and old ale measures are as 60 to 59.

To convert old corn measure into new, multiply by .96943 or thirty-one thirty-seconds; wine by .83311 or five-sixths ale by 1.01704 or fifty sixtieths.

Wood, the fuel of France, is sold by the corde of 576 square feet: and 80 square cordes make what is called a journal.

At 70° the specific gravity of water is 0.99913; at 38° is 1.00113; and at 54° is 1.00064. The difference between 62° and 39° in a gallon of 277.276 inches is one-third of a cubic inch.

A last is a commercial measure, of twelve barrels of soap, ashes, herrings, etc.; ten quarters of corn, or two cart loads; twenty-four barrels of gunpowder; twelve sacks of wool; and 1,700 pounds of flax or feathers.

A Scotch pint is four English pints.

A Scotch pint is 105 cubic inches, and a wheat firlot 21¼ Scotch pints.

The Scotch quart 206.8 cubic inches.

A tub of butter is 84 pounds and a firkin 56 pounds.

A Scotch boll is an English sack.

A soldier's canteen contains three pints.

A litre is 61.0279 English cubic inches, or 2⅛ wine pints.

The stere, or cubical metre, is 35.3171 cubic feet English.

There are 545,2670,000 cubical yards in a cubic mile.

A Roman quadrantal was a cube containing 80 pounds of water, or 48 sextaries and 8 congii. A gower was 7 pints.

The *Ephah* was the sixth part, or 1747.7 cubic inches, nearly an English cubic foot.

The Winchester bushel is 35.2466 litres. The stere is 35.317 cubic feet.

MEASURES OF WEIGHT.

Weight is the tendency or force with which bodies of various density tend to fall toward the earth.

The standard of weights is the cubic inch of distilled water, weighing 252.458 troy grains; the troy pound 5760 grains, or 22.8157 inches The same standard of 7,000 troy grains makes the pound avoirdupois, 27.7274 cubic inches: ten of which or 277.274 being the Imperial gallon; a quart 69.32; and a gill, of 5 ounces of water, equal 8.664.

In Troy weight, 24 grains make a pennyweight, (meaning grains of wheat) 480 an ounce and 5760 a pound.; or 20 pennyweights an ounce and 12 ounces a pound.

In Apothecaries' weight, twenty grains make a scruple, 60 a drachm; and then as in troy weight, 480 makes an ounce, and 5,760 a pound. There are 12 ounces to the pound, 8 drachms to an ounce, 3 scruples to a drachm, and 20 grains or drops to a scruple. The drachm is 60 grains.

In Avoirdupois weight, 16 drachms make an ounce; 256 a pound; 16 ounces a pound; 112 pounds a hundredweight; and 20 hundredweight or 2,240 pounds, a ton, English. The American ton is 2,000 pounds.

175 pounds troy are equal to 144 pounds avoirdupois; and 175 ounces troy are equal to 192 ounces avoirdupois.

80 ounces avoirdupois are equal to 73 ounces troy, and 14 pounds avoirdupois to 17 troy. A troy pound is 13 ounces 2.65 drams avoirdupois; and a pound avoirdupois is 1 pound 2 ounces 11 pennyweights 16 grains troy.

The avoirdupois pound of 7,000 grains is 453.61 French grammes; and the troy pound, 5,760 grains, is 373.14 grammes.

One troy pound=0.822857 Imperial pound.

One Imperial pound=1.215271 pounds troy.

Henry III, enacted that an ounce should be 640 dry grains of wheat; 12 ounces a pound; 8 pounds a gallon of wine; and 8 gallons a London bushel. Latterly the malt liquor measure has been 282 inches to the gallon, and the wine measure 231.

7,000 grains of water, thermometer 62 degrees, and barometer 30 inches, are 1 pound avoirdupois.

The French gramme is 15.434 English grains.

The smaller French weights are in tenths, decreasing, as deci, centi, and milli grammes.

The larger are deca, hecato, chilio, and mirio grammes, in tenths, increasing.

The kilo-gramme, or 1,000 grammes is equal to 2 pounds, 2 ounces, 4 grains avoirdupois.

In Greece, a drachma was 2 pennyweights, 16 grains; a minæ 1 pound, 1½ ounces; a talent 67 pounds, 7 ounces, 5 pennyweights.

The Roman weights were the As, equal to 12 ounces, and the uncia an ounce.

The American quintal is 100 pounds.

The Mysore cutcha seer is 9 ounces, 11½ drachms.

A bale of Egyptian cotton is 90 pounds, of Brazil 160, of Georgian and Sea Islands 280, Orleans 300, East India 300, West India 350 to 400.

A pack of sheep's wool is 240 pounds.

The livre, or French pound, is 500 grammes, or 7,714 grains English, or 1 pound, 1 1-5 ounce. 10 drachms avoirdupois. The quintal, of 100 kilo-grammes, is 220.486 pounds.

The Bengal maund is 74 pounds, 10 ounces, 10⅝ drachms avoirdupois; the seer 1 pound, 13 ounces, 13.866 drachms; the chattock 1 ounce, 13.366 drachms. The Baza maund is 82 pounds, 2 ounces.

A seam of glass is 24 stone of 5 pounds each.

The weight of a cubic inch of distilled water, in a vacuum is 252.722 grains; and in air is 252.456 grains.

The quintal is 10 mirio-grammes, or 2 hundredweight, or 224 pounds, English, nearly.

A sack of wool is 22 stone of 14 pounds, or 308 pounds. In Scotland, it is 24 stone of 16 pounds.

A pack of wool is 17 stone 2 pounds, or a horse load.

A tod of wool is 2 stone of 14 pounds each; and a sack is 13 tod; 12 sacks is a last, or 4,368 pounds.

50 or 60 pounds is a truss of hay, old or new, and 40 pounds a truss of straw; 36 trusses being a load.

A Spanish quintal is 312 Spanish pounds. The arroba is 25 Spanish pounds, of 6,544 grains each; and 6 arrobas make a quintal.

The Portuguese arroba contains 32 Lisbon pounds of 7,005 grains.

The Venetian mirre contains 30 pounds of 4,215 grains.

The shippondt of the northern nations is, in Sweden, for copper 320 pounds, of 9211 grains, and for provisions 400 such pounds. At Riga it is 400 pounds of 6,149 grains. At Hamburgh 300 pounds of 7,315 grains.

100 pounds English is equal to 112⅔ pounds of Russia, to 93 pounds 5 ounces of Hamburgh, and to 132 pounds 11 ounces at Leghorn, and 104 pounds 13 ounces in Portugal, and 91 pounds 8 ounces at Amsterdam.

The commercial pound of Amsterdam is 7,636 grains, and the troy pound equal to 7,602 grains. The Dutch stone is 16 pounds. The Norway pound is 7,833 grains. The Spanish pound is 7,038 grains. The Chinese kin is 5,802 grains, or 375 two-tenths French grammes.

The Turkish pound is 7,578 grains. The Danish 6,941. The Irish 7,774. The Naples 4,952. The Scotch pound troy 7620.8. The Smyrna pound 6944.

The following table shows the weight, in pounds, of a cubic foot, of the following substances:

Name.	Pounds.
Loose earth or sand	95
Common soil	124
Strong soil	127
Clay	135
Clay and stones	160
Mason's work	205
Distilled water	62.5
Pure gold	1203.625
Pure silver	654.8
Cast iron	450.45
Steel	489.8
Lead	709.5
Platina	1218.75
Copper	486.75
Cork	15
Portland stone	157.5
Tallow	59
Oak	73.15
Brick	125
Crown glass	180.75
Fir	34.375
Mahogany	66.4
Air	0.0753

MEASURES OF LENGTH.

Measures in length are the distance of one object from another in some agreed standard.

A line is the tenth of a digit, and the 100th of a foot.

A digit measure is three-fourths of an inch, or 4 barleycorns laid breadthways.

A hair's breadth is the 48th of an inch.

A barleycorn is .00217th of a cubic inch, or about 460 make a cubic inch, or 3 to an inch in length.

A geometrical pace is 4.4 feet English, and an English mile contains 1,200, or 1,760 yards, or 5,280 feet.

The Paris foot is 9 lines shorter than the English foot, or 0.91 to 1.

The Roman foot was 0.915.

The Rhineland or Leyden foot is 0.86925 English.

A Scotch mile contains 1,500 paces.

A German mile 4,000. A Swedish and Danish mile 5,000. The Russian mile 750 paces.

A great league in France is 3,000 paces, and a mean league 2,500.

A nautical league is one-twentieth of a degree.

A hand used for horses is 4 inches.

A degree of latitude is 69 one-seventh English miles at the equator.

A nail's breadth is the 16th of a yard, or 2¼ inches.

A surveyor's chain is 4 poles, or 66 feet, divided into 100 links of 7.92 inches. A square chain is 16 poles, and 10 square chains are an acre.

640 acres are a square mile; and 4,840 square yards are an acre, 169.58 yards each way.

The Irish acre 7,840 square yards.

A French arpent five-sixths of an English acre.

The Scotch acre 1.27 English.

121 Irish acres are equal to 196 English.

48 Scotch acres are equal to 61 English.

11 Irish miles are equal to 14 English.

80 Scotch miles are equal to 91 English.

The Turkish dreah, or pik, is 3 palmi, or 26.41 inches, and the lesser pik is 19.03 inches.

The jaghire is 10.46 English inches. A cawney is rather more than an acre.

A hide of land was one plow's work.

An ox-gang is 15 acres, or as much as an ox can plow in a year.

The long-line adopted in the navy is 48 feet.

A sea league is 3.4536 miles, or the 20th of a degree.

6,078 feet are a sea mile.

A palm is 3 inches. A fathom 6 feet.

The French metre is 36.9413 French inches, or 39.371 English, or 3.2389 feet.

In Greece, a digit was three-fourths of an inch, a cubit 13½ inches, and a large cubit 18⅛ inches; a pace 2 yards and ½ an inch, a stadium 201 yards 1 foot 3 and two-fifths inches; 8 and two-thirds stadia a mile nearly. The plethron, 10,000 square feet.

A Bengal coss is 6 000 feet, or 1 mile 240 yards.

The haut or cubit is 18 inches.

A baggah of land is 1,600 square yards, about a third of an acre.

A span was 10.944 inches.

Ezekiel's reed was 10 feet, 11 and one-third inches.

A Sabbath day's journey was 1,155 yards or about two-thirds of a mile. A day's journey was 33¼ miles.

The Egyptian cubit, or ardub, was 21.888 inches.

The Greek foot was 12½ inches.

The Hebrew foot was 1.212 English feet. The Hebrew cubit 1.817; the sacred cubit 2 English feet; and the great cubit 11 English feet.

The stadium, 625 feet; and the milliarium, 5,000 feet.

The Amsterdam foot is .927; and the ell 2.233.

The Berlin foot .992.

The Bologna foot .125.

The Brabant ell 2.268.

The Brussels foot .95.

The Chinese imperial foot 1.05.

The Chinese lis is 629 yards.

The Turkish foot is 1.165.

The Florence foot .995.

The Geneva foot 1.919.

The Hamburgh foot .933.

The Italian mile 5,299 feet.

The Portuguese foot .952.

The Madrid foot .915.

The Moscow foot .928.

The Neapolitan mile, four German miles, or one-sixtieth of a degree.

The Roman palm .733. The Roman foot .966.

The Roman mile one seventy-fifth of a degree.

The geographical or Italian mile is 1,000 geometrical paces, or five-sixths of an English mile.

The Roman braccio is four palms.

The cauna eight palms.

The Russian werst is 3,508 English feet, about two-thirds of a mile.

The Scotch ell is 37 2-10 inches.

The Scotch mile 5,952 feet.

The Spanish league 4 miles English.

The Swedish foot 1.073 English feet.

The Venice foot 1.14.

The Venice ell 2.089.

The Vienna foot 1.036.

The Vienna post mile 24.888.

The Wirtemburg foot 11.28.

The Levant pig is three-fifths of the French ell. The Venetian ell is eight-fifteenths of the French ell.

The candi, of India, is equal to the Venetian ell. In Siam, the ken is 36 inches nearly, and is divided into 2 soks; these into 2 keubs; and each keub into 12 nions, at ¾ of an inch.

3 inches is a palm; 3 palms, or 9 inches, a span. 5 feet is a pace. 2 yards is a fathom.

The German mile is the 15th of a degree of latitude, or more than 4½ miles English.

A league is 3 sea miles. 17 Spanish leagues is a degree, or about 4 miles, which is the Dutch and German league. The Persian league, or parasang, is 30 stadia or furlongs.

The Paris line .0888.

The Paris ell is 43.9 inches.

The French toise 6 feet 4.733 inches.

The French league 1-25 of a degree.

The French metre 39.37079 inches. The metre is 443.2959 lines, and .513074 of a French toise. Eight chiliometres is about 5 miles English. 1,000 feet is nearly 305 metres.

The metre is the ten millionth part of the quadrant of the earth from the equator to the north pole. It differs slightly from the length of a pendulum which, in the latitude of London, vibrates seconds in a vacuum, at the level of the sea, where it is 39.1393 inches; therefore, the metre is only .23 of an inch longer than our pendulum.

The millimetre, or thousandth part, .03937 inches English.

The centimetre .39371.

The decimetre 3.93708.

The decametre is 10 times the metre.

The hecatometre 100 times.

The chiliometre 1,000 times; and the myriametre 10,000 times.

The area is 3.95 English perches.

An inch English is 2.54 centimetres; a yard is 0.91438 metres; and a mile is 1609.3149 metres.

The French metre is the ten millionth of a quadrant of the earth, taken as 6217.857 English miles, or 32,809,167 feet, and a mean degree of latitude at 69.0429. A centesimal degree is 54 minutes. A league at 25 to a degree is 2.7617 miles. A post league 2,000 toises, or 2.3 miles English; a toise being 6 feet 6¾ inches English. The pied one-sixth of the toise; and the aune 3 feet 11¼ inches English.

A degree at the equator is 365,101 feet, or 69.148 miles, or 69 1-7 nearly. In latitude 66.20 Maupertius measured a degree of latitude, in 1737, and made it 69.403; and Swanberg, in 1803, made it 69.292. At the equator, in 1744, four astronomers made it 68.732; and Lambton, in latitude 12, 68.743. Mudge, in England, makes it 69.148. Cassini, in France, in 1718 and 1740, made it 69.12, and Biot 68.769: while a recent measure in Spain makes it but 68.63, less than at the equator; and contradicts all the others proving the earth to be a prolate spheroid, which was the opinion of Cassini, Bernouilli, Euler, and others, while it has more generally been regarded as an oblate spheroid.

Degrees of longitude are to each other in length, as the cosines of their latitudes. Longitudinal lines run from north to south; latitude from east to west. For every 10° they are as follows:

Equator	69.2
10°	68.15
20	65.27
30	59.93
40	53.1
50	44.48
55	39 69
60	24.6
70	23.67
80	12.02

The diameter of the equatorial circle is 41,837,494.8 feet, and its circumference 131,436,444 feet, which, in a sidereal day, gives a velocity of 1,525 feet per second of rotation.

Then 1,525 × 4=6100 for the velocity of the surface of the whole sphere, which+16.08728, the mean force per second, gives 98.132 feet per second for the orbit velocity of the earth; and this multiplied by 31 558,151 seconds in a sidereal year, gives a mean orbit of 586,527,362.6 miles; and a mean radius, or distance from the earth to the sun, of 93,348,800 miles. The aphelion distance is 94,918.500 miles, and the perihelion 91 779,000.

The pendulum which vibrates seconds 39.1393 inches at London, is the standard for the British measures. One mile is equal to 1618.833 such pendulums.

MEASURES OF TIME.

Time is best defined as the succession of motion and phenomena, independent of relative human perceptions. Time is measured by man by the impressions of successive ideas, and these diminish in a ratio of their own increase; consequently, time appears less as men advance in age, or are variously employed. At ten, a year seems to be twice as long as at twenty; three times as at thirty; four times less at forty; five times at fifty; and six times at sixty; circumstances of employment and position being the same. Hence a month employed in traveling seems equal to three of usual pursuits. Time being mentally measured by the impressions of new ideas. Absolute time, independent of the feelings of individuals, is measured by certain regular motions, as the rotation of the earth, the swing of a pendulum, the fall of a body, the revolutions of the moon round the earth, or the earth round the sun. The tropical year is 365 days 5 hours 48 minutes 51.6 seconds; but the sidereal year, or return to the same star, is 365 days 6 hours 9 minutes 11 seconds; but as the line of apsides or aphelion point advances 655 seconds, the orbit is completed in 365 days 6 hours 15 minutes 20 seconds, and this is called the anomalistic year. The Chaldeans made the sidereal year 365 days 6 hours 14 minutes, or one minute 49 seconds more than our present year, and the tropical year 365 days 5 hours 49 minutes 30 seconds, being 38 minutes 4 seconds more than ours. If Hypparchus was right in his measure of the tropical year, it is 11.2 seconds less than in his time. The Brahmins made it 1 minute 43 seconds more than now.

The precession of the equinoxes is performed in 25,868 years; and the revolution of the line of apsides is 20,931, or 1 degree, 43 minutes, 10 seconds in a century. The precession of the equinoxes is 50 minutes 25 seconds per annum, or 1 degree 52 minutes 45 seconds in a century, or the 360 degrees in 25,868 years. Leap year is the year which divides evenly by four; but the year 1900 will not be leap year, to make up for the odd minutes gained between the astronomical and computed year, as 365 days. The astronomical equinoxes are on the 21st of March and the 21st of September, and the sun is in the tropics on the 21st of December or June. Quarter days in civil reckoning are March 25, June 24, September 29, and December 25, being festivals of the Catholic Church. The Synodical lunar month of her departure from the sun's center to the return, or from full to full, is 29 days 12 hours 44 minutes 12 seconds, and was the universal month of the ancients, twelve being accounted a year. The difference between the solar and lunar year is nearly eleven days. The sun and moon return invariably to the same relative positions every 223 lunations; according to the ancient Chaldeans in 6585 days 8 hours. Our modern tables make it 17.29 seconds less. The Eastern nations, where the day varies little, reckon the day from sunrise. The Romans reckoned as we do, from midnight. Christian nations assign thirty days to April, June, September, and November, thirty-one to other months, and twenty-eight to February, making three hundred and sixty-five; but three hundred and sixty-six in Leap-year, when February is twenty-nine. The Romans added the day in Leap-year on the sixth of the calends of March, making two-sixths or *bis sextus*, and hence the word Bissextile. The astronomical day is the time which elapses from the sun's being on the meridian of a place till his return, divided into twenty-four hours of sixty minutes. And astronomers begin the day at the departure of the sun from the meridian of the place, counting twelve hours till midnight, p.m. or after; and twelve hours from midnight till noon a.m. or before; their day after twelve at night being a day later than civil reckoning, which begins a new day at twelve at night, and reckons from twelve at night to twelve the next night. As the earth advances in its orbit 61 minutes 9.9 seconds, when in its perihelion, and only 57 minutes 10.7 seconds, when in its aphelion, while it returns the same meridian to the sun, that meridian arrives at the same fixed star in twenty-three hours 56 minutes 41 seconds or 3 minutes 5.59 seconds less; others make it twenty-three hours 56 minutes 34 seconds or 3 minutes 56.6 seconds less. Sidereal days are always the same, and accord with a true clock; but owing to the unequal velocity, as expressed, of the earth in its orbit in the perihelion and aphelion, the sun's return to the meridian varies; and also as the earth's path is inclined to the axis of rotation, the solar days vary. Owing to the first cause, the extreme difference is 7 minutes 39 seconds on March 21, and 6 minutes 5 seconds on May 6; 0 on July 1, making the sun slower than the clock; but owing to the obliquity it is 0 on March 21; 9 minutes 53 seconds on May 6th, and 0 June 22, making the sun faster than the clock. The combination of both causes produces the table of equation of time by which true clocks ought to be kept faster or slower than the meridian sun or a sun dial, called apparent time, and the other true or mean time. As the earth moves forward in its orbit 59 minutes 8.3 seconds, while it turns on its axis, any place arrives at a fixed star 3 minutes 56.6 seconds, before it arrives again at the center of the sun, called twenty-four hours; hence the sidereal day is but 24 hours 56 minutes 3.4 seconds, which is the real period of revolution. Hence, in 365 solar days, the earth turns 366 times on its axis, and by this exact quantity it gains in its orbit with reference to the sun and stars in every revolution, and hence the procession of the equinoxes. For as the orbit is caused by the sun, and the equinoxes have reference to the sun and not to the stars, so the equinoxes fall back 24,890 miles, or in space 50.30 seconds with reference to the stars. Every other body like the earth turns once on its axis by going round a central body, and this, therefore, is the sole cause of the equinoxial points. The Chaldeans, Egyptians, and Jews, began their civil year from the autumnal equinox. The Persians, Greeks, Romans, and the English till 1752, began the year at the vernal equinox. Thence to make dates agree with those of other nations, between January and Lady-day, writers used to put two dates, as Feb. 10, $\frac{1708}{1709}$ The bottom date being from January 1, and the upper that from the previous Lady-day. Sidereal days are always 23 hours 56 minutes 3.4 seconds; but as the axis of the earth is inclined to the orbit, and the earth moves faster in the winter than in the summer the clocks which measure equal time do not agree with the sun. A clock and a sun dial will, therefore, vary as follows: March 21, clock too fast 7 minutes 35 seconds; April 5, do. 2.55 seconds; April 20, June 13, September 5, December 25, they are equal. When the sun is in Libra and Scorpio, or in October and November, the difference is from ten minutes to 16 minutes 18 seconds, and the clock ought to be so much faster than the dial. The difference of velocity makes the dial faster than the clock, while the earth is moving from its perihelion on January 1, to the aphelion July 1; and on the contrary, the dial is slower from July 1 to January 1. But the obliquity makes the dial faster from March 21 to June 22; and from September 22 to December 21, and slower from June 22 to September 22, and from December 21 to March 21. The union of both produces the common equation table, page 39, showing to the nearest minute how much a true clock should be faster or slower than the sun. The pendulum for true and exact measuring of time was a suggestion of Galileo, in consequence of his observing the oscillations of a chandelier. Every oscillation, whether long or short, of the same pendulum, is performed in the same time. A pendulum which vibrates seconds at London ought to be 39.139 inches nearly, and the length of pendulums for less or greater times is as the square of time. In India a day is divided into 60 Ghurries, a Ghurry into 60 Puls, a Pul into 60 Prans, and a Pran into 10 Tas, in 2-5ths of a second. The beats in an hour of a common second's clock are 3.600, and 17.280 a common watch; but second watches beat 18,000 times, or 5 per second. A luminous point to produce a visual circle must go round seven times in a second. Fewer than 30 vibrations in a second give no sound, and when the vibrations exceed 7,520 in a second the tones cease to be discriminated. 10 beats of a healthy pulse is equal to 9 seconds. The Roman lustra were periods of 5 years; and the Greek olympiads periods of 4 years; and the first commenced in 776 B. C. The Metonick cycle was 19 years, intended to be equivalent to the Chaldean period. It was afterward adopted as the golden number for Easter. The Hegira, or Flight, took place July 16, 622, and is the Mahomedan Era. Their year is 12 lunar months, or 354 days 8 hours 48 minutes; and 11 days being lost, a year must be allowed every 33, to reconcile their dates with ours. The periodical month of the Turks and Arabs, or sidereal period of the Moon is 27 days 7 hours 43 minutes 48 seconds. The synodical month, or return to the conjunction of the Sun is 29 days 12 hours 44 minutes 3 seconds 11 thirds. The Jews began the year in March, and the months were Nisan, Zif, Sivan, Tammuz, Ab, Elul, Tisri, Bul, Cisleu, Tibeth, Shebat, Adar. The Sabbath, or seventh day is Saturday. The days and nights, from sunrise to sunset, were divided into twelve equal parts or hours, 1, 2, 3, etc. The night watches were three hours each, from sunset to sunrise. The months were lunar, or 30 days and 29 days, and they introduced an extra month every two or three years. The day commences and ends at sunset. The Jewish months were alternately 29 and 30 days, and their year of twelve lunations 354 days. Their year commences with the vernal equinox. To recover the four days they intercalcate a whole month after every two or three years, following their twelfth month, or Adar; and they call this extra month, ve-adar. The Jewish day commences at six in the evening, or sunset, and continues till the same hour on the following evening. Their civil year commences with the new moon near the vernal equinox, in the month called Tisri, of 30 days, corresponding with part of September and part of October. The year 1829 was the Jewish year 5589, and ended September 27, beginning September 9, 1828.

Months.	Days.	Equ. in	Minutes.	Months.	Days.	Equ. in	Minutes.
January	1	4	Clock faster than the Sun.	August	9	5	Clock faster.
"	3	5		"	15	4	
"	5	6		"	20	3	
"	7	7		"	24	2	
"	9	8		"	28	1	
"	12	9		"	31	0	
"	15	10					
"	18	11		September	3	1	Clock slower than the Sun.
"	21	12		"	6	2	
"	25	13		"	9	3	
"	31	14		"	12	4	
February	10	15		"	15	5	
"	21	14		"	18	6	
"	27	13		"	21	7	
March	4	12		"	24	8	
"	8	11		"	27	9	
"	12	10		"	30	10	
"	15	9	Clock faster.	October	3	11	
"	19	8		"	6	12	
"	22	7		"	10	13	
"	25	6		"	14	14	
"	28	5		"	19	15	
April	1	4		"	27	16	
"	4	3		November	15	15	
"	7	2		"	20	14	Clock slower than the Sun.
"	11	1		"	24	13	
"	15	0		"	27	12	
				"	30	11	
"	19	1	Clock slower.	December	2	10	
"	24	2		"	5	9	
"	30	3		"	7	8	
May	13	4		"	9	7	
"	29	3		"	11	6	
June	5	2		"	13	5	
"	10	1		"	16	4	
"	15	0		"	18	3	
				"	20	2	
"	20	1	Clock faster.	"	22	1	
"	25	2		"	24	0	
"	29	3					
July	5	4		"	26	1	Faster
"	11	5		"	28	2	
"	28	6		"	30	3	

The Mahometan year in 1829 was 1244, and ended July 2, beginning July 14. The Persians gave names to every day in the month, just as we give them to days of the week. Saturday, the 7th day, is, by the Arabs, called Subt. And Monday is called Jama, in all the Eastern languages. Law proceedings preserve the Roman names of the days, as Dies Solus, Lunæ, Martis, Mercurii, Jovis, Veneris, and Saturni, derived from the Roman deities. But in ordinary use, the names are derived from the Saxon or Teutonic deities, the Sun, Moon, Tuesco, Woden, Thor, Friga, and Saturn. The months, or lunar periods, are Roman; and September, October, November, and December were so called when the Roman year began in March. April is so called from Aperit, the spring. As the orbits of the planets complete their seasons, their periods are taken to be their years; hence Mercury has nearly 4 years in ours; Venus two-thirds; Mars is nearly 4 times as long; Jupiter 12 times; Saturn 30; Herschel 83; and more distant planets longer. September, etc., were the 7th, etc. month of the year of Romulus. From the spring to the summer solstice is 92 days 21 hours 45 minutes. From the summer to the autumnal equinox, 93 days 13 hours 35 minutes, northern signs. From the autumnal to the winter solstice, 89 days 16 hours 47 minutes. From the winter to the spring equinox, 89 days 1 hour 42 minutes. Southern signs.

MEAT. The growth of the live and dead meat trade, the facilities for shipping and preserving it fresh during long voyages, whether canned or simply in the quarters, is one of the wonders of modern civilization. Improved processes in the curing of salted meats is also as wonderful as it is interesting. The packing, preservation, and shipping of meats at all our great packing centers, is now carried forward continuously winter and summer, and on a scale of magnitude, astonishing to those who witness it for the first time. The patents for preserving meats are various and numerous. Of over 100 processes, twenty-six are for preserving by drying, thirty-one by excluding atmospheric air, nine by covering with an impervious medium, as collodion, fat, gelatine, paraffine, etc., and seven by injecting with various salts. Freezing in bulk, and keeping the meat frozen by means of ice until it arrives at its ultimate destination, salting and barreling, salting and smoking, salting and drying, and canning are the only plans yet found, that give entire satisfaction combining, as they do, cheapness with integrity of quality. In 1871, the total export of meat and meat products, was in value as follows:

Live animals and fowls	$ 1,019,604
Pork	4,302,330
Hams and bacon	8,126,683
Beef	3,825,66€
Preserved meats	208,362
	$17,492,645

In 1877 our meat exports were as follows:

Live animals	$ 3,325,203
Pork and pork products	81,653,042
Fresh beef	4,552,523
Salt beef	2,950,952
Total	$92,481,720

In 1878 our live stock exports amounted to $5,845,157; our hog products to $87,674,419: fresh beef, $5,009,856; and salt beef to $2,973,234. These exports went principally to Great Britain, France, and other European States and the West Indies. Since that time our exports, especially of live and dead animals, have continued to increase. For the year ending March 1, 1880, the exports of live stock was of the value of $12,065,459, and of other food products, $374,568,342. For the year ending March 1, 1881, the export of live stock was of the value of $20,681,738, and other food products was exported to the value of $456,244,111. Early in the year 1881, certain interested persons in Great Britain, got up a scare on Trichina in swine, and representations to the governments of Great Britain and France, resulted in an embargo upon the importation of hog products into France, and to the taking of strong ground by Great Britain. Almost before action was taken by the French government, the French Academy, showed the fallacy of the action, demonstrating that the single individual poisoned, was so by eating pork, born and killed on French soil. (See Trichina).

MECHANICAL COLLEGES. (See Agricultural Colleges.)

MECHANICAL POWERS. The simple machines, the lever, pulley, wheel and axle, wedge, and screw.

MECHOACAN. *Convolvulus panduratus.* Wild potato vine. A perennial, herbaceous bindweed, with tuberous root, of a slightly cathartic property.

MECONIC ACID. The acid with which morphia is combined. It is tribasic, white, crystalline, acid, and soluble in water and alcohol; the solution turns red when a per salt of iron is introduced into it. Comenic and pyro-meconic acids are derivatives.

MECONIUM. Once applied as the name of opium; now, only used to designate the excrement to be found in the intestines of all new-born animals.

MEDIASTENUM. The portion of the cavity of the chest made by the folding of its membrane (pleura).

MEDIC. The genus Medicago. The principal species is *M. sativa*, lucerne. (See Alfalfa.)

MEDIUM. In science, the substance in which any body is immersed. It is called rare, dense, opaque, or transparent, according to its nature. It causes resistance to motion, and, more especially, acts upon the passage of light, bending (refracting), it from its straight course. Astronomers are disposed to admit the existence of a very rare medium or ether beyond the earth's atmosphere, filling the space of our solar system.

MEDULLA or MEDULLIN. In botany, that tissue which constitutes the pith of certain plants, as the pith of the sunflower. Medullary rays are the vertical plates of cellular tissue, which radiate from the center of the stem of exogenous plants, through the wood to the bark. They cause that appearance in timber which carpenters call silver grain, or flower of the wood. The medullary sheath is a thin layer of vessels, which surround the pulp of exogenous plants, and thence extend into the leaves and parts of fructification.

MEDULLARY SUBSTANCE. The white, internal portions of the brain. Medullary tumors contain a substance of the same appearance.

MEDULLIN. The pith of plants.

MEGRIMS. (See Epilepsy.)

MELASOMES, MELASOMA. A tribe of heteromerous coleoptera, of a black or dark uniform color.

MELASSIC ACID. The product of heat and alkalies on solutions of grape sugar; the acid of molasses.

MELIC GRASS. *Melica.* A genus of perennial, harsh grasses. (See Grasses.)

MELILOT CLOVER. (See Clover.)

MELLIPHAGANS. A family of birds (*Tenuirosters*,) some of which feed on honey.

MELOE. A genus of coleopterous insects. They are remarkable for the blistering power they possess.

MELOLONTHIANS. The family of coleopterans to which the May-beetle or cockchafer belongs, (*Melolontha vulgaris.*)

MELON. All our valuable members of the *cucurbitaceæ*,, belong originally to the East, and to central Asia, but the precise home of no one of them is known certainly, since the native plant of no one species is found growing wild, on account of their cultivation from remote antiquity. The home of the muskmelon is supposed to be the Caucasus, and since the Jews bewailed the loss of the watermelon, during their wanderings in the wilderness, this fruit was certainly cultivated in Egypt, previous to the Exodus. To this day the muskmelon reaches its greatest perfection in Persia, and the pulp of the watermelon furnishes an article of food during its season to the modern Egyptians. The watermelon was carried by the Arabians in their western emigration, and after the discovery of America they were quickly and widely disseminated. The cucumber family, in all its branches, found here a genial climate, and in no country in the world are the whole tribe, including melons, pumpkins, and squashes, so widely cultivated. The best soil, for both the musk and watermelon, is a light, rich sandy loam, but they will grow well on good prairie soil, if well drained, and the lands are ridged up to correspond to the width of the rows at which the hills should be planted, nine feet for watermelons and seven feet for muskmelons. It is an error to suppose that the melon will thrive in a poor soil. Each hill, even on good corn land, should have a half bushel of good compost manure. For field culture, dead furrows may be thrown out at the proper distance for the rows, cross mark the land at equal distances and in the checks, throw half a bushel of rich compost, turn four furrows as deeply as possible over this, cross mark again over the remains of the check rows to designate the hills, with a plow, then plow the balance of the lands; plant plenty of seed, not less than ten or fifteen to each hill. The cultivation is simply to keep the soil clean, many throwing earth always to the plants until the vines render plowing no longer possible. When the plants are out of the way of the cut worms and striped beetles, thin the plants to three in a hill. If the land gets weedy, after the vines run so as to interfere, turn them back with the handle of a hay rake, cultivate the balks, turn the vines back again, and so proceed until the field is finished. It should be unnecessary to say that both watermelons and muskmelons are among the most healthy, as they are the most grateful of fruits, if ripe and eaten fresh from the vines, and particularly unhealthy if green or stale. There is no reason why every farmer should not raise an abundance of these fruits, since their cultivation is precisely like that of the pumpkin and squash. Indeed, we have grown very good late melons among Indian corn, as it is not uncommon with pumpkins.

MEMBRANE. The tissue or expansion of animal or vegetable matter surrounding the bones, and lining cavities. That lining the intestinal and urinary apparatus is mucous. The fibrous membrane covers all the bones and many muscles; and the serous tissue exists on the outer surface of the lungs and intestines, etc.

MENINGES. The membranes which cover the brain.

MENISCUS. A lens, concave on one side and convex on the other.

MENSTRUUM. Any fluid which dissolves a given solid.

MENSURATION. The admeasurement of the contents of solids or areas of surfaces.

MENTUM. The chin. The lower and anterior portion of the under jaw of animals.

MEPHITIS. A noxious vapor; hence mephitic.

MERCURY. Quicksilver, fluid, white, brilliant; it freezes at 40°; boils at 660°, rising in vapor unchanged. It is soluble in nitric acid, and the oxides combine with numerous acids. Calomel is a chloride of mercury; corrosive sublimate, a bi-chloride is one of the most fatal poisons.

MERE. A pool, lake, or pond.

MERIDIAN. A great circle passing through the zenith of any place and the north and south pole, on which the sun comes at 12 o'clock. The magnetic needle lies nearly in the meridian, the departure from this line being called its variation east or west.

MERINO SHEEP. (See Fine-wooled Sheep.)

MESENTERY. The membrane which binds the small intestines to the backbone; it is a fold of the peritoneum, and contains the vessels, nerves, and absorbents, going to or from the bowels.

MESLIN. In Spain, a union of flocks; more commonly a mixture of seeds sown together, as wheat and rye, oats and peas, etc.

MESO. An affix to many compound words, meaning the middle.

MESOCOLON. The membrane surrounding the colon.

MESOPHYL. The central layer of the leaf; we have also mesocarp, the fleshy part of the fruit.

MESOTHORAX. In entomology, the posterior segment of the thorax, bearing the second pair of wings and third pair of legs.

MESOTYPE. The silicate of alumina and soda; it occurs in trap and ancient lavas.

MESTA. A mixture of flocks.

META. A prefix to many compound words.

METABOLIANS. Insects which undergo complete metamorphosis.

METACARPAL. That portion of the hand between the fingers and wrist; metatarsal is the same part in the foot.

METAGALLIC ACID. Gallic acid changed by heat.

METALLOID. Potassium, sodium, and other alkaline metals; it is sometimes applied to the inflammable elements, as sulphur, phosphorus.

METALS. Elementary bodies, remarkable for their luster; they conduct electricity and heat, and are negative electrics. Of the peculiarities of some of the metals, Appleton's New Cyclopædia says: The peculiar brilliancy and reflective power of the metals, which may be enhanced by polishing, results from their great opacity. The color of the metals is generally white with a grayish, bluish, or pinkish tint; copper and gold are the only exceptions. In extremely thin films some of the metals allow the passage of certain rays of light. Gold leaf transmits light of a faint greenish hue. Most of the metals have a high specific gravity, a property which was regarded as characteristic until the discovery of the alkaline metals, which are lighter than water. With the exception of arsenic, they may all be fused, the temperature required for fusion varying from 100° F. to the highest heat of the oxy-hydrogen blowpipe. Some of the metals may be volatilized. Mercury, the only liquid metal, is solidified at—39° F. Arsenic when heated passes directly into vapor without fusion. Most of the metals possess a certain mobility of particles that allows of their being extended or otherwise altered in form. The two nearly related properties of malleability and ductility, resulting from this, are not possessed by the metals in the same degree. A few of them, as antimony, arsenic, and bismuth, are decidedly brittle. Some assume a plastic condition before complete fusion, notably iron and platinum; on this property depends the operation of welding. The strength of the metals is very dissimilar, iron in the form of wire being about twenty-six times as tenacious as lead. They are all conductors of heat and electricity, although differing widely in this respect. The following table gives their names, specific gravity, and melting points:

Names of Metals.	Specific Gravity.	Melting Points.
		Fahrenheit.
1. Gold	19.25	2016°
2. Silver	10.47	1873
3. Iron	7.78	2800? Smith's forge.
4. Copper	8.89	1996
5. Mercury	13.56	- 39
6. Lead	11.35	612
7. Tin	7.29	442
8. Antimony	6.70	
9. Bismuth	9.80	497
10. Zinc	7.00	773
11. Arsenic	5.88	
12. Cobalt	8.53	2810?
13. Platinum	20.98	oxyhydrogen blowpipe.
14. Nickel	8.27	2810?
15. Manganese	6.85	Smith's forge.
16. Tungsten	17.60	
17. Tellurium	6.11	620?
18. Molybdenum	7.40	oxyhydrogen blowpipe.
19. Uranium	9.00	
20. Titanium	5.30	
21. Chromium		
22. Columbium		
23. Palladium	11.50	
24. Rhodium		
25. Iridium		
26. Osmium		
27. Cerium		
28. Potassium	0.86	136
29. Sodium	0.97	190
30. Barium		
31. Strontium		
32. Calcium		
33. Cadmium	8.60	442
34. Lithium		
35. Silicium		
36. Zirconium		
37. Aluminum		
38. Glucinum		
39. Yttrium		
40. Thorium		
41. Magnesium		
42. Vanadium		

METAMORPHOSIS. Transformation. In entomology, the changes the metabolian insects pass through of larva, pupa, and imago. In botany, the doctrine that the flowers, stamens, carpels, and seeds are modifications of the leaf.

METASTASIS. The change of an affection or pain from one part of the body to another.

METAYER. A farmer who rents land at a certain proportion of the crop, usually half, the owner finding tools and animals.

METEOROLOGY. (See Atmosphere, Climate, Dew, Earth, Electricity, Rain, Soil, etc.)

METEORITE, AEROLITE. Masses of metallic matter occasionally precipitated to the earth.

METEORS. Transitory phenomena occurring in the air; aerial meteors are winds, tornadoes, etc., aqueous meteors are rains, hail, fogs; luminous meteors are halos, rainbows, lightning, northern lights.

METHEGLIN. Metheglin, or mead made of honey, has been known since the remotest times.

Long after the introduction of wine, and even beer, it was the national drink of the English, as beer is to this nation and the Germans now. It is one of the most healthful, moderately used, of any of the fermented spirituous liquors, and as insidious as it is seductive, if immoderately used. A story is told of a British officer soon after the Revolutionary war, who, visiting this country, was made drunk on metheglin. He journeyed from New York to Philadelphia through New Jersey, famous then for its metheglin as it has since become for its cider, remained in Philadelphia a week, and returned to New York declaring that it took him a week to get well drunken on the honey wine, and, on my honor, he added, I think it will take me a year to get sober. To make metheglin the sweet or honey water obtained from the operation of purifying or clarifying the honey is boiled in a kettle and repeatedly skimmed off. The boiling continues until the mass has attained such a consistency as to bear a hen's egg, with its point reaching out of the liquid. If there is not honey water enough, or if none at all, mix honey and water, the honey being one-fourth to one-third of the weight of the water. After it is sufficiently boiled, cool it off, put it into a cask so as to fill it nearly full; then bring the cask into a place of from 54° to 59° Fahr., covered with a cloth, and allow it to ferment. After six weeks, and in warm countries much sooner, filter it through blotting paper and put it into small casks. What remains may be filled into bottles, which are closed, but not tight, with a rag, and put away in a cool place. The fermentation also continues in this second cask, which is but lightly closed with a bung covered with a cloth. The mass in the cask is gradually reduced by fermentation, so that what remained in the bottles can now be added. After nine or ten months the metheglin is again put into another cask, with the bung driven in tightly and the cask set in some cool place. When completely fermented a healthy beverage is obtained, that bottled quite air-tight will keep for a long time and continually improves. Another notable drink is honey wine. Boil slightly thirty pounds of honey and sixty quarts or fifteen gallons of water for two hours, skim and cool it off and treat it like metheglin, except that a nutmeg and one ounce of coarsely-ground cinnamon are put into a linen or cotton bag, and inserted in the bung hole, and thus kept suspended in order to impart an aromatic flavor to the wine. This beverage, similar to the Spanish grape wine, but excelling it in quality, invigorates the stomach, promotes digestion, purifies the blood, and is very beneficial to the chest. There is another kind of honey wine, which, by being kept bottled a few years, will equal the best Madeira, and form a most delicious beverage, though it is somewhat troublesome to prepare it. Mix forty pounds of honey with eighty quarts or twenty gallons of running water, put it into a clean kettle, gently boil it and skim it. After thirty minutes gradually add five pounds of finely-ground chalk, continually stirring the mass. Skim off the tough substance which gathers at the top of the kettle until no more of it appears on the surface, then pour the mass into a vessel, allowing it to subside and cool, so that the chalk may settle. Let the kettle in the meanwhile be thoroughly cleansed of the chalk remaining in it, and the mass carefully poured back again into the kettle, with an addition of nine pounds of finely pulverized charcoal, and then gently boil the whole for two hours. Put the liquid again in a clean vessel to cool off a second time, after which filter it through a pointed bag of felt or flannel. After this pour the liquid once more into a kettle and heat it up to the boiling point. Then take the whites of thirty-five eggs, mix them with water, stirring the whole until a foam appears, and add it gradually to the other mixture. The liquid is perfectly clarified by the addition of this foam, which takes off the particles of charcoal that may have remained, together with other impurities. The chalk removes the acid taste, and the charcoal that of wax. The liquid, after the whites of eggs has been added, is gently boiled another hour, allowed to cool down, and then filled into a cask having a small space empty about the bung hole, which is lightly covered with a piece of linen so as to permit the mass to ferment. The additional treatment is the same as before given. Clarified in the cask and bottled, this wine will keep for an age. Cool cellars of from 38° to 41° Fahr., are, of course, a main requisite. The bottles are to be laid in wet sand, on which salt water is occasionally poured. Metheglin, even when young and not yet possessing much vigor or spirit, will make a pleasant beverage mixed with tart, especially red wines. All tart wines, in general, can thus be made agreeable and thoroughly improved.

METHOL. A hydrocarbon, obtained by distilling xylite with sulphuric acid.

METHYL. A volatile, combustible spirit, soluble in water, closely resembling alcohol. Numerous compounds of methyl are known.

MEXICAN TEA. (See Goosefoot.)

MEZEREON. *Daphne mezereum.* A highly ornamental shrub with pink flowers. The spurge laurel; the whole plant is poisonous. It is readily cultivated, although exotic.

MEZZANINE. In architecture, a low story introduced between two taller ones.

MIASM. Malaria, infectious vapors from marshes, etc. Malarial districts are especially deadly at night.

MICA. A bright laminated mineral of every color, elastic, and more or less transparent. An ingredient in granite and most ancient rocks, often occurring in large sheets, and used as a substitute for glass.

MICA SLATE. A transition slate, full of bright specks of mica mixed with quartz.

MICROMETER. An instrument affixed to microscopes and telescopes for measuring the size of objects.

MICROPYLE. In botany, a small hole over the apex of the nucleus of a seed.

MICROSCOPE. An optical instrument used to examine objects too minute to be seen by the naked eye. Microscopes are single or compound; a single microscope being one through which, whether it consists of a single lens or a combination of lenses, the object is viewed directly; and a compound microscope one in which two or more lenses are so arranged that an enlarged image of the object formed by one of them is magnified by the second, or by the others, if there are more than two, and seen as if it were the object itself. A magnifying glass is a single microscope.

MIDDLEMEN. (See Marketing.)

MIDDLE RAIL. The central rail of the door, on which the lock is placed.

MIDGE. Minute insects infesting wheat, the gooseberry, and various plants. They are sometimes very destructive to wheat, barley, rye, grass, etc. The eggs are deposited in June and July, in the opening flowers of the grain. These hatch in about eight days, and produce minute, orange-colored grubs, which feed upon the juices of the grain when in a milky state, inside the chaff or outer covering, or upon the pollen of the flower. When fully grown most of the larvæ descend and burrow in the earth, where they remain all winter. The pupæ usually are formed in the ground in May or June; some, however, remain in the heads, and the perfect fly or midge makes its appearance the following season to deposit its eggs on the grain and grass. Lime or ashes, strewn over the grain when in blossom and wet with dew, will be useful. Newly-slaked lime and wood-ashes will be required, in the proportion of a peck to a bushel to the acre. When the maggots have left the grain and are in the ground, plowing is recommended as soon as the grain is harvested. The chaff and refuse-straw together, containing the larvæ or pupæ, should be scalded, burnt, or otherwise destroyed. Early sowing of all wheat in the autumn, or late sowing of spring wheat in the spring, will enable the wheat to become too far advanced, and hard, before the fly makes its appearance in the first case, and by not coming into blossom in the last, until the flies have disappeared. When the midge has been very abundant the previous summer, deep fall plowing has been recommended, and a different crop should be sown next season. Until we find some parasitic fly, like the European species, to aid us in their destruction, there is very little hope of successfully battling with this little pest. In this country a species of thrips is said to destroy the eggs or larvæ; a coccinella or lady-bird feeds upon the larvæ, and the yellow-bird is said to feed upon them. In Europe they are destroyed by several parasitic hymenoptera viz., *Callimone, Macroglenes, Platygaster*, etc. The earwig also destroys either the wheat-midge or a thrips which frequents the wheat. The gooseberry-midge (*Cecidomyia* (*Asphondilia*) *grossulariæ*) injures gooseberries by depositing its egg in the fruit, and the larva, or grub, being hatched, feeds inside, and causes the gooseberry to present a prematurely ripe appearance, to turn red, and then drop from the bush. It is recommended to pick all fallen fruit from the ground and burn it immediately, as, although this proceeding may not be of any use the same season, the berries being already destroyed, the following year, the last season's generation being destroyed, there will be scarcely any midges to attack his future crops.

MIDRIB OF A LEAF. The central collection of woody fibers and vessels; the prolongation of the leaf stem.

MIDRIFF. The diaphragm; the muscle which divides the cavity of the chest from the abdomen.

MIGNONETTE. *Reseda odorata.* A plant of the most delicate fragrance and of easy cultivation, but which transplants with difficulty. Therefore it should be sown where it is to stand, or else sown in pots and transplanted with the ball entire. A good plant should be in every window collection in winter. Sow the seed in the pot in which it is to flower in September, and after the seed is up give plenty of heat, but not too much water. Many complain that they lose their mignonette in winter; this is owing to its being kept too damp. It should have little or no water for about three months during the dull season, and care should be taken to keep it from drip, which is sure to kill whatever plant it falls upon. When small pots are used, particular care need not be taken to have the soil very rich, provided it is light; but when sown at once in flowering pots, richer material should be used, draining well, and placing on the top of the crocks, in the bottom of the pots, flaky pieces of decayed manure for the double purpose of affording nourishment to the plant when coming into bloom, and to keep the soil from choking up the drainage. Autumn sown plants shifted into larger pots at Christmas will bloom till May; and another sowing now will succeed them, after which it may be had plentifully; and no amount can be too large in the open ground. Unpromising plants, if topped back about this time, come in nicely for winter boxes in May. Pots of them may be set among stocks, geraniums, or other dwarf plants, the box filled up with rich, light soil, and finished off with a good watering to settle the earth around the roots. Boxes thus arranged are beautiful ornaments for the window-sill; the geraniums or other flowers giving brilliancy and the mignonette fragrance. Tree mignonette, a vigorous plant from the common kind sown in April should be chosen, put into a pot by itself, and all summer the blossom buds to be taken off as fast as they appear. In the autumn the lower side shoots must be taken off, so as to form the plant into a miniature tree. It may afterwards be transplanted into a larger pot with soil formed of sand, and turf broken into small pieces. The plant should be kept in a warm room all winter, regularly watered every day, and in the spring the stem will begin to appear woody. The second summer the same treatment should be observed, and the following spring it will have bark on its trunk and be completely a shrub. It may now be suffered to flower, and its blossoms will be delightfully fragrant; and will be produced every summer for many years.

MIGRATORY. Migrating or moving with the season to the North or South, as numerous birds and fishes.

MILE. 1,760 yards. The sea mile is one-sixtieth of a degree, or 2,025 yards.

MILFOIL. (See Forage Crops.)

MILIARY. Granulated, like many small seeds.

MILK. This wonderfully constituted, natural product of the females of mammalia, produced in the precise proportions as to constituents, for the most perfect assimilation by the systems of young animals is now acknowledged by scientists as being not only a perfect food for infants, but also as being capable of sustaining life perfectly in mature age. In old age it is well known to be one of the most valuable in the whole category of foods. Cow's milk is composed of water, eighty-seven to eighty-eight parts, the twelve to thirteen parts remaining in 100, being fat, (butter,) caseine, (cheese), milk sugar, a substance analagous to glucose, and earthy (mineral) matter. Milk is not only capable of supplying—theoretically—every tissue of the animal body, keeping the whole system in vigor and health, but then there is no waste. The constituents necessary to form bone, muscle, fat, hair, in fact the whole economy of the system, is contained, and in the proper proportions for all growing animals, and again mixed with the proper proportion of water, for perfect digestion and assimilation. Hence, milk warm from the cow, but preferably from the mare or goat has always been regarded as one of the best foods for consumptives, or dyspeptics, that could be given. In wild breeds of animals, the specific gravity of milk, as well as its composition, is pretty constant since each and every animal is constant to a given type. Animals improved by careful crossing, feeding and selection, however, differ very materially in their milk, some breeds, as the Jersey, being especially rich in butter, and others again, as the Ayrshire, and Dutch cows, being rich in cheese. When the lactometer was brought into use—an instrument for testing the specific gravity of milk—it was thought by many that a perfect check had been discovered to the watering of milk, and the courts of New York are said to have come near convicting a man of adulteration on this test. Yet a particular cow may give milk lighter or heavier than the average standard. In fact, as between individual cows, the variation may be ten per cent. So, as we have said before, some breeds will give milk rich in butter, and consequently lighter, while others will give milk rich in cheese, and consequently heavier. So cows fed on watery food will be largely increased in quantity, and from naturally containing an abnormal quantity of water will be heavier than the standard. Nevertheless, the milk of a mixed herd, taken as a whole, will always be uniform. Again, rich food, with a proper quantity of water, will increase the flow of milk up to the point of assimilation by the animal. Poor food will diminish the yield to a minimum. Yet, poor food does not necessarily produce poor milk, only a reduced flow, nor rich food richer milk, but an increased flow. Thus the improved lactometer is the most valuable, as showing the specific gravity of milk. Knowing the gravity of a particular herd, if it vary much, it is pretty conclusive evidence that the milk has been tampered with, and should become a fit subject for analysis. Nevertheless, the lactometer should not be used to convict a man of crime, for there are plenty of means, known to scoundrels, of keeping adulterated milk up to its standard, so far as specific gravity is concerned, and the test by gravity is not a sure test of purity. As to the average quantity of milk given by cows and the cream as between the herd Ayrshires and natives with which he has carefully experimented, Dr. Sturtevant of Massachusetts gives the following data: With reference to the average yield of milk in Massachusetts, (because we wish to get a basis by which we can ascertain the comparative yield of milk,) I find, on looking over the Agriculture of Massachusetts, a record of seventy-six different experiments, carried on by nineteen different people, in Worcester county, during a series of years, by which it appears that it took, on the average, 20.9 pounds of milk to make a pound of butter. In 1864, the statistics of 425 cheese factories in the State of New York gave the proportion of milk to the pound of cheese as 9.11. In the statements, I make, I reduce butter and cheese to the milk valuation by allowing twenty-five pounds of milk for a pound of butter, and nine and one-half pounds of milk for a pound of cheese, which will certainly be fair. I find, then, that according to the census of Massachusetts, in 1865, the amount of milk sold from each cow was 691 quarts. In nine towns in the Hoosac Valley, with 7,480 cows, the average yield, in 1865, was 1,179 quarts per cow. The average premium dairy of seven cows in Essex county, is reported, in 1865, to have given about 1,750 quarts. Another dairy of nine cows, in Danvers, in 1856, is reported to have given about 2,000 quarts per cow. Another gentleman, who feeds daily five quarts of a mixture of rye, corn, and cotton-seed meal to his herd, reports a sale of 2,274 quarts per cow for one year. Another premium herd of six grade Durhams reports 2,460 quarts per year. The only returns of yearly yields of single cows that I find in the Massachusetts Reports are four native cows, four owners, 3,189 quarts per cow, and forty-four native cows, in four herds, 2,160 quarts per cow;—that is the average of the herd, counting all as in milk. These are the records of premium cows and competing herds, with but one exception, and must manifestly be far above the average. I now go outside of the State of Massachusetts, having exhausted all the definite facts that I can find in our Reports, to the State of New York. I will not give the particulars from which I draw my conclusions; I will state it as probable, and have you take it upon trust, that the average yield of dairy cows in the State of New York, is not far from 1,300 quarts. The average of the best dairies in the State, 1,800 quarts. The possible average which can be attained by the best farmers, with their best herds, 2,300 quarts. Here, you will notice, there is a common difference of 500 quarts, between common, best and superior dairies. I speak not of the yield of individual cows, but of the average of a herd of cows. Dr. Sturtevant also relates that, of the purchase of Waushakum Farm by himself and brother, they procured the very best native cows they could find, continually disposing of poor cows and replacing them by better, and breeding in stock. The outcome was as follows: In 1866, with an average of 35.7 cows, we produced 2,160 quarts per cow, on an average. In 1867, with an average of 36.3 cows, the average yield per cow, was 2,229 quarts. In 1868, with an average of 27.4 cows, the average yield per cow was 1,850 quarts. The average yield for the three years, from thirty-three cows, was 2,079 quarts per cow. We then imported some Ayrshire cows, and these with other Ayrshires purchased in this country, comprised our herd for the next three years. As we were now breeding, we had to change our system of feed. A system which would allow us to send a cow to the butcher when injured, would never answer with a breeding herd of valuable animals. In 1870, average number of cows, 19.8; average yield per cow, 2,616 quarts; 1871 average number of cows 18.7; average yield per cow 2,300 quarts. Mr. Miles, of Fitchburg, who makes a very candid and apparently fair record of his herd of 9.3 cows for three years, gives his average as 2,587 quarts per cow per year. In order to bring the matter into the most simple showing, he represents the facts reduced in another form, as given in the table below:

Breed.	Possible Average.	Average of best Dairies.	Common Average.
Natives......	2,300 quarts.	1,800 quarts.	1,300 quarts.
Ayrshires.....	3,000 "	2,500 "	2,000 "

Dr. Sturtevant continues as follows: Here is a common difference of 700 quarts in each class; and if my figures are correct (and I have taken every fact I could obtain, and excluded none), this sum, 700 quarts, may well represent the breed difference of the Ayrshire and native cattle. Consequently, any farmer who exchanges his natives for Ayrshires of the same rank among Ayrshires as his natives are among natives, increases, by this change, the average annual yield of his dairy, per cow, 700 quarts. The milk farmer who is selling his milk at four cents a quart, can increase his annual yield by at least twenty-eight dollars per cow, by replacing natives by Ayrshires of equal grade. It is probable that these same results will apply in a determinable ratio between grade Ayrshires and natives; but I have not yet collected sufficient facts to warrant a definite statement of my own ideas of the value of grade animals. When, through the exertions of the friends of agriculture, and the workers, sufficient facts are published, I shall reserve the right to change these figures. The breed difference is there, and is great. Thus much our present knowledge enables us to state; and according to my present figures, which include every fact I have been able to collect, 700 quarts is this breed difference. I should not lay so much stress upon the records of Waushakum Farm, did I not know that they are perfectly accurate. Similar judgment was exercised in selecting both natives and Ayrshires; similar care, similar ideas of feed, modified only by circumstances, and similar recording of facts; we have here the conditions of a true comparison of breeds. The milk has been weighed daily from each cow on this farm; and I have the recorded weights, with the food each day or month, and other notes of interest, preserved for future reference. As a curious fact, let me add, that of all the cows whose yield for the year I can find given in my Massachusetts Report (I have not the Reports from 1858 and 1862), the average of the four premium native cows is 3,189 quarts; the average of the three Ayrshire crosses per year is 4,673 quarts; the extremes among the native cows are 2,692 quarts, and 3,826 quarts; among the Ayrshire grades, 3,700 quarts, and 6,048 quarts; the average of the best native or grade, six cows, from twenty, for one year, was 2,462 quarts; the average of Waushakum herd of Ayrshires, six selected animals, for one year, was 3,123 quarts. Here, also, we have about 700 quarts, representing the breed difference between Ayrshires and natives. Our practice has been, in selecting any cows, to select the best we can find among a great many individuals, and in selecting our native cows we had our choice among tens of thousands; we had the whole country to choose from; and we selected the very best, in our judgment, that we could find, and paid the largest prices for them· and at the time when good milch cows were selling for from fifty to sixty dollars, we had a standing offer, well known to all the farmers in the region, of $125 for any cow that would milk twenty-six quarts a day. We purchased cows under that plan, and we claim, therefore, that while our comparison of the best cows in each breed is certainly fair, it is yet not quite fair, because in selecting the natives, we had tens of thousands to select from; and in selecting the Ayrshires, we had only a few thousands in Ayrshire, and a thousand or so in this country to select from. So it is a fair comparison, because it takes the best Ayrshire cows and the best native cows and compares them together. We could very easily compare the average Ayrshire cow and the average native cow, provided we had the statistics which would give us the average in each case; but it is fair to presume that in the cases presented to our agricultural fairs, by farmers, each farmer presented the best cow he had, and thought she was a very superior cow. Condensed or desiccated milk is produced in large quantities at Elgin, Ill., the only factory, I believe, in the West. It is condensed by evaporating in a vacuum pan, as it is called, precisely as in the modern mode of finishing the juice of the sugar cane. Dr. Voelcker, of England, has given the following: When milk is evaporated at a low temperature, and a little sugar is added, when the process of evaporation is nearly completed, the residue which is left on final evaporation, on being reduced to powder, constitutes a white powder with a yellow tinge, which dissolves for the greater part in boiling water. The solution resembles in appearance and taste milk, and answers pretty well as a substitute for milk for ships' use, or when fresh milk can not be obtained. Desiccated milk, if well prepared and perfectly dried, may be kept in closed bottles for many months without undergoing any change, but it does not dissolve perfectly in water, and is deficient in the agreeable taste which characterizes good fresh milk. Usually a portion of the cream is removed before the evaporation of the milk, for if the whole milk be condensed by slow evaporation, the desiccated milk is very apt to assume after a short time a bad taste resembling rancid butter. The following are analyses which I made some time ago of two samples of desiccated milk:

	No. 1.	No. 2.
Moisture..............................	4.06	1.78
Fat (pure butter)........................	8.73	16.32
Caseine..............................	20.25	20.37
(containing nitrogen)...............	(3.24)	(3.26)
Phosphate of lime and magnesia.........	2.34	2.33
Alkaline salts..........................	2.48	2.91
(containing phosphoric acid).........	(0.26)	(0.31)
Sugar..............................	62.14	56.29
	100.00	100.00

The second sample, it will be seen, contains nearly twice as much fat (pure butter) as the first, which was evidently produced from skim-milk. The sample No. 1 had a nice taste, and, notwithstanding the deficiency of butter, was a superior preparation in comparison with the second sample, which had a disagreeable taste of rancid butter. A much better description of concentrated milk has been prepared for a good many years past in America under Borden's patent, and a few years since an American Company — the Anglo-Swiss Condensed Milk Company—had established a factory at Cham, near Zug, in Switzerland, for the production of pure Swiss preserved milk. This company, with a capital of £12,000, employs about sixty operatives in their factory. The number of cows hired for the year is 1,440, and the average amount of condensed milk prepared daily during each of the 365 days of the year is 110 cases, of four dozen each of one pound cans; these equal 1,927,200 cans as the product of the year. The price of the crude milk is about two pence per quart; and the daily cost of the tins or cans made at this establishment amounts to £16 10s. About one-half of the product is sent direct to London, where one-half is consumed, while the remainder goes for ships' stores, is exported to the colonies, and sent to the provincial towns of England. One-half of the produce not sent to London is distributed over Germany, and there is some demand from France and Russia. The success of the condensing factory depends entirely upon the ability to put a fine flavored, perfect article into the market. The milk must be uniformly good, and a fastidious neatness and cleanliness must be observed in the establishment. The milk is evaporated down in vacuo at a uniform temperature of 160° Fahr., with the addition of the best refined white sugar, until it reaches the consistency of thick syrup or honey. It takes about seven hours to condense the milk, seventy-five per cent. of its original bulk in water being driven off. The condensed milk thus prepared has been preserved in good condition for years. Mixed with three to four pints of water it readily dissolves, yielding a somewhat sweet but agreeably tasting fluid, having a flavor of boiled milk. It consists of nothing but cows' milk and the best white sugar, and is well adapted for use during long voyages and in all other situations where good cows' milk is not readily procurable. A sample of preserved milk prepared by the Anglo-Swiss Company, on analysis, yielded the following results:

Water	24.89
Fat (pure butter)	8.36
Caseine (curd)	10.15
(containing nitrogen)	(1.624)
Milk and cane-sugar	54.18
Mineral matter (ash)	2.42
	100.00

About one-half of the solid substances of the condensed milk consists of sugar added in the process of condensation. The remainder consists of butter, caseine, milk-sugar, and ash constituents. It is but right to state that the analyses of other samples of preserved milk, prepared by the Anglo-Swiss Company, show about ten per cent. of butter, and somewhat less water than was found in the sample analyzed In buying condensed milk, however, one should know that it is pure. It is chemical test alone which will solve this. The only other recourse is to buy only of respectable companies who have a reputation to lose. It should be labeled so as to show that it is whole milk, honestly condensed. In fact all commodities of sustenance should be branded just what they are, and, if found adulterated or subtracted from, heavy penalties should be attached. The following tables will show some interesting information in relation to condensed milk taken from the United States Department of Agriculture Report for 1872:

Components.	Pure milk.	Pure milk condensed.	Condensed milk, New York Co'y.
	pr.cent.	pr.cent.	pr.cent.
Butter	4.00	16.00	1.75
Caseine	4.00	16.00	15.80
Sugar	5.00	20.00	18.90
Salts	0.65	2.60	2.21
Water	86.35	45.40	61.34
	100.00	100.00	100.00

In the latter case there remained not more than one-eighth of the butter contained in the original milk, seven-eighths having been skimmed off and sold for cream. It is a notorious fact that most of the condensed milk companies regularly send cream to the New York market. It is added that analyses of samples of the plain condensed milk of several companies, presented by Dr. Chandler in May 1872, are as follows:

Components.	American.	Borden.	Rockland.	Eagle.	Condensed milk —standard.
	pr. cent.	pr.cent.	pr. cent.	pr. cent.	pr.cent.
Butter	13.74	11.39	11.67	11.77	13.12
Caseine	14.12	12.96	12.63	13.03	14.44
Sugar	17.24	14.12	13.89	14.38	16.30
Salts	2.64	2.30	2.24	2.36	2.60
Water	52.26	59.23	59.57	58.46	53.54
	100.00	100.00	100.00	100.00	100.00

Of the average adulteration of milk and its effect on prices, Dr. Chandler calculates, from long-continued investigation, that the milk supply of New York and Brooklyn receives, on an average, one quart of water to every three quarts of pure milk before the commodity reaches consumers. As the result of a large number of experiments with milk from different breeds, Dr. Sturtevant presents the following conclusions: The butter-globules of the milk show a certain and definite relation between the quality of the milk and the breed. The breed determines, to a large extent, the composition of the butter. The breed determines, to a large extent, the most economical and advantageous manufacture of cheese. In the Ayrshire and Jersey breeds he considered his experiments fairly complete; in the Dutch or Holstein breed, more limited. As to the characteristics of the milk of these different breeds, as indicated by his experiments, Dr. Sturtevant says: The milk-globule of the Jersey breed is larger than is the corresponding globule of the other breeds mentioned, and there are fewer globules under a certain size, one twenty-seven thousandth of an inch, and such, for convenience, I shall call granules. The milk-globule of the Ayrshire breed is smaller than that of the Jersey, and intermediate in size between those of the Jersey and Holstein, and the milk from individual cows of the Ayrshire breed can be grouped into two classes or grades, according to the size and distribution of the globules. This milk abounds in granules. The milk-globule of the Holstein is the smallest of the three. The globules are more uniform in their size than in the Ayrshire milk, and there are fewer granules. The globules determine some of the physical characteristics of the milk. If samples of the Jersey, Ayrshire and Dutch milk are placed in a percentage-glass, under like conditions, it will be noticed that the cream will rise in each sample with a different rapidity; the larger globules, on account of their less specific gravity, reaching the surface first. As a matter of experiment, some Jersey milk threw up its cream in four hours, leaving a blue skim-milk; some Ayrshire samples, in about ten hours, leaving a white skim-milk scarcely recognizable as such; some Dutch milk, in about five hours, leaving a blue skim-milk. The larger milk-globules, and few granules being in part the explanation of the first, the evenness of size of milk-globules and few granules the interpretation of the reaction of the third, and the numerous granules and unevenness of size of globule offering a solution for the appearance and action of the second sample. The milk of these breeds acts differently in the churn. The larger the globule, the quicker is the butter produced from the milk; and the more uniform the size of the globule, the larger the yield of butter from a given quantity of cream of equal richness by analysis. The globules of similar size appear to be evenly affected by the process of churning, and break at about the same time. This was well illustrated by an experiment made of churning a portion of milk from two cows separately, and weighing the produce. The amount of butter was largely in excess of that gained by churning the same quantity of the same milk mixed, and the microscope revealed the cause. A curious feature brought out by these experiments is, that the mixed milk from two breeds will not produce as much butter as will the same milk churned separately. The explanation is in the variation in the sizes of the globules. When a large-globuled milk and a small-globuled milk are churned together, the larger globules separate first into butter, and the breaking of the smaller globules appears to be retarded. When, therefore, a Jersey cow is kept in an Ayrshire or Dutch herd for the purpose of influencing the color of the butter, the large globules of the Jersey milk are broken first in the churn; and while the smaller globules are being broken, the butter which first came is being overchurned, and theoretically, at least, the quality of the result is impaired, if not the quantity lessened. When a few Ayrshire or Dutch cows are kept in a herd of Jerseys, and the milk churned together, both theoretically and practically a large portion of the butter of the small-globuled milk is left in the buttermilk in the state of globules. Dr. Sturtevant arranges the breeds in the order of the average size of the milk-globules, as follows: Jersey, Ayrshire, (butter family); Ayrshire, Holstein, or Dutch (cheese family). Likewise we can arrange the breeds in accordance with certain properties of the milk: the rapidity with which the cream rises—Jersey, Ayrshire, Dutch; the rapidity with which the cream churns—Jersey, Ayrshire, Dutch; the completeness with which the cream rises—Jersey, Dutch, Ayrshire; the value of the milk for cheese—Ayrshire, Dutch, Jersey; qualities desirable for the milk-retailer—Ayrshire, first; Dutch or Holstein, second; Jersey, third. In conclusion, the following, condensed from a statement by Mr. Gold, of Connecticut, will show the importance not only of keeping the cows healthy but also of exceptional cleanliness in the care of milk, from the time of milking through every stage of its manipulation. Cows differ almost as much in the quality of their milk as they do in their external form and appearance. The amount of the principal constituents, as caseine or curd, butter, oil, and sugar, can be easily ascertained and their variations marked, but there are more subtle qualities, giving rise to flavor and to its hygienic properties, which, while more difficult of determination, are of no less importance in a sanitary point of view and in the estimation of the customer. If the product varies so much when the animal is in health, how will it be when disease supervenes to form another important element in the calculation? Cows often continue to give a good flow of milk under local and constitutional disorders. The cow-pox, the fouls, garget, disturbances of the alimentary canal, foot and mouth disease, and pleuro-pneumonia, though interrupting, do not always prevent, the secretion of milk. The cow-pox, even in its mildest form, often causes the teats to crack and bleed, and the exudation may drop into the pail. Harsh handling of the udder in milking, or some slight injury, often causes one-quarter to give bloody milk; and garget, when it does not entirely stop the flow of milk, injures its quality in all degrees of vileness. All the secretions of an unhealthy animal must be tainted, and milk is no exception. Garlic and onions, and in some degree the cabbage family, to which the turnip belongs, give their peculiar odor to the milk. Weedy pastures abound in vegetation of strong odors and taste, liable to be transferred to the milk. Drink as well as food may introduce impurities. Out of 170 families supplied with milk from a dairy in Islington, England, seventy suffered from typhoid fever. One hundred and sixty-eight individual cases occurred in ten weeks, and thirty died. An investigation showed that the cows drank water from an old underground tank, built of wood and much decayed. Prof. Law, of Cornell University, relates a similar case where the milk had a ropy or slimy character, and a microscopic examination revealed the presence of certain animated germs, which had their rise in the filthy pool from which the cows drank. These entered into the secreted milk, and there multiplied to such a degree as to render it entirely unfit for food. Even impure air breathed by the cow will taint her milk. It is reported on good authority that the milk from a dairy in the State of New York when brought to the cheese factory was found tainted, and on examination the cause was discovered to be a putrid carcase lying in the pasture. Milk and cream set in the dairy are very susceptible to odors of every kind. The smoke of the kitchen, of cooking vegetables, are readily absorbed. The proximity of the hog-pen, or of the milking-yard, sometimes taints the milk. Wherever milk is kept, either in the spring-house or dairy, every pains should be taken to secure a pure atmosphere. When the milk is set in a kitchen, dust and smoke will affect it injuriously, and first-quality butter can not be made from it.

MILKING. The importance of regularity, care, and system in milking can not be overestimated. The quicker a cow is milked, the more completely will the milk be given down, and the ability to milk fast is only acquired by practice and an attention to the proper manner of obtaining the milk most easily. The act of milking is difficult to be described, and yet easy enough once the individual has been shown how. The teat should be grasped by the hand, the thumb and fore-finger should be first closed around the teat, and then the others in quick succession. Having squeezed it dry, raise the hand to the lower part of the udder, but without letting go entirely of the teat. It will almost instantly fill again, proceed as before, working each hand alternately, and so continue until the udder is stripped clean. When you begin to milk do not cease until you have milked the cow entirely clean. Slow milking not only needlessly worries the cow, and in the end dries her up, for if not taken as fast as it is given down it is apt in the end to be withheld. Milking should be done by grasping the teats diagonally, one forward and one hinder one. In stripping do not use the thumb and fore-finger pulling down. Every drop can be had by pressing the hand well up and under the bag, gathering the milk with the thumb and fore-finger, and pressing it out with the others.

MILKTREE, COWTREE. *Galactodendron dulce.* A tree of South America, of the same family as the fig (*Urticaceæ*). The sap obtained by tapping is like milk, and very palatable; it contains a creamy matter like beeswax, fibrin, sugar, an acid, salts, and water. Other trees also yield milk, as the *Clusia galactodendron* and the *Tabernæ Montana utilis.* The milky juice of most plants is acrid, and often very poisonous.

MILK VESSELS. In plants, the anastomosing tubes lying in the bark or near the surface of plants, in which a white, turbid fluid is secreted.

MILK-VETCH. *Astragalus.* This is an extensive genus of herbaceous and shrubby plants; many of the species are very handsome and well suited for the flower garden. There are four species indigenous to England.

MILKWORT. *Polygala.* All the species of this genus are very showy. The annual kinds require sowing in the open ground, preferring a peat soil. Some of the species possess useful medicinal qualities. A considerable number of the species are natives of the United States, among which the best known is the *P. senega,* or Seneca snakeroot.

MILLIPEDE. The centipede.

MILLET. *Sorghum, setaria* and *panicum,* are all popularly and botanically denominated millet. Under the head Sorghum, this important genus will be treated. In this article only the millets, Italian, (*Setaria Italica*), and German millet (*panicum miliaceum*) usually known as Hungarian grass, (*P. Germanicum*). The first used to be largely cultivated under the name of millet and Bengal grass, but it has lately given place to Hungarian grass. All farm stock take kindly to the hay made from Hungarian grass, but if the seeds are allowed to get ripe, it is supposed to bring on disorders of the kidneys, especially in horses. For this reason it should be fed rather sparingly to horses unless it has been cut when in bloom; cut at that time, we have never observed any evil effects from feeding the hay to horses. We have never, however, fed it except with full rations of oats, to working horses, and always cut it just as the blossoming season had past, at which time, any of the plants have their maximum of nourishment in the stalk and leaves. Fed to cattle it is an excellent forage, and if well cured will carry them nicely through the winter; two feeds a day and one feed of straw being given. In the absence of careful experiment to determine the precise effects it may have on stock, when fed steadily it would not be advisable to keep stock wholly on it.

MILL-STONE GRIT. A geological formation immediately under the coal; beds of coarse quartzose sandstone.

MILSEY. A sieve in which milk is strained.

MILVINES. A family of raptorial birds, of which the kite (*Milvus*) is a member.

MIMUS. The genus of passerine birds, of which the mocking-bird (*M. polyglottus*) is a species.

MINDERERUS SPIRIT. Solution of acetate of ammonia, a febrifuge.

MINERALOGY. The science which has for its object the examination and description of minerals.

MINIUM. Red-lead, used in painting.

MINT. (See Peppermint.)

MINUS. Less, distinguished by the mark—, and used in physics to designate quantities below a standard; thus, all degrees of temperature below zero (0) are minus, and read minus 50,—30, etc.

MIOCENE. The intermediate portion of the tertiary epoch, in which some seventeen per cent. of recent shells are discovered.

MIRAGE. *Fata Morgana.* Looming. An optical delusion, in which ships and objects at sea appear depicted against the clouds.

MIRROR. Any polished surface used as a reflector. Mirrors are plane, concave, or burning (magnifying), and convex, or minifying.

MISTLETOE. *Viscus album, verticillatum.* Shrubby, parasitical plants, growing occasionally on large trees. Many fabulous virtues were attributed to it.

MIST. That atmospheric condition in which the moisture of the air is condensed in fine drops (See Dew.)

MITE. A name generally applied to minute insects of various kinds, which attack the leaves of trees and plants, living by either burrowing under the epidermis, just as the mange insect does under the scurf skin of animals, and acari found on the outside of the leaves and tender shoots, subsisting by sucking the juices, which produces fungoid-like brown patches on the leaves of pear trees, and are so small as to be scarcely visible to the naked eye. They are sometimes found in myriads, as are all the louse family, and do great damage to various trees. The remedy is to use a wash of whale oil soap, weak carbolic acid, or in the case of such plants as may be small enough, (pot plants), to dip them in the solution by inverting the pot in which they grow. Fumigation with tobacco smoke is also a remedy. All infested leaves also should be picked off and burned. Mites as a class are wingless, belonging to the *acarii.* Those living on the outside of plants are called lice. Many minute insects that infest hams are dipterous (two-winged) insects in their perfect state. To this latter class the cheese mites belong, others are minute wood borers, the larvæ of minute beetles. They however, are not properly called mites, since only those we have named may properly be so called.

MITRAL VALVES. The valves of the left ventricle of the heart.

MITRE. In building, the junction of two pieces of wood, etc., by cross fitting.

MOBILITY. Capacity for movement, mobile.

MOCKING BIRD. (See Mimus.)

MODILLON. An ornament, or scroll, placed at intervals under the corona.

MOHAIR. The silky hair of the Angora goat, used for camlets and other costly stuffs.

MOISTURE. The water of all lakes, ponds, rivers, brooks, and springs, is derived from rain. This is the evaporation from the whole surface of the earth, whether land or water. This is held in suspension by the air, until changed meteorological conditions set it free, either as dew or frost, or as rain, hail, or snow. This moisture, some of it, runs off along the surface, some sinks down indefinitely to form springs. These two forms being the supply of lakes, ponds, and streams, the balance is held by the soil, to be given up to the roots of plants, to rise again by capillary attraction to the surface, and again to be given off to the air as evaporated moisture. The moisture which runs off along the surface and that which enters into the soil by percolation will vary according to the nature of the soil. Loose soils will percolate all the water except those of the most dashing showers, where the angle of elevation is not acute. Water will always sink down perpendicularly, unless it meets with obstructions as rocks, strata of clay or other impervious substances. These impervious strata form the water line along which the water glides, at last to be collected in underground reservoirs forming springs. (See articles, Drainage, Meteorology, Rain-fall, etc.)

MOLARS, MOLARES. The grinding teeth, placed behind the incisors.

MOLASSE. A soft, green sandstone, of the miocene epoch, found in Switzerland,

MOLASSES. The thick, dark fluid which runs from raw sugar; it consists of uncrystallizable sugar, an acid, aromatic bodies, and water; when fermented, it yields rum by distillation.

MOLD. Mold is produced by fungus growths. The sporules producing mold being everywhere present in the air, and only requiring warmth and moisture to enable them to grow, wherever deposited. Bread mold, is a minute fungus, *Ascophora mucedo*, found on moist, starchy substances, in the process of decay. These minute cryptogamous plants are found in almost every substance, in the presence of heat and moisture, especially peas, hops, and other plants. Once it attacks it spreads rapidly, unless checked by dryness. Hence blight is the result of the action of mold, and not the disease itself; rather the action causing disability in the plant to perform its natural functions, and sometimes whole fields will be suddenly attacked, and the crop be ruined.

MOLD-BOARD. The large curved side of a plow, which turns the furrow slice.

MOLDINESS, MOLD, MILDEW. Minute cryptogamic plants, of a grayish aspect usually, but of all colors, which appear upon damp linen, cotton, and vegetable substances, as bread; they belong to the genera *Aspergillus mucor*, and other mucedines, and are to be avoided only by dryness and proper exposure to the sun and dry air. The genera which appear on plants, as the hop, pea, etc., are very numerous.

MOLE. The moles of America belong to the genus *Scalops*, and not to the true moles, *Talpa*, found in Europe. The ground mole, *Scalops aquaticus*, is found in the Eastern and Southern States. The Western mole, *S. argentea*, being found in Indiana, Michigan, Illinois, Iowa, Missouri, and Kentucky, and in fact in the valley of the Mississippi nearly to the gulf, being always found in dry land. The fore parts of this animal is strong and muscular, its fore hand-like paws, extending side ways, the more readily to enable it to make its way under ground, in excavating its galleries, in search of its food, which is entirely insectivorous. They have been accused of eating vegetable roots and tubers. This, however, is a mistake. It certainly often does much damage to garden crops, by loosening the earth and uprooting plants in burrowing. The only question for the farmer to decide, is whether the moles or insects do most mischief. We have seen lawns rendered unsightly by moles. So we have seen the grass entirely killed by the ravages of the larva, (white grub,) of the May beetle. A little labor will eradicate the burrows of the mole, but it is difficult to destroy the white grub, especially where they are so thick as to so entirely destroy the sod, that it may be rolled up like a carpet. It is undoubtedly true that shrew mice and other small rodents, follow in the tracks of moles, and eat corn, tubers and other vegetables, but there is no well authenticated evidence that the mole does so. When moles become so numerous as to be severely destructive, they may be trapped by sinking pitfalls of tile or other material under their run-ways, or they may be caught under deadfalls. These should be placed under one of their regular galleries, leading to their place of rest if possible, since it is not always that they travel in the surface burrows. They may also be poisoned by placing strychnine in small pieces of meat and laid in their burrows. The Star nosed mole, *condylura cristata*, is another species, and quite rare, except in some portions of Central Illinois, where it is rather common. It inhabits all the Eastern and Northern States to the Mississippi, and is found even in Minnesota. It prefers rather moist soils, and is found in the vicinity of swamps. It does not burrow to such great length as the species previously described, and is not so strong. Its fore feet are longer and narrower than the common ground mole, and the tail is longer and larger. It may readily be known by its ciliated nose, from whence its name.

MOLECULE. An atom not capable of mechanical subdivision. The minute atoms of which bodies are formed. Of organic molecules, the late Prof. Henry said, we are able to construct a crystal of alum, from its elements, by combining sulphur, oxygen, hydrogen, potassium and aluminum; but the chemist has not yet been found who could make an atom of sugar from the elements of which it is composed. He can readily decompose it into its constituents, but it is impossible to arrange the atoms artificially, as in the ordinary cases of chemical manipulation, to produce a substance in any respect similar to sugar. When the attempt is made the atoms arrange themselves spontaneously into a greater number of simpler and smaller groups or molecules of high order, each containing no less than thirty-four atoms of carbon, oxygen, and hydrogen. For the building up of organic molecules, the vital principle must come into play upon inferior groups of simple elements. Thus are formed plants, trees, insects, fishes, and sentient animals; in fact everything which has life. Atoms, once formed, may be combined and re-combined in the laboratory of the chemist, and new compounds arranged out of them. Organic bodies formed of organic molecules, are greatly complex, and readily distributed and resolved into a greater number of lesser groups. Thus taking the constituents of cane sugar, Prof. Henry shows that organic bodies, are in what may be called a state of power, or of tottering equilibrium, like a stone poised on a pillar, which the slightest jar will overturn; they are ready to rush into closer union with the least disturbing force. In this simple fact is the explanation of the whole phenomena of fermentation, and of the effect produced by yeast and other bodies, which, being themselves in a state of change, overturn the unstable equilibrium of the organic molecules, and resolve them into other and more stable compounds. Fermentation, then, simply consists in the running down from one stage to another of organic molecules, changing their constitution, and at last arriving at a neutral state. There is, however, one fact in connection with the running down of the organic molecules which deserves particular attention, namely, that it must always be accompanied with the exhibition of power or energy, with a disturbance of the ethereal equilibrium in the form of heat, sometimes even of light, or perhaps of the chemical force, or of that of the nervous energy, in whatever form of motion the latter may consist. It is a general truth of the highest importance in the study of the phenomena of Nature, that whenever two atoms enter into more intimate union, heat, or some form of motive power, is always generated. It may, however, be again immediately expended in effecting a change in the surrounding matter, or it may be exhibited in the form of one of the radient emanations.

MOLE-PLOW. A plow provided with a deep, sharp foot beneath the sole to penetrate the earth. (See Draining.)

MOLE-TREE. *Euphorbia lathyrus.* Commonly called Caper Spurge, and, by the French, Epurge; a plant with a biennial root; stem two to three feet high; found in the United States in gardens and lots. It is a naturalized foreigner, and was originally introduced under a notion that it afforded protection against the cursions of moles.

MOLLITES. A disease of the bones, hoofs, etc., in which they become soft, and often flexible.

MOLLUSKS, MOLLUSCA. The animals inhabiting shells, and those of similar conformation, but without that covering; they are of low organization, and cold blooded.

MOLTING. Change of plumage. It takes place annually for the entire plumage, and also partially where feathers of new colors are produced.

MOMENT, MOMENTUM. The availing force of a moving body at any time; its velocity multiplied into its weight.

MONADELPHOUS, MONADELPHIA. Flowers in which the stamens are united into one mass by their filaments.

MONANDROUS, MONANDRIA. Plants or flowers having one stamen only.

MONAS, plural **MONADS.** A genus of extremely minute, simple, polygastric, infusiorials.

MONILFORM. Resembling a string of beads.

MONKSHOOD. *Aconitum napellus.* Wolfsbane, aconite. Handsome perennial-rooted plants, with large blue flowers, very poisonous and narcotic.

MONO. An affix to many compound words.

MONOCHROMATIC. Having but one color, incapable of decomposition by the prism.

MONOCHLAMYDEÆ, MONOCHLAMYDEOUS. All flowers with only one envelope, or perianth, as the tulip, lily. Those furnished with a calyx also, are called diclamydeous.

MONOCOTYLEDONS, MONOCOTYLEDONIA. Endogens. Plants and trees, the seeds of which have but one lobe, as grasses and palms.

MONŒCIA. Plants which bear pistillate and staminate flowers, perfectly distinct, but on the same stem, as Indian corn.

MONOGYNIA. Flowers with one pistil.

MONOMERANS. A section of the coleopterous insects, in which the tarsus is supposed to be formed of a single joint.

MONOPETALOUS. A corolla, the petals of which cohere into a tube: synpetalous, gamopetalous.

MONOPHYLLUS, MONOSEPALOUS. A calyx with the sepals united. *Monosepalous* is used to indicate the same form.

MONSOONS. The periodical trade winds of the Indian ocean.

MONSTROUS PLANTS, MONSTROSITY. Plants which, by cultivation or otherwise, have become changed from their original forms.

MONTANT. In building, any upright piece in framing.

MOON BLINDNESS. (See Eyes, Inflammation of.)

MOONSTONE. *Adularia.* Semitransparent feldspar.

MOON TREFOIL. *Medicago arborea.* A species of medick.

MOONWORT. *Botrychium.* A genus of indigenous, unimportant ferns.

MOOR-BAND PAN. The incrustation produced in some ferruginous soils. The pan may be calcareous in limestone soils, and when not very hard can be destroyed by the subsoil plow.

MOOR GRASS. *Sesleria dactyloides.*

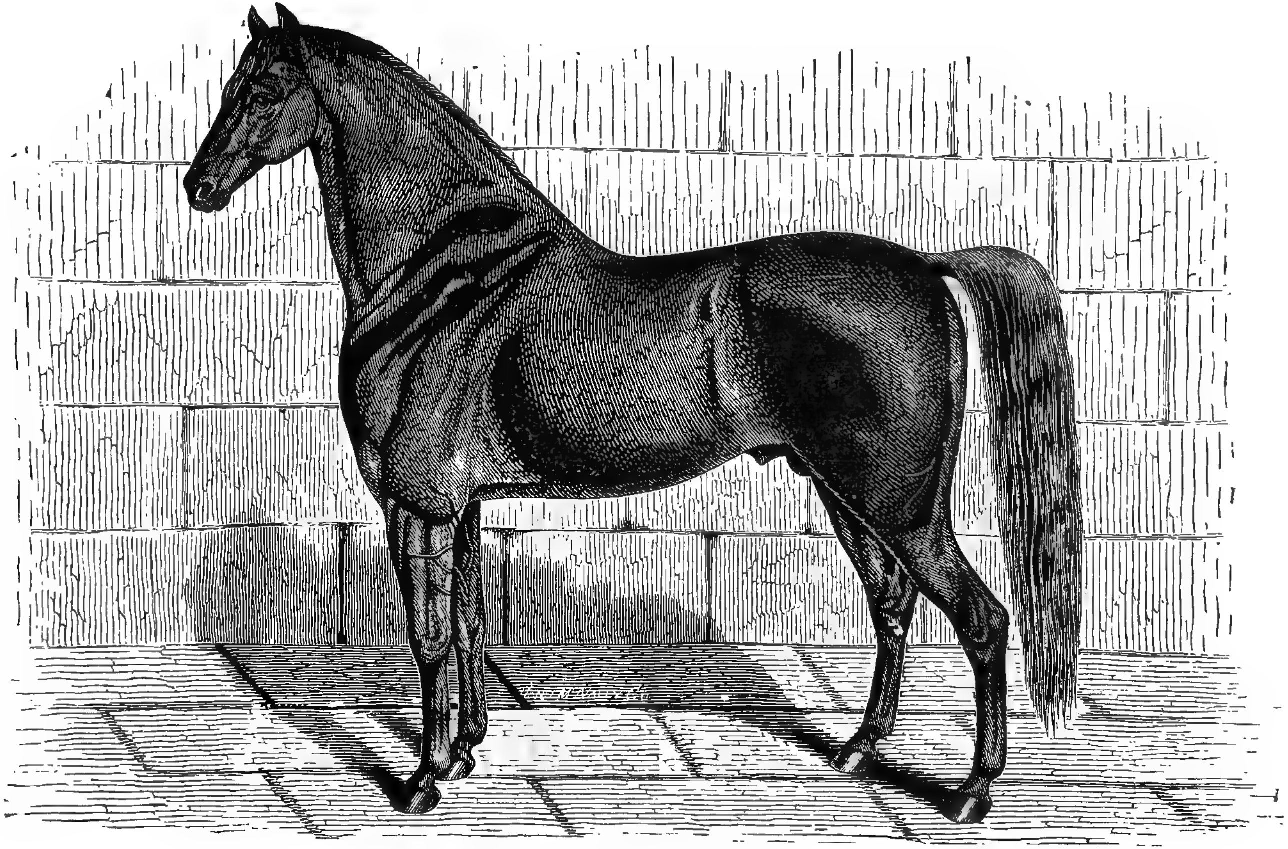
MOOSE. *Alce.* The largest of the deer genus. They live in troops in swampy places, and are confined to the northern portions of the States, and to Canada. The American moose is, *A. Americanus;* the European species is, *A. Malchis.*

MOOSE ELM. The red elm.

MOOSE WOOD. *Acer striatum.* The striped maple. This term is also applied to the *Dirca palustris*, or leather wood.

MORAINE. The longitudinal masses of stones and rubbish found at the bases and along the edges of great glaciers, or in places where they have existed.

MORASS. Swampy land.



BLACK HAWK (MORGAN).

MORDANT. A substance which unites chemically with the fiber of wool, cotton, etc., and with the coloring matter also, forming with both insoluble compounds. Acetate of alumina, alum, solution of tin, and pyrolignite of iron (red liquor) are important mordants.

MORDELLA. A genus of coleopterans, now the type of a family, *Mordellidæ*. They are heteromerans, with an elevated and arched body, low head, thorax, semicircular, or trapezoid, elytra very short, pointed at the tips.

MOREL. *Morchella esculenta.* The latticed mushroom. An edible mushroom much esteemed in Europe. It grows in woods, has a wide, hollow stalk two inches high, with a yellowish or grayish ribbed head, of small width, and two or three inches deep.

MORGAN HORSES. The Morgan horse, which probably owes its principal celebrity to the Black Hawk strain (see cut), and his descendants have years since passed the zenith of their popularity. Admirable as these horses were for light driving, their small size and light weight was against them, and in speed, except in rare instances, they could not compete with the descendants of Messenger and other first-class thoroughbred trotting sires. For draft teams they were found not to be of value for the reason heretofore assigned, the want of size. The stock was widely disseminated especially, in the Northwest, and while they added style and vigor to the common stock of the country, the decrease in the size of the get has rendered undersized horses much more common than formerly. Farmers were not slow to see this, and hence they were in as much haste to get rid of the blood as they were in the first place to breed to it. It is perhaps to be regretted that more of this stock could not have been kept pure, since their ambition, handsome form, docility, courage, and great style would have made them most acceptable horses, for pony phætons, for ladies and children and light driving on the road. The animal from which sprung the Morgan horses, is pretty generally conceded to have been the horse Justin Morgan, so named from the gentleman who bought him at two years old in 1795. He is recorded to have been foaled in 1793, and to have been sired by True Britain, who was sired by imported Traveler. The dam of the Justin Morgan horse is reported to have been a Wildair mare, sired by Diamond, and he by Wildair. The horse Justin Morgan was a dark bay, with black mane and tail, and without white hairs; he was about fourteen hands high, weighing about 950 pounds, and with coarse, heavy, but straight mane and tail, docile, obedient, spirited, and a fleet runner at short distances. He was not a fast trotter but an honest one, going in four minutes to the mile easily, and as honest at a dead pull as he was exhaustless on the road. The most noted of his descendants were Black Hawk, though all of his get seem to have been imbued with wonderful stamina, spirit, and beauty of form.

MORNING GLORY. A convolvulus of which there are many species, chiefly twiners. Annuals, biennials, and perennials. *Convolvulus major* is the well known morning glory, climbing plants of various brilliant colors, and effective for covering trellises, rock work, etc. *C. tricolor* is the dwarf morning glory, more or less trailing in habit, though some are of upright growth as *C. Mircaulis. C. Mauritanicus* is fine for hanging baskets and vases. Of the convolvulus family, the *Ipomeas* are a superb class of twining plants. The Cypress vine, *I. quamoclit* is well known. *Bona nox* expands in the evening. A curious variety, *leptophylla*, from Colorado, has an immense bulb, which is perennial, the stems being annual.

MOROXYLIC ACID. An acid found in the bark of the white mulberry tree.

MORPHIA. The active narcotic principle of opium.

MORPHOLOGY. The doctrine of the metamorphosis of plants, from which it appears that petals, stamens, and carpels are merely modified leaves; that their position and mode of development are similar to that of leaves. A seed is also analogous to a leaf bud.

MORTIFICATION. Gangrene; the death of part of the body. When it occurs in the limbs, a distinct line of separation of a red color may be seen between the mortified and living parts; the limb should be removed as soon as possible above the healthy part. Mortification of internal organs, when extensive, is necessarily fatal; when it comes on there is great loss of strength, freedom from pain, usually a disagreeable or gangrenous odor, delirium, cold sweats, and death. The lungs are most subject to gangrene, as a consequence of inflammation. Sloughs and sphacelus are small portions of gangrenous flesh removed from wounds.

MORTISE. The union of two pieces of wood or other substance, by introducing one into a hole made in the other; the former is called the tenon.

MORUS. The generic name of the mulberry.

MOSSES. In common language, are any minute, small-leaved, cryptogamic plants. Thus club-moss is a lycopodium; Iceland and reindeer mosses are lichens; and the numerous species of Jungermannia are all comprehended under the same term. But in systematic botany no plants are considered mosses except such as belong to the natural order, *Bryaceæ* or *Musci.* Such plants are simple-leaved; without spiral vessels or stomata; with a distinct axis of growth; and with the sporules, or reproductive matter enclosed in cases called sporangia or thecæ, covered by a cap or calyptra. It is not a little singular that such plants should have cases called staminidia, containing powdery matter; among which are found animalcules, not distinguishable from such as are called spermatic, and which swim about freely in water. None of the mosses are of any known use, except for the purpose of packing plants, and surrounding their roots when they are sent to a distance. They are bad conductors of heat, and might be employed, instead of straw, to guard delicate-growing plants from the influence of frost.

MOTH. The common understanding of the word moth, is the larva of a class of insects, *Tineæ*, which destroy clothing, carpets and various fabrics. The term, however, now includes entomologically, the genus *crambidæ*, in which the bee or wax moth is placed. The word is also used to designate the perfect insect of those caterpillars, which are hairy, (downy) and fly by night. The various species are all noxious and however brilliant the perfect insect may be they should be destroyed wherever found.

MOTHER-WATER. In chemistry, the solution from which crystals have been obtained, and which furnish a second supply when evaporated.

MOTION. In mechanical philosophy, motion is the change of place; that is, of the part of space which the body occupies, or in which it is extended. Motion is real or absolute when the moving body changes its place in absolute space; it is relative when the body changes its place only with relation to surrounding bodies; and it is apparent when the body changes its situation with respect to other bodies that appear to us to be at rest. All the phenomena of motion are derived by mathematical deductions from the three following laws of motion of Newton: A body must continue forever in a state of rest, or of uniform motion in a straight line, if it be not disturbed by the action of an external cause. Every change of motion produced by any external force is proportional to the force impressed, and in the direction of the straight line in which the force acts. Action and reaction are equal, and in contrary directions; that is, equal and contrary changes of motion are produced on bodies which mutually act on each other.

MOTTLED. *Maculatus.* Stained with colored blotches or dots.

MOULDING. The curved or straight lines, or fillets used in architecture, as decorations or members of the common orders.

MOUNTAIN ASH. (See Apple.)

MOUNTAIN LAUREL. *Kalmia latifolia.* A handsome shrub; the flowers are poisonous. It sometimes grows fifteen or twenty feet high.

MOUNTAIN LIMESTONE. The strata of this material lies immediately below the coal measures.

MOUNTAIN MAHOGANY. *Betula lenta.* The black birch.

MOUNTAIN MAPLE. (See Maple.)

MOUNTAIN RICE. *Oryzopsis asperifolia.* A perennial; culm almost naked, leaves rigid, erect, and sharp at the point; flowers in a panicle.

MOW-BURNED. Injured by fermentation in the mow. Fodder, when too green, heats rapidly, becomes black, and acquires a bituminous taste; this is disagreeable, and sometimes injurious to cattle.

MUCID ACID. An acid produced by the action of nitric acid on gum and sugar of milk. It is a white crystalline powder, feebly acid, soluble in six parts boiling water, and insoluble in alcohol.

MUCILAGE. A thick solution of gum in water. The ropy fluids extracted from certain plants by pressure are also called mucilage.

MUCIVORA. A family of dipterous insects, which feed on the juices of plants and decaying matter.

MUCK. A name for peat, marsh mud, and decaying vegetable matter generally.

MUCOUS MEMBRANE. The membrane which lines the mouth, nostrils, exterior of the eyes, lungs, stomach, intestines, bladder, and, urinary apparatus. It secretes an animal fluid, mucus, by which it is moistened and protected from the contact of air and other substances. Irritations and inflammations are very common, and do not extend so rapidly as in other membranes. They are usually subdued by bleeding, cathartics, or special medicines when the lungs or urinary membrane is attacked.

MUCRONATE. In botany, a leaf or other organ, having a rounded extremity, tipped with a sharp point or prickle.

MUCUS. The viscid, ropy secretion of the mucous membrane. It contains five per cent. solid matter (albumen), and is azotized.

MUD. The fine particles of earth and organic matters suspended in rivers, etc., and deposited by subsidence. When mellowed by exposure to frost, and composted with one bushel of lime to the cubic yard, it makes a good amendment to loose, thin soils destitute of humus.

MUD FEVER. Scratches. (See Grease.)

MUDER. *Calotropis gigantea.* An asclepiadeous plant, used in scrofula in the East.

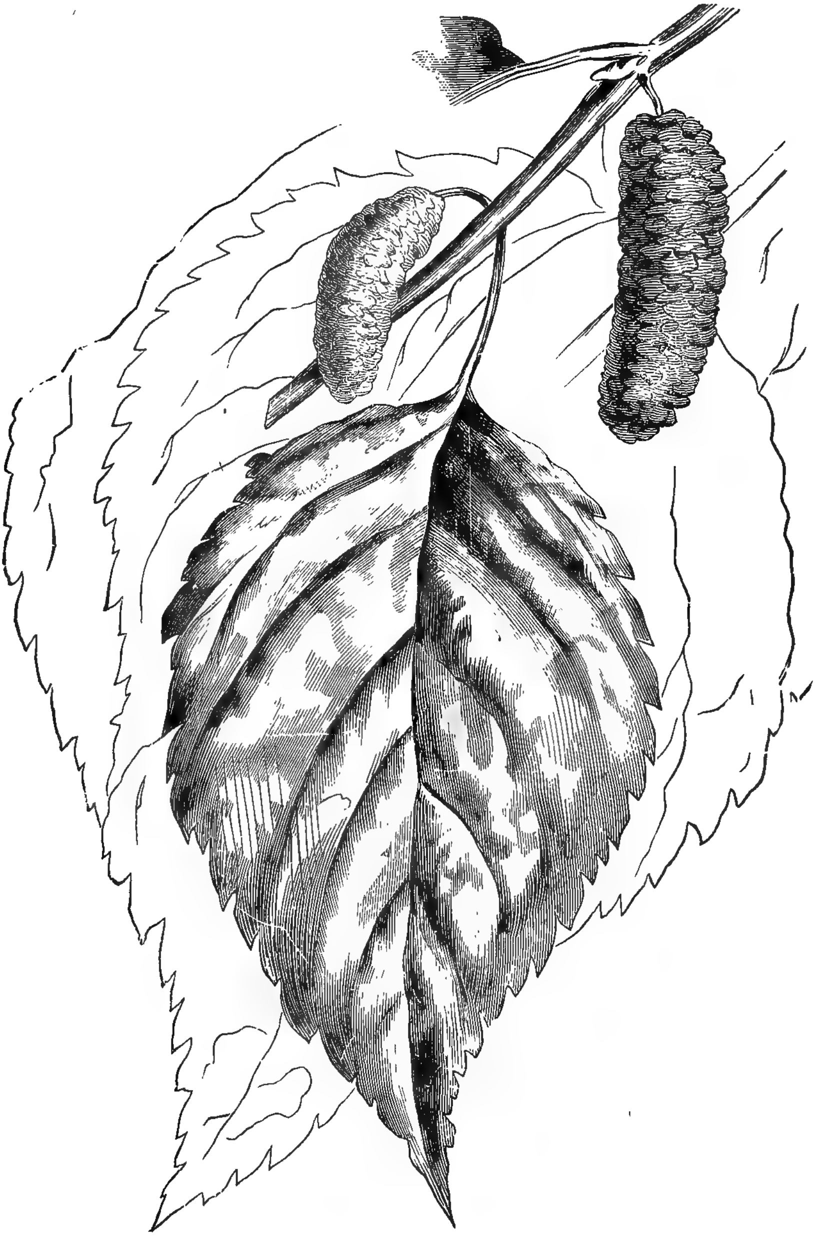
MUFFLE. A semi-cylindrical vessel of earthen-ware, capable of resisting a high temperature, in which crucibles are placed in assaying, and by which means they are exposed to a great heat without coming in contact with the fuel. The upper, curved side, is usually cut into slits, to allow the passage of reflected heat.

MUGWORT. *Artemisia vulgaris.* A kind of wormwood.

MULBERRY. *Morus.* The red mulberry, *Morus rubra*, is the only native species of the mulberry in the United States. The black mulberry of Europe is occasionally cultivated for its fruit. The white mulberry, *M. alba*, is cultivated in silk growing regions for feeding silk worms, and the paper mulberry, *Broussonetia papyrifera*, is grown sparingly as a shade tree. Our native mulberry delights in rich, moist, bottom lands, where we have seen it, in Illinois, two feet through. Usually the tree is only of moderate size. The timber is most lasting and valuable, almost rivaling live oak in durability. As a shade tree and for ornamental planting the native mulberry is not desirable, except in extensive grounds. Grown singly, it is a spreading tree. It is liable to the attacks of but few insects, the wood is valuable for turning and carving, and the bark is sometimes used in the place of cordage, after having been first steeped in water to separate the fibers. The bark of the root is reported to be a cathartic and vermifuge. The mulberry is propagated either by seeds or from cuttings; the cuttings grow easily, and where a given variety is wanted, cuttings must be resorted to, since plants do not come true from seed. There are a number of sub-varieties in cultivation, bearing superior fruit. The fruit, however, is not held in much estimation, except by children, and if it were, it is entirely too soft for shipping. An exception, however, should be made in respect to Downing's everbearing mulberry; a cut of leaves and fruit, which we give, natural size, on page 54. The fruit is one to one and a half inches in length and from one-half to five-eighths of an inch in diameter, and under high cultivation will exceed this size. Color, purplish black, and of a rich sub-acid taste. The tree is hardy, vigorous and comes into bearing the third or fourth year after removal from the nursery, the fruit growing larger as the tree acquires age. The tree is elegant in itself, and seems quite worthy its distinguished originator, Mr. Charles Downing, of Newburg, N. Y. It is now thirty-six years since it was first originated.

MULBERRY CALCULUS. A stone of the bladder of the color and appearance of the mulberry fruit, and consisting of the oxalate of lime.

MULCH. Any dry litter placed about trees, or vines, covering the ground, is called mulching. The object of mulching is to keep the soil cool, moist, and free from weeds, and to protect the roots from freezing in winter. Hence the more porous the mulch the more valuable it becomes. Hence green grass, manure or tan bark, should be used sparingly. Two inches of tan bark is the most that should be applied. The best possible mulch is charcoal dust. This however is costly anywhere, and generally difficult to get. Mulching is beneficial to vines and small fruits if applied after a general rain, and after the season of cultivation has passed to remain during the winter and removed when the season of cultivation returns, for mulch is not expected to supersede cultivation, but to supplement it. So any garden vegetables may be mulched with profit after they have gained sufficient size so cultivation may cease. Even in the case of fruit trees we are not in favor of keeping the ground constantly covered with mulch, as has been



DOWNING'S EVERBEARING MULBERRY.

advocated by some. It induces root growth at the surface of the ground if persisted in, and this will be detrimental to the tree when the final removal of the mulch is decided on. In winter mulching, especially of trees, the mulch should not be placed next the stem, since it induces the attacks of mice.

MULE. A mule is a hybrid between two species of the same genus. Thus, there may be as many varieties of mules as there are species that are fertile one with another (See article Hybrid.) By common consent however, the term mule is understood to be the product of the male ass and the female horse. The mule is a very timid animal and there is no stock on the farm that requires such careful handling. If properly treated, they are gentle and perfectly safe. If abused they soon become vicious and learn to use their heels. In the raising of mules it is not so usual to halter break them at weaning time or before as it is with colts. We have, however, always done this, since when the mule is finally taken up for work at two years old, they may be considered half broken. In fact it is generally the case, that if kindly handled, the young mule will go right along, rather awkwardly it is true, but nevertheless, steadily, the first time they are put to the wagon. Until the mule is three years old, it should not have anything but light work. Thus they will be more active than if allowed to go until three years old before being broken; besides this they will not be so strong and difficult to handle. In handling the young mule either to halter break or to labor, care must be taken that it does not get away since if so it will never be forgotten. The same general rules may be followed as advised for the horse, which see, but, the mule will be more quiet and more easily approached to handle, if a a horse or broken mule, with which it is acquainted, be present. Even another unbroken mule will tend to inspire confidence. Mules are particularly sensitive to cold, far more so than horses. On the other hand they are far less affected by heat than horses. Thus mules, whether the young and growing or the working mules must have warm stabling in winter. In the South the protection of a good wood lot is by some considered as sufficient, the best masters, however, provide warm sheds in addition. From the time the young mule is dropped until ready for work, it must be liberally fed, so it may be kept growing. There is nothing gained in allowing any farm stock to suffer for want of sufficient food. It is especially the case with mules. A mule that has been half starved and frozen during the winter, never recovers. It may indeed get flesh, but, will never be of the same stamina as the mule kept warm and well fed, besides, this extra feed enables the mule to go to work a year sooner than it otherwise would. A good lively two-year old mule will bring more than a stupid three-year old. South of 40° for all kinds of farm work and teaming on the road, mules are fully equal to horses. They are not so liable to scare, [illegible] if so, not so much inclined to run away. They stand the sun and heat better than horses, and require rather less care in cleaning. We have never found, that weight for weight, the mule would eat less than the horse. Their true value lies in being able to work hard in the hottest weather, which the horse can not. North of 40° the mule becomes less and less valuable, until north of forty-three degrees, the horse is the most serviceable and generally used. When they have warm stables in winter, they make admirable teams, even in the climate of Minnesota, since even so far north, in the West, there is plenty of summer weather that will seriously distress the horse. The proper color for a mule so far as service is concerned, is a self, dark color; cream colored mules, especially if they have a white skin, are soft and unserviceable. So, pure white mules are objectionable both in color and stamina. Spotted or calico mules, and light dapples are said to be always washy. Iron-gray, duns, and bays are the best colors, and mare mules are considered more hardy and trustful than horse mules and always bring a better price in the market. To those who have the facilities for breeding and rearing mules it is a particularly lucrative business. They will sell for more money at two years old, merely halter broken, than the average horse will at three, after being broken. The late and increasing demand for mules for export to Europe, has given a fresh impetus to the trade. St. Louis is the principal mule market in the United States. Buyers visit the farmers in the mule breeding districts, central Indiana, and Illinois and southeast of the Mississippi River, and southern Iowa and all of Missouri west of the river. Compared with horses there were in the United States in 1877, 1,443,500 mules, valued at $99,480,976, or an average of $68.91; of horses there were 10,155,400, valued at $610,206,631, or an average of $60.08, making a difference in favor of mules each of $8 83. This is an important showing as to value, when we remember the slight variation in the price of mules, in comparison with that of horses, and shows conclusively, that the profit lies in breeding mules rather than common horses, whenever the climate is suited to mules.

MULLEIN. *Verbascum.* The common mullein, *V. Thapsus*, is fortunately not common in the West, seeming, like the Canada thistle, to delight in dry soils. Wherever found it is generally on very dry or poor, sandy lands. It is a biennial plant with woolly, entire, and alternate leaves throwing up its flower spike the second year from seed. It is usually indicative of worn or poor soil; perhaps one reason why it is not more found in the West, the fertile soil not being congenial to the plant. *V. Blattaria* or the moth mullein and *V. Lychnitis*, are also common in some localities, but are not considered so common as the common variety.

MULLION. The upright post or bar dividing two lights in a window.

MULTIARTICULATE. A term applied in natural history, to the antennæ, legs, etc., of animals or insects which have many joints.

MULTIFID. Divided into many segments.

MULTILOCULAR. Having many compartments or chambers.

MURIATE. (See Chlorine)

MURICATE. Thorny. In zoology, a surface armed with short conical eminences, having a sharp apex.

MURIDÆ. A family of rodents, of which the mouse is a type.

MURRAIN. A disease, one of the forms of Anthrax, (which see). Bloody murrain is malignant anthrax, sometimes called black quarter from the engorgement of the neck, shoulder, quarter, breast, or side of the animal, producing a black and bloody appearance of the tissues in the latter stages of the disease. There will be lameness, stiffness, and great tenderness of the affected limb, with crackling when pressed, swelling of the parts, and sometimes oozing of yellow or bloody serum from the skin. Black tongue is another form, both in horses and cattle, with black, purple, or red blisters on the tongue, ending in sores, with more or less swelling. Murrain attacks all the herbivora, and may be communicated, in its malignant forms, to dogs, birds, and even man, taking the form in man of a malignant pustule, sometimes very fatal. As soon as murrain attacks a herd, remove all the well animals to a high, dry pasture, and the ailing ones to another entirely isolated. Above all let the water be pure. Put a seton in the breast, daily smeared with irritant ointment. As medicine, the following is recommended by the best English surgeons, especially by Youatt, than whom there is no better authority: Take two to four drachms chloride of lime, one ounce prepared chalk, two drachms laudanum, mix and give every two or three hours in warm gruel. In severe cases, French veterinarians recommend quinine in one to two drachm doses every two or three hours. Stimulants, as carbonate of ammonia, are also valuable. If a veterinary surgeon can be had, he would be likely to use hypodermic injections of two grains solution of iodine, five grains iodide of potassium, one ounce water, using a syringe full every hour, in extreme cases throwing it directly into the vein.

MUSACEÆ. A small family of tropical plants, resembling the marantaceæ, and including the plantain (*Musa sapientum*) and banana (*M. paradisiaca.*) The leaves are also used for thatch, and the fibers of the stem for cordage. The curious flowering plants called strelitzias are of this family.

MUSCICAPA. A genus of dentirostral passerine birds; living on insects and small birds.

MUSCIDÆ. A family of dipterous insects, resembling the fly (*musca.*)

MUSHROOM. Mushooms are eaten by every civilized nation, when fresh, forming a delicate and palatable food. The difficulty in obtaining non-poisonous kinds, and the distressing and sometimes fatal effects of eating poisonous fungi deter many persons from using them at all. Nevertheless, a person may soon come to be able to determine between the poisonous and non-poisonous kinds. Prof. Peck, the New York State botanist, gathered eighty species there and Dr. Curtis, of North Carolina, has tested a list which we give further on. A species of morel, a peculiar, round, pock-marked fungus, is found growing under oak trees in northern Indiana and other oak openings in the West. The genus *Agaricus*, however, is the species generally cultivated. Mushrooms are propagated from spawn, sold in the form of bricks, and made as follows: A quantity of fresh horse-dung, mixed with short litter, is composted with one-third part of cow-dung, and a small portion of good loam. This compost is cut up into bricks, which are to be set on edge, and frequently turned, until they become half dry. Then a couple of holes are to be made in each, by means of the dibble, and in each hole is to be put a piece of spawn as large as a walnut. When the bricks are dry, they must be piled upon a layer of dry horse-dung, six inches thick, and covered with sufficient fresh dung to produce a gentle heat through the whole. As soon as the spawn has spread itself through the bricks, the process is ended, and they may be stored in a dry place, where they will preserve their vegetative powers for many years. Beds for the culture of mushrooms are constructed in several different ways. Sometimes they are in the open air, when they require a covering of boards to prevent injury from cold or wet weather; at other times, in boxes or baskets, in pits or frames, in sheds or moderately warm cellars; and again, in mushroom houses. The latter are decidedly the best, when the necessary expense may be justified. They are sheds built in a dry place, ten feet wide, and of any length desired. A walk runs through the center, so as to accommodate a bed on each side of four feet in width. In the first place, it is necessary to procure a sufficient quantity of good horse dung, and make it up into a heap, which must be turned frequently to induce regular fermentation. In a fortnight all the rankness will probably have escaped, when it will be time to build the bed. The dung should be well shaken by the fork, and built up with perpendicular sides to the height of twelve inches, and then gradually drawn to the center like the roof of a building. In a mushroom house, the beds should be three feet high on the back side, sloping toward the walk. Every forkful is to be well beaten into its place, so that the sides of the bed be even and firm. Cover the dung with long straw or litter, in order to exclude frost and prevent the escape of the volatile gases. In the course of ten days, or a fortnight, the temperature will be sufficiently reduced, and the covering is to be removed in order that one inch of fine loam may be laid upon the dung. On this plant the spawn, which has been broken into pieces of the size of a walnut, in rows six inches apart each way. Put on a second inch of mold, which, after being beaten smooth by the spade, must be protected by the covering of straw. Where the bed is in the open air, it will need mats during stormy weather. Guard against the extremes of heat and cold, and of drought and moisture. A medium temperature is probably somewhere about 60° The covering of straw must vary in thickness from three to twenty-four inches, according to circumstances. When the mold appears too dry, a gentle application of tepid water should be given in the morning; in summer, this may be necessary every other day, but in winter perhaps once a month. After each watering, the covering ought not to be replaced for some fifty or sixty minutes. If the operation be successful, young mushrooms may be expected in about five or six weeks after the date of spawning, although from a variety of causes, the time is frequently much longer. Where the bed has been kept too hot and moist, the spawn may have been destroyed; but, in many cases, it requires only a little extra warmth, or a gentle sprinkling of water to produce a generous crop. In gathering mushrooms, after the straw has been removed, each one is drawn up by a gentle twist of the fingers, and the hole is then filled with earth. A knife ought never to be employed, because the stumps left in the ground become nurseries of maggots, which prove very destructive to the succeeding growth.

Mr. William Saunders, of Washington, D. C., remarks on the mushroom, *Agaricus*, as follows, and describes the variety generally cultivated. The *Agaricus campestris*, or common mushroom, is the only species that is generally grown artificially. It is thus botanically described; Stipes, (or stalk,) two or three inches in length, white, solid, fleshy, furnished with an annular veil, (a thin membraneous substance encircling the stalk.) Pileus, (cap, or edible part.) fleshy, dry, convex, convexo-plane, white, changing from yellowish to brownish. Gills, (thin parallel plates, underside of the cap.) free, ventricose, (swelling unequally on one side,) pink, changing to deep purplish brown. Flesh (internal substance) white. There are several species of the *Agaricus* besides the preceding, and also a few varieties of the *A. campestris*, that are sometimes grown for the table. It is unnecessary to describe them here, as those who purchase spawn need be under little apprehension of receiving a spurious article; at least so far as my experience goes. I have never been disappointed in this respect. So far from there being any difficulty in growing them, I venture to say that not one in fifty who makes the attempt will fail. Of course some little attention is requisite, as with everything else artificially circumstanced. A knowledge of the condition under which they are most plentifully found in nature will be of material assistance to the grower. In very dry seasons, mushrooms are most plentiful in low situations, on rather strong soils; on the contrary, should there be much wet, they are more abundant in uplands and drier localities. A continuance of warm, dry weather, followed by slight showers, and a hazy, still atmosphere, brings them most profusely. These considerations are worthy of being kept in mind in their artificial culture. There is no particular season for making a mushroom-bed. In winter it requires to be under cover, and in summer the difficulty lies in keeping it cool and moist. Autumn is perhaps the best season for making a bed out of doors; and, if a constant supply be an object, a bed should be made up in some spare cellar about the beginning of November. Some varieties of edible fungi have been lately described by Dr. Curtis, which we give below; the italics refer to the generic name, and the Roman to the names of varieties:

Agaricus. (*Amanita.*) Cæsarius, strobiliformis, rubescens.
Armillaria. Melleus.
Boletus. Luteus, elegans, flavidus, collinitus, granulatus, bovinus, subtomentosus, edulis, versipellis, scaber, castaneus.
Cantharellus. Cibarius.
Clavaria. (*Ramaria.*) Flava, botrytis, fastigiata, muscoides, tetragona, cristata, rugosa, uliginea, macropus, subtilis, pyxidata, aurea, formosa.
Clitocybe. Nebularis, odorus, giganteus, cespitosus.
Clitopilus. Prunulus.
Collybia. Radicatus, esculentus.
Coprinus. Comatus, atramentarius.
Cortinarius. Infractus violaceus.
Cortinarius. Pholideus, cinnamomeus, castaneus.
Fistulina. Hepatica.
Hydnum. (1. *Mesopus.*) Imbricatum, subsquamosum, lævigatum, repandum, rufescens.
Hygrophorus. Chrysodon, eburneus, pratensis.
Lactarious. Torminosus, insulsus, piperatus, deliciosus, volemus, subdulcis,
Lepiota. Procerus, rachodes, excoriatus, mastoideus.
Marasmius. Oreades, scorodonius.
Merisma. Coralloides, caput-Medusæ.
Merisma. Frondosus, cristatus. confluens, giganteus, sulphureus, berkeleii.
Pholiota. Squarrosus, mutabilis.
Pleurotus. Ulmarious, tessulatus, Pometi, glandulosus, ostreatus, salignus.
Polyporus. (1. *Mesopus.*) Leucomelas, ovinus, porripes.
Psalliota. Campestris, arvensis, amygdalinus, cretaceus, sylvaticus.
Russula. Adusta, lepida, virescens.
Russula. Ochroleuca, alutacea.
Sparassis. Crispa, laminosa.
Tremella. foliacea, mesenterica.
Tricholoma. Russula, frumentaceus, hypopithyus, Columbetta. ca-tus, albellus consociatus, personatus.
Volvaria. Bombycinus, speciosus.

Dr. Curtis says that hill and plain, mountain and valley, woods, fields, and pastures, swarm with a profusion of good, nutritious fungi, which are allowed to decay where they spring up, because people do not know how, or are afraid, to use them. And adds: By those of us who know their use, their value was appreciated, as never before, during the late war, when other food, especially meat, was scarce and dear. Then such persons as I have heard express a preference for mushrooms over meat had generally no need to lack grateful food, as it was easily had for the gathering, and within easy distance of their homes, if living in the country. Such was not always the case, however. I remember once, during the gloomy period when there had been a protracted drought, and fleshy fungi were to be found only in damp shaded woods, and but few even there, I was unable to find enough of any one species for a meal, so, gathering of every kind, I brought home thirteen different kinds, had them all cooked together in one grand *pot pourri*, and made an excellent supper. One important use to which several species of fungi can be applied is the manufacture of catsup. For this purpose, not only is the mushroom, *Agaricus campestris*, and the horse-mushroom, *Agaricus arvensis*, available, but also *Agaricus rubescens* is declared to be excellent for the purpose, and a delicious, but pale, extract is to be obtained from *Marasmius oreades* Other species, as *Coprinus comatus* and *Coprinus atramentarius*, are also available, together with *Fistulina hepatica* and *Morcehella esculenta.* In some districts, when mushrooms are scarce, it is stated that almost any species that will yield a dark juice is without scruple mixed with the common mushroom, and, it should seem, without any bad consequence, except the deterioration of the catsup.

MUST. The fresh juice of the grape before fermentation. Other juices capable of fermentation.

MUSTANG HORSES. The mustang has been denominated the wild horse of North America, and with the same truth as the term wild horse of South America is used. There are no wild horses in America except such as having escaped from domesticity in an early day have since become wild so far as the term may be properly applied to animals which are obliged to subsist entirely without the care of man. The mustang has descended from the Spanish horses brought hither by early adventurers, and escaping from confinement, have covered the plains of Central America, Mexico, Texas and California with vast herds, furnishing the Indians of the plains of Texas, New Mexico and Arizona with fleet and untiring chargers, domestication having had the seeming effect of improving their powers of endurance. The mustang as found on the plains of Mexico and Texas is undersized, slight limbed, long necked, long backed, and with seemingly weak haunches. Their hoofs, also, are inclining to flatness. Their heads are long, lean, but well shaped and well set. Their nostrils wide, and their manes and tails fine. Considering their external appearance they perform admirably under the saddle. They are easily outstripped by well bred horses, are vicious, but easily subdued, under the severe treatment of the herdsmen of the plains, or cow-boys as they are called, nearly as wild as the mustangs themselves. Their money value is exceedingly small, and year by year they are becoming less and less in numbers, civilization gradually rendering them less and less numerous, from the constant increase of better blooded stock among the ranches of Texas, and the stockmen of the far West.

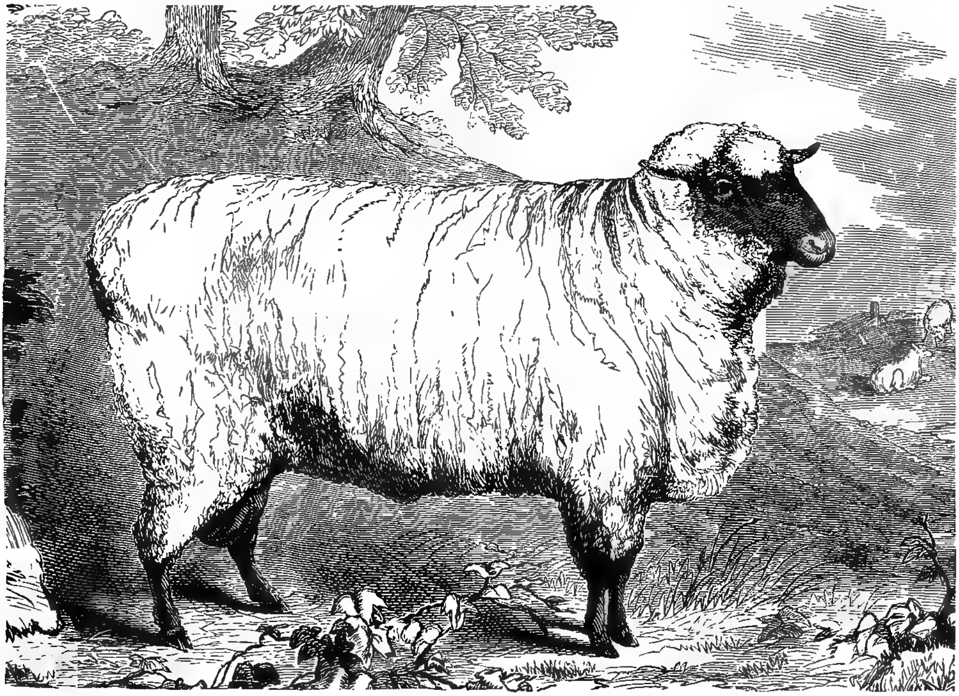
MUSTARD. The mustard family *cruciferæ* includes many most valuable plants to man; among them nasturtium, water cress, cabbage, turnip, the radish, horse radish, pepper grass and mustard. The varieties of mustard cultivated for the seeds which are ground into the mustard of commerce, are the white, *Sinapis alba*, and the black, *S. nigra*. The latter makes the stronger mustard, but the white the handsomest. The wild mustard, or charlock has come to be a most common and noxious weed in the West, infesting the fields of slovenly farmers until some of the oat fields are yellow with the blossoms. It has come in generally by sowing the seed of badly cleaned flax, and following with oats, and then seeding with oats just as they come from the thresher. Thus for want of a little care in cleaning seed grain, fields have been overrun at a great expense to the outcome of crops, to say nothing about the unsightly appearance over large tracts of land. The seed may be eradicated by two successive crops of Indian corn kept clean, or by a clean kept corn crop and a summer fallow. The cultivation of the seed for manufacturing may be either broadcast or in drills, the latter preferable. A rich deep, moist, and mellow, sandy loam is preferable for the crop, though it will grow well on any soil of average fertility, if warm and tolerably well drained. In drills the seed should be sown rather thin, the drills two feet apart for ease in cultivation. If an implement is had that will work in an eighteen inch row this distance is preferable. When a majority of the seed is ripe or the pods turned yellow, cut with a reaper, and set it up like flax or buckwheat. When dry thresh immediately, having the bottom of the wagon rack covered with a cloth to catch the shelled seeds. Broadcast it may be sown a peck to the acre. In drills six quarts is ample. It will reseed itself, and to rid the land of it, plow under the crops when in flower, and follow with corn.

MUSTELLA. The genus containing the weasel and other vermin quadrupeds.

MUTAGE. A process to stop the fermentation of must. It is practiced either by diffusing sulphurous acid in the cask into which the liquor is racked by burning sulphur matches, or by adding a little sulphite of lime to the must; the latter is the best.

MUTICUS. Beardless, without awns, or aristæ.

MUTTON SHEEP. Within the last ten or fifteen years the demand for superior mutton has led to the extensive importation of sheep adapted particularly to the production of mutton. Flocks of the improved breeds are now found all over the United States, and especially within easy reach of our larger cities. The wool of some of the mutton breeds is also eagerly sought for by manufacturers of clothing wool, and for the manufacture of various fabrics in which a long stapled or combing wool is desired. For superiority of mutton the South Down stands pre-eminent everywhere. In the Atlantic States north, the South Down is crossed on selected grade Merino ewes, giving lambs that are much sought for. In the Atlantic States, South, South Down and Cotswolds are largely bred. In the West the Cotswold has become a favorite sheep, for its large size, constitutional vigor, and the length and quality of the wool. In Kentucky and Tennessee in the Blue Grass and other regions of flush pasturage, the Lincolns are gaining ground on account of their great size, and the length and luster of the wool. In the hill region, the Merino, the South Down and their crosses, are used. The Leiceister is also much liked by many breeders East, West and South for their early maturity, and fattening qualities for the food eaten. On the great plains and the mountain regions of the United States, where sheep are herded in immense flocks, the Merino and its crosses with native and Mexican sheep are used, since the larger breeds do not work well in large flocks. One hundred of mutton sheep is about the number that should be flocked together, but the natives and Merinos may be kept in flocks of one thousand or more. The natives and Merinos, either Spanish, French or American Merinos, are not distinctively mutton breeds. In fact the quality of their mutton is not first rate, neither is it produced of any considerable weight per carcase. Yet in the United States, from the large numbers kept, the bulk of the mutton of the country is produced from natives, Merinos, and their crosses. Yet in treating of mutton sheep, they will not be included, but will be found under the head of fine-wooled sheep, which see. The breeds of sheep therefore that are considered the best breeds for mutton are the coarse wools, short, middle and long, as distinguished from the finer Merino wools. Of the improved mutton breeds, the South Down holds its rank against all others, but in the United States, wool as well as mutton must be taken into consideration. Then again Americans are not so choice in their taste for mutton as the English and hence the larger breeds that will produce high grades of combing wool, weight of carcase, and aptitude to lay on flesh are sought for. Nevertheless in the neighborhood of large cities, prime South Down mutton will always pay. The Lincolnshire sheep, one of the largest races in England, will show the best staple of long combing wool, next in rank is the Leicester, a race of sheep for combing wool the most generally distributed of any in England. It is tender in constitution, but of early maturity, and prime fattening quality. The next in rank for combing wool are the Cotswold sheep. In the United States, and especially in the West the Cotswold are much liked, they are hardy in constitution, mature well and make excellent mutton except it is rather fat. The long wooled sheep that have been the most widely disseminated in the United States, of the short or middle wools, are the South Downs, the Hampshire Downs, the Shropshire Downs, and the Oxfordshire Downs. Of these the Hampshire Downs are the largest, averaging 113 pounds thirteen ounces each, and the South Downs eighty-eight pounds, in two lots of fifty each. Of the long wools the Cotswolds, Leicesters, and New Oxfordshire, have been widely spread. Of these fifty each of Leicester and Cotswold weighed to average the first 101 pounds and the second 119 pounds thirteen ounces each. The Leicester as generally shown in this country and in England are larger, rivaling the Cotswolds in weight. Even in Canada where much attention is paid to Leicester sheep, there is said to be comparatively few flocks of the true Leicester, probably from the fact that the true Leicester is delicate in constitution. Yet they have early maturity, good form, and tendency to fatten, and are said to have been made by crossing the Leicester on Lincolns, and other of the large breeds. In England, Leicester wethers from twelve to fifteen months old have been marketed to weigh from 120 to 150 pounds each. The fleeces will average six to seven pounds each. In this country they have been sheared, wethers up to fifteen pounds, and breeding ewes eight pounds. The New Oxfordshires were produced between Leicester and Cotswold, the latter blood predominating. Yearlings in ordinary flesh weigh 125 to 175 pounds, and fat, full grown wethers from 175 to 200 pounds. For mutton, however, the Downs excel all others in the superiority of their flesh, and they are justly prized here as in England, where quality is the test. Mr. J. R. Dodge, in a late visit to England, thus describes them, and some other mutton breeds as he saw them. Speaking of the Downs he says: The distinguishing characteristics of the ancient Sussex Downs have been retained more fully in the course of improvement than have the peculiarities of any other improved breed. That improvement has been effected, as I have little reason to doubt, solely by selection, there being little, if any, positive evidence that the Leicester or other blood has aided in the amelioration. In the production of Hampshire and Shropshire and other breeds, bearing the Down name, it is well known that other blood has been effectively used; but it should be remembered that these families, or rather breeds, are not really improved Downs, but have come from selected individuals of other hardy primitive breeds, moulded into a modification of the South Down type by large and repeated infusion of that blood, with occasional dashes of Leicester to give greater size and aptitude for fattening. The changes effected in the true South (or Sussex) Down have been mainly these: Speckled faces have been changed to a uniform tint of brown or fawn color, sometimes almost a gray; the forehead and cheeks have been partially covered with wool; a greater symmetry of form has been obtained; a larger size and greater fattening aptitude. The flock of Lord Walsingham exhibited some deviation from the Sussex type, having somewhat greater length and a decided development of the fore quarter, giving greater weight, at the expense of reduced value, to the butcher. They are splendid animals, and have been largely sought by continental purchasers, though disapproved by many breeders of the South Down in its purity. The true South



HAMPSHIRE DOWN RAM.

Down may, perhaps, be considered a purer breed, stamping its peculiarities upon its cross-bred offspring more certainly and strongly than any other of the English breeds; and for this reason, together with its hardiness and the unsurpassed quality of its mutton, it is deemed of greater practical value in its crosses than in its pure-bred flocks. But for the fact that quantity and quickness in lamb production are of more pecuniary value than superior quality, it would far surpass the Leicester in its prevalent use for cross-bred early lambs. The Hampshire Down, see cut page **665**, bred largely on the chalk-downs of Berkshire, Hants, Wilts and Dorset, was originally the result of crosses upon the Wiltshire horned sheep and the Berkshire Nott, which secured greater size and increased hardiness of constitution. Sixty years ago, in the hands of different breeders, working with different aims, there was a lack of uniformity, which began to disappear about 1845, under the skillful efforts of modern breeding, and the necessity of obtaining superior flesh-making tendency through an infusion of the blood of some of Jonas Webb's largest and best-fleshed Downs. This Hampshire, or West county Down, much larger than the true Down, and superior in fattening aptitude, is the natural result of the enclosure of the commons, the introduction of artificial manures, and the production of such crops as turnips, rape, vetches, trifolium, rye and Italian rye grass. This is one of the facts with which the history of British sheep husbandry teems, illustrating the necessity of change in breeds, with changed conditions of production or consumption. It is estimated that the weight, both of mutton and wool, have been increased in this region fifty per cent. The statistics of 10,000 Hampshires for three successive years showed the average yield of lambs to be ninety-one per cent, the mortality of ewes, five and a half per cent., and of tegs, three per cent. per annum. The wool is of fine quality, but short staple, averaging four and a half pounds per fleece. The best specimens of these sheep may be found at the Overton and Weyhill fairs, in Hampshire, and the Britford and Wilton fairs in Wiltshire. The wether lambs are now usually sold in the latter part of summer or early autumn, and the ewes are kept three years for breeding. The Shropshire Down, though of comparatively recent origin, still occasionally exhibiting variations from absolute fixity of type, are very widely diffused and highly regarded. They resemble the Sussex Downs, with greater size and weight, a somewhat longer face (which is uniformly dark in color, but not black), a full and large eye, flat and well-wooled forehead, and thin and erect ears of good size. The quality of the flesh is superior, being close-grained, the tissues well bedded in fat, and the color dark and rich. And while the mutton is claimed to be equal to the best South Down, the fleece is much heavier, a fine flock on good land often yielding seven pounds per fleece. They do not mature quite so early as the Leicester or Cotswold, on account of the closer texture of the meat, but with ordinary management yearlings can be marketed in good condition during the summer without other supplies than abundant grass. It is a very prolific breed, twins coming in large proportion—fifty per cent. of doubles being a common result. There have been instances in which a flock of a score or two of ewes have brought up more than twice the number of lambs. The yearlings are frequently made to yield eighteen to twenty pounds per quarter as early as May. There is a reported instance of an old wether being fed up to fifty-nine pounds per quarter. As compared with the Hampshire, they are less in size, but they mature earlier. The Oxford Down is another improvement of local forms of this branch of farm economy, and locally highly esteemed. There is another breed of English sheep inhabiting the rich, alluvial soils of Kent, known as the Romney Marsh sheep, which pertinaciously retains its distinctive features, though modified and improved by recent breeding. It is a large sheep, not very symmetrical in form, having narrow fore-quarters and flat sides, and coarse bone and muscle. It has a white face, a long and thick head, and a tuft of wool on the forehead. The wool is of more value than the mutton, perhaps (but would not be profitable without it), being long, fine and lustrous, and in demand at good prices for export to Flanders and to France for the manufacture of cloth of gold and similar fabrics. Other breeds have been introduced upon the marshes, but can not maintain themselves in competition with the Romneys. The country is flat, open to the east, and very bleak, yet these sheep live through the winter in the open fields, and have little protection or supplied feed. The ewes are comparatively prolific, about thirty per cent. of doubles being expected in reproduction. The lambs come late, after the severity of the winter is over. With a good course of turnip feeding, after the first wintering, they can be brought to seventeen pounds, sometimes to eighteen pounds per quarter, yet they are more usually kept over a second winter. They are not very early in maturing, and grass is the main reliance for growth, if not for fattening. The lands where breeding sheep are kept generally carry three per acre in winter, and five or six in summer. The fattening fields carry four or five sheep. There are cattle on the farms, but sheep greatly predominate, and furnish the principal profits. The breed of British sheep kept to the greatest age, and fed almost exclusively upon the natural growth of permanent pastures, and the management of which, therefore, bears the nearest analogy to our own practice in sheep-husbandry, is that generally known as the Scotch Black-face. It also has the widest range of any of the British breeds. It is found, and has been for centuries—so long a period that doubts exist whether they are aboriginal or an importation during the Norman conquest or the Norwegian occupation of the Western Isles—upon nearly all the mountain lands of Great Britain, including much of the area of Scotland, the mountain chain extending through the north midland counties of England, and the heath and moorlands both in England and Scotland. They are a hardy race, whose place could not be occupied by any of the more improved breeds, enduring, to an almost incredible extent, both cold and hunger, and getting a fair subsistence beneath the drifts of winter, thriving where the pampered long-wools would starve. And yet they are not Merinos. Their wool is of inferior quality, hairy, uneven, used for carpets and coarse cloths, and weighs about four pounds per fleece. The average three-year old wether yields twenty-eight pounds per quarter, deemed unequaled by epicurean taste in quality of meat and richness of gravy. The ewes are kept for five years, and are then drafted without distinction, while the wethers are full grown and fat on good grass lands at three, but they are now generally sold for fattening on turnips in the low countries. Thus the slowest of breeds in maturing is made to subserve the purposes of meat-production, and increase the farm profits under apparently unfavorable conditions. As the Black-faces monopolize the higher mountain lands, the Cheviots occupy the lower elevations, the hills of the border counties between England and Scotland. They have been systematically improved by the crossing of carefully selected rams of Lincolnshire, before the day of the improved Lincoln race. It has been claimed that the Leicester blood produced the improvement, but the hardiness of the breed and the testimony of breeders tend to invalidate the opinion. They were formerly light in bone and wool, of scraggy frame, but with a constitution wonderfully hardy. Draining of lands, provision of shelter, and a greater abundance, both of summer and winter food, have aided the efforts of the breeder, and the result has been one of the most useful and profitable of known breeds of sheep No animal has so contributed to the prosperity of the Scottish border and hill farms as the Cheviot sheep. Their mutton ranks very high in the Smithfield market, and some people give it a preference over the game-flavored mutton of the Black-face. In the mountainous section of Somerset are found the Exmoor sheep, a horned breed, so hardy that a few days' burial in a snowdrift is said to be not too severe a test of their endurance. They have long been remarked for their drum-like roundness of form, though they are becoming square under the recent efforts of breeders They are larger, and in all respects better than the Welsh mountain sheep, good feeding bringing them up to eighteen and twenty pounds per quarter, and in some cases to twenty-four pounds. At eighteen months they can be made to weigh fifteen to twenty pounds per quarter. The Welsh, the Scotch Black-face, the Cheviot, have been tried upon the Somerset hills, but most farmers have gone back to the improved Exmoor. They have white faces, legs and fleeces; the wool close set, and now increased in weight from three pounds up to four pounds. Their mutton is considered of excellent quality. The drafted ewes are often purchased for lamb-breeding, as they are prolific mothers and good nurses. The Welsh is another mountain breed, indigenous and still unmodified in the higher elevations, while they are the basis of the more cultivated flocks inhabiting the more productive valleys. They are small, weighing as store sheep about seven pounds per quarter. The head is small and well set up; the poll clean, except sometimes a tuft upon the forehead; the faces unusually white, with occasional instances of gray, speckled, or rusty brown. They are narrow-chested, low-shouldered, high-rumped, long-tailed, active in movement, having little regard for fences or hedges, hardy and thrifty with scanty herbage. The wool is fine, though not very even in quality; fleeces weighing about two pounds. They are not prolific, as one lamb is enough for a mother to care for in mountain pastures, but are good nurses, and are sought for on that account for breeding fat lambs from Leicester or Down crosses.

MUZZLE. The nose of an animal. A kind of halter fastened over the nose to prevent an animal from biting. Muzzle of a plow is the end of the beam to which the clevis is attached.

MYCELIUM. The young, flocculent filaments of fungi. (See Fungus.)

MYOLOGY. An account of the muscles of the body.

MYOPS. Shortsightedness.

MYRIAMETER. Ten thousand metres, equal to two leagues.

MYRICIN. That portion of wax which is insoluble in alcohol.

MYRISTICACEÆ. A family of tropical trees, exogens, containing the nutmeg. Nearly allied to the laurels.

MYRONIC ACID, MYRONATES. An acid existing in cruciferous seeds, and containing sulphur.

MYROBALANS. A bitter, austere fruit, used in India in calico dyeing and medicine.

MYROSYNE. A substance resembling emulsin, or caseum, in mustard seeds.

MYRRH. An odoriferous gum resin imported from the East. Sweet cicely is sometimes called by this name.

MYRTACEÆ. A family of small trees and shrubs, particularly developed in tropical climates, and yielding the pimento, cloves, guava, cajeput, and other aromatic products.

MYRTLE. *Myrtus.* There are eleven principal species, and many varieties. They are mostly green-house and hot-house evergreen shrubs. *Myrtus communis* is the common myrtle. The myrtle bilberry is a whortleberry, *Vaccinium myrtillus.* Sweet Gale or Dutch Myrtle (***Myrica** gale*) is the bayberry, or wax myrtle.

N

NACREOUS. Reflecting iridescent light, like pearl.

NACRITE. A pearly mineral. Silicate of alumina and potash.

NÆVUS. A natural mark, blotch on the skin.

NAG. A small horse.

NAILS. The horny extremities modified into claws, talons, hoofs, etc. They are of the same composition as hair, 100 pounds during decomposition yield twenty pounds of ammonia. The composition of horn, gives, of nails, hoofs, etc., fifty-two carbon, 6.7 hydrogen, 17.3 nitrogen, twenty-four oxygen and sulphur, with less than one per cent. ashes, in 100 parts.

NAKED. In botany, without the customary covering, as a stem without leaves, corolla without calyx, etc.

NAPHTHA. A highly inflammable fluid, of a peculiar odor, specific gravity 0.75, which exudes from the earth in some places. A similar fluid is distilled from wood tar, and called wood naphtha. It is used as a solvent of India rubber, and for other purposes. Petroleum is identical in its composition.

NAPHTHALINE. A white crystalline, volatile product of the destructive distillation of pit coal. Naphthalic acid, naphthalamide, etc., are derivatives.

NAPIFORM. Formed like a turnip, tuberous. Swelled in the upper part.

NARCEIA. A vegetable alkaloid from opium, producing salts of a blue color.

NARCISSUS. Ornamental bulbous rooted flowers, hardy, and blooming in the spring.

NARCOTICS. Anodynes. All drugs which produce sleep, drowsiness, and allay pain, as opium, henbane, tobacco, camphor, stramonium, and other plant extracts.

NARES. The nostrils.

NARRAGANSETT PACERS. This wonderful breed of saddle horses seems now entirely extinct. A century ago, and up to the early years of the present century, it was one of the most valued and distinct breeds of horses in New England. These horses are said to have been of Andalusian origin, of fair size, of fine carriage, and natural and easy pacers. That is their mode of traveling was to pick up both feet on a side squarely and alternately. Rhode Island has the credit of having raised these admirable saddle horses in the greatest numbers, and for a long time large numbers of them were shipped to the West Indies. As roads improved in the United States, and in the West Indies, the demand for them became less and less, and although they have exercised a considerable influence in the formation of the horse stock of New England, as a distinct breed, the Narragansett Pacer is no longer to be found.

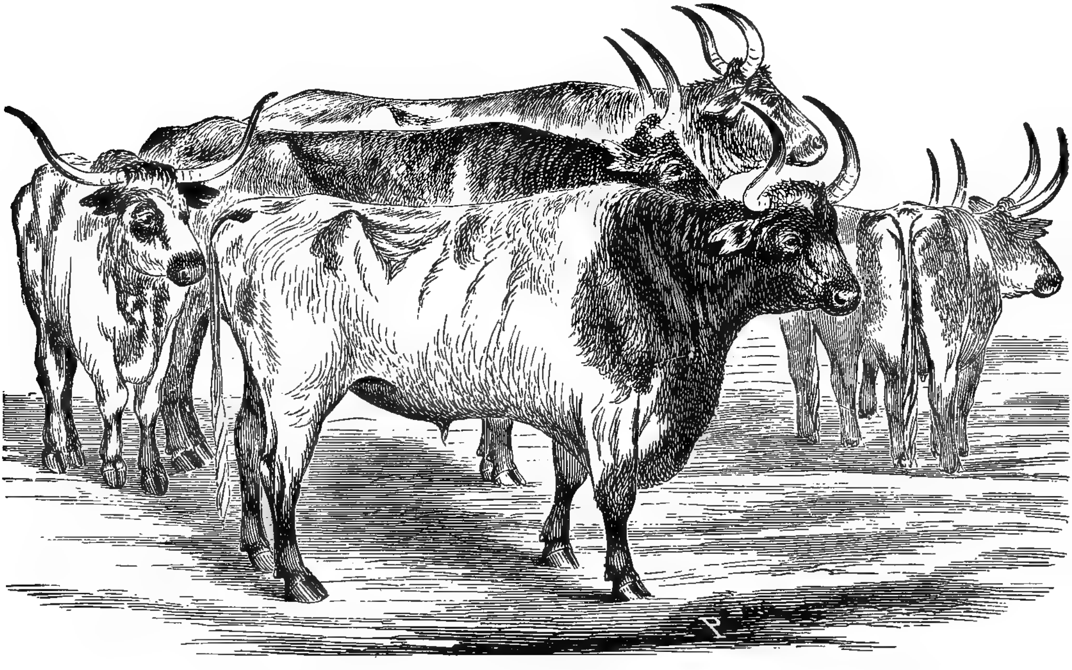
NASCENT. In the act of being produced or evolved. A chemical phrase given to the evolution of gases from fluids, at which time they are more fitted to unite with other bodies. Hydrogen, nitrogen, and other gases, in the aëriform state, combined only slowly with substances, but when nascent enters readily into union.

NASTURTIUM. (See Cress.)

NASUTA. A prolongation of the muzzle into the form of a nose.

NATANS, NATANT. Floating or swimming.

NATATORY. In zoology, when the feet or tail are provided with a membrane or hairs to repel or displace water, and buoy up the insect or animal.



GROUP OF TEXAS CATTLE.

NATIVE CATTLE. The genus *Bos* is not native to either North or South America. They were originally brought here by the early Spanish adventurers, and escaping domestication, became semi-wild, and increased to such numbers on the vast plains of Texas, Mexico, California, and the pampas of South America, that they were slaughtered simply for the value of their hides and tallow. The so-called native cattle of America, therefore, are the mixed descendants of the various breeds brought hither from time to time. The Spanish type being preserved in all the country south of Texas, in North America, and in South America; and in the Northern United States the characteristics of the better breeds, as the Devon, Hereford, old Durham, Galloway, and Dutch cattle prevailing, according to the locality. In the New England States, resolving themselves into the New England reds, from the strong infusion of Devon and Sussex blood, producing cattle admirably adapted to the yoke, and for subsisting in that hilly country. In the West and the border States of the South, the strong infusion of the old Durham or Teeswater is as clearly seen, which many years ago even made this region famous for the superior quality of the native beef. In the Middle States the breeds were more mixed up, and in their descendants may be traced various breeds we have mentioned. And it was not unusual to find many polled cattle thirty or forty years ago, and which were especially prized for their milking qualities. The history of the introduction of cattle into the New England States shows that the earliest cattle introduced to Plymouth, and the first in New England, were brought in 1624. In 1631 these are mentioned in the old records as having greatly increased. In the meantime a number had been imported for the colonists at Salem. In 1632 and 1633 Captain John Mason, who with Gorges had obtained large tracts of land on the Piscataqua river, made several importations, in his commerce with Denmark, of Danish cattle and horses, which subsequently became largely diffused over the country. These Danish cattle are described in the old records as large, coarse, and of a yellowish color, and it is supposed that they were obtained by Mason as being well able to endure the hardships to which they would be subjected. They were soon spread among the colonists of Massachusetts bay, and have, undoubtedly, left their marks on the stock of New England, and are discernible even to the present day, mixed with a great variety of crosses with the Devons, the black cattle of Wales, the Danes, and Holland, and the various other English breeds then unimproved. These New England cattle make excellent working oxen, being hardy, docile, easily broken to the yoke, and having a tendency to fatten when well fed, while the cows are often superior milkers. Sixty years ago one of the most intelligent, earnest, and liberal importers and breeders of stock in this country, wrote of the native cattle of New England as follows: I am not satisfied that the delicate Devons are any better suited to the yoke than the vigorous and spirited bullocks which are found in Massachusetts and Maine. It has been asserted, and by authority which I am always disposed to respect, that the cattle of Massachusetts are derived from the Devons; but Lancashire, Leicester, and Hereford blood can be traced by a practiced eye in many of the best working oxen exhibited at the New England agricultural shows. If color determines the question, it is but fair to state that from 100 yokes of the finest draft cattle of Massachusetts, which were exhibited in 1822 at the Worcester county show, the best were taken to Brighton, where a pair of very light yellow oxen received a premium for docility and speed at the plow. On a former occasion a yoke of black and white bullocks received the award. The most hardy, active cattle had the shape of kyloes, and were brown. In activity, patience, and strength the cattle of Great Britain have never surpassed the cattle of New England. At the present day the native cattle of the North and West (except in the more primitive districts), are made up of crosses of all the better breeds that from time to time have been imported from England. ' In fact, in wide districts, scarcely any inferior cattle can be found, the most of them being good grades, hence mixed breeds would be a better name. The Texans (see cut) are really the only native cattle of the United States, and these only as having bred in a wild, or semi-wild state since their escape from the Spanish adventurers.

NATROLITE. A fibrous, yellowish mineral. Silicate of alumina and soda.

NATRON. Soda. Impure, native sesquicarbonate of soda.

NATURAL HISTORY. A description of natural objects, as animals, plants, insects, fishes, minerals and fossils.

NATURAL ORDER OF PLANTS. Groups of plants having a close similarity in internal organization, and frequently in external characters and properties.

NATURAL PHILOSOPHY. Physics, mechanical philosophy. The science which investigates the mechanical laws of nature; and the relations of weight, movement, pressure, or of mechanical forces in masses.

NAUCA. A seed in which the scar of the hilum occupies a third of the surface.

NAUSEA. A feeling similar to that preceding the act of vomiting.

NAVE OF A WHEEL. The hub, the block in the center of the spokes, which receives them.

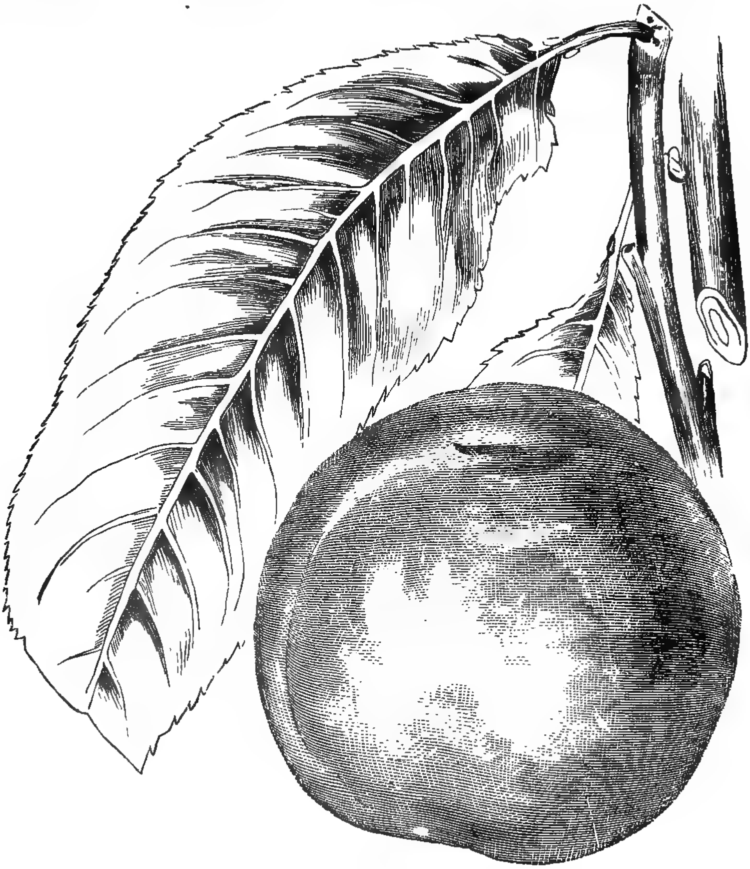
NAVEL-WORT. *Hydrocotyle umbellata.*

NAVEW. *Brassica campestris.* The wild plant is a native of England; in the cultivated form it is known as colza and rape.

NAVICULAR. Having the figure of a boat. It is applied to the nut bone of the foot, as well as to the form of seeds, etc.

NAVICULAR DISEASE. This disease is known also as contraction of the feet, and produces the peculiar crippled gait known as grogginess. The intense agony of the suffering animal may be partially imagined by any person, who, from a boot which contracting on the foot, has doubled the edges together on themselves. When the disease has progressed for some time common humanity would seem to dictate that the animal be killed, to end its misery. If taken early in the disease, care may result in a cure, with only more or less lameness. The disease is most common in horses, driven fast on hard roads, or those used for racing and leaping. It may be sudden in its attacks or be preceded by pointing the toe, and a peculiar tripping gait. Wasting of the muscles of the shoulders is generally present from the fact of disease, and not that there is sweeny there as many ignorantly suppose. The foot will be found dry, hot, and generally tender at some point. At the first sign of the peculiar lameness, take off the shoe, bleed from the artery above the coronet, give the foot a cold water bath for a few hours of the day and poultice at night, (bread and milk or linseed meal). If the inflammation does not yield in two weeks, blister the coronet, and if the disease is still obstinate, a seton may be put in the frog, by paring down thin, using a sharp pointed, short, stout, curved seton needle, the point of the needle entering an inch from the toe and brought out midway between the bulbs of the frog and the forward part of the hollow of the heel; taking care not to go so deep as to interfere with the sinew. Tie the ends of the tape with which the needle is armed, and dress it daily for a month with one part of powdered cantharides to eight parts each of oil of turpentine and Canada balsam. If this does not cure give the horse rest and quiet until the disease runs its course, when he may be able to do some light work.

NEAT CATTLE. The term neat cattle is generally accepted as implying all breeds of the ox tribe domesticated by man. They are therefore as diverse in their characteristics as the nations and peoples who have bred them. In England, the United States and in Canada, they may be said to be bred to the most profitable use as they have been to the highest practical type of excellence in the various breeds for beef, labor and milk. The judging of cattle is a fine art only to be acquired by intelligent thought and practice There are judges so acute and critical, that by the touch, and other external signs, will judge of the live weight, dead weight of quarters, and tallow within a very few pounds. Yet, to the average farmer it would be mere guess work, and as liable to error on one side as the other. An acute and critical breeder upon the subject of judging cattle has said, were an ox of fine symmetry and high condition placed before a person not a judge of live stock, his opinion of its excellencies would be derived from a very limited view, and consequently from only a few of its qualities. He might observe and admire the beautiful outline of its figure, for that might strike the most casual observer. He might be pleased with the tint of its colors, the plumpness of its body, and the smoothness and glossiness of its skin. He might be even delighted with the gentle and complacent expression of its countenance. All these properties he might judge of by the eye alone On touching the animal with the hand, he could feel the softness of its body, occasioned by the fatness of the flesh. But no man, not a judge, could rightly criticise the properties of an ox further. He could not possibly discover, without tuition, those properties which had chiefly conduced to produce the high condition in which he saw the ox. He would hardly believe that a judge could ascertain, merely by the eye, from its general aspect, whether the ox were in good or bad health—from the color of its skin, whether it were of a pure or cross breed—from the expression of its countenance, whether it were a quiet feeder—and from the nature of its flesh, whether it had arrived at maturity or not. The discoveries made by the hand of a judge might even stagger his belief. He could scarcely conceive that that hand could feel a hidden property—the touch—which of all tests is the most surely indicative of fine quality of flesh, and of disposition to fatten. It can feel whether that flesh is of the most valuable kind; and with decided accuracy foretell the probable abundance of fat in the interior of the carcase. In short, a judge alone can discriminate between the relative values of the different points, or appreciate the aggregate values of all the properties of an ox. The parts of the ox by which it is judged, let it be remembered, are called points. Thus it may be seen that a person even totally ignorant of cattle may judge of some of the most apparent properties, or points, of a fat ox; but were a lean one placed before him, he would be quite at a loss what opinion to pass on its present, and far more of its future, condition. The outline of its figure would to him appear rugged and angular, and consequently coarse. To him the body would feel as a number of hard bones, covered with a tough skin and coarse hair. A judge, on the other hand, could at once discover the good or the bad points of a lean as well as of a fat ox; because the properties of the former are the same in kind, though not in degree, as those of the latter; and, in accordance with the qualities of these points, he could anticipate the future condition of the lean ox, save and excepting the effects of accidents and disease. But, it may be asked, if the qualifications of a judge of cattle may be so easily acquired as is here represented, how is it that the opinion of a judge is always held in deference, and is always referred to in cases of difference of opinion? This question admits of a very satisfactory answer: Errors in the judging of cattle arise not so frequently from not knowing the points to be judged of, as from judges attributing to one or more of their favorite points too great an influence over the future increasing condition of the ox; and as long as there are so many points to be considered, and as most of them may be partially altered by local circumstances, a difference of opinion may exist among judges of lean stock. Now, what are those points of an ox, a thorough knowledge of which is so essential to constitute a perfect judge? Could they be described and illustrated with such precision as that they might be applied at once to every ox, in whatever condition he might be, a great advancement would be made towards establishing fixed rules for the right judging of all the domestic animals. Fortunately, nature has herself furnished rules for ascertaining points for judgment, a knowledge of which can nevertheless be only acquired by careful observation and long and constant practice. The first point to be ascertained in examining an ox is the purity of its breed, whatever that breed may be, which may be ascertained from several marks. The color or colors of the skin of a pure breed of cattle, whatever those colors are, are always definite. The color of the bald skin on the nose, and around the eyes, is always definite, and without spots. This last is an essential point. When horns exist, they should be smooth, small, tapering, and sharp-pointed, long or short, according to the breed, and of a light color throughout in some breeds, and tipped with black in others. The shape of the horn, however, is a less essential point than the color. The second point to be ascertained in an ox is the form of its carcase. It is found that the nearer the section of the frame of a fat ox, taken longitudinally vertical, transversely vertical, and horizontally, approaches to the figure of a parallelogram, the greater quantity of flesh will it carry within the same measurement. That the carcase may fill up the parallelogram as well as its rounded form is capable of filling up a right-angled figure, it should possess the following configuration: The back should be straight from the top of the shoulder to the tail. The tail should fall perpendicularly from the line of the back. The buttocks and twist should be well filled out. The brisket should project to a line dropped from the middle of the neck. The belly should be straight longitudinally, and round laterally, and filled at the flanks. The ribs should be round, and should project horizontally, and at right angles to the back. The hooks should be wide and flat; and the rump, from the tail to the hooks, should also be flat and well filled. The quarter from the aitch-bone to the hook should be long. The loin bones should be long, broad and flat, and well filled; but the space between the hooks and the short-ribs should be rather short, and well arched over with a thickness of beef between the hooks. A long hollow from the hooks to the short-ribs indicates a weak constitution, and an indifferent thriver. From the loin to the shoulder-blade should be nearly of one breadth, and thence it should taper a little to the front of the shoulder. The neck-vein should be well filled forward, to complete the line from the neck to the brisket. The covering on the shoulder-blade should be as full out as the buttocks. The middle ribs should be well filled, to complete the line from the shoulders to the buttocks along the projection of the outside of the ribs. These constitute all the points which are essential to a fat ox, and which it is the business of the judge to know, and by which he must anticipate what the lean one, when fed, would realize. The remaining points are more applicable in judging of a lean than a fat ox. The firs of the points in judging of a lean ox is the nature of the bone. A round, thick bone indicates both a slow feeder, and an inferior description of flesh. A flat bone, when seen on a side view, and narrow, when viewed either from behind or before the animal, indicates the opposite properties of a round bone. The whole bones of the carcase should bear a small proportion in bulk and weight to the flesh, the bones being only required as a support to the flesh. The texture of the bone should be small-grained and hard. The bones of the head should be fine and clean, and only covered with skin and muscle, and not with lumps of fat and flesh, which always give a heavy-headed, dull appearance to an ox. The fore-arm and hock should also be clean and full of muscle, to endure traveling. Large joints indicate bad feeders. The neck of an ox should be, contrary to that of the sheep, small from the back of the head to the middle of the neck. The reason of the difference, in this respect, between the ox and the sheep is, that the state of the neck of the ox has no effect on the strength of the spine. A full, clear and prominent eye is another point to be considered; because it is a nice indication of good breeding. It is always attendant on fine bone. The expression of the eye is an excellent index of many properties in the ox. A dull, heavy eye certainly indicates a slow feeder. A rolling eye, showing much white, expresses a restless, capricious disposition, which is incompatible with quiet feeding. A calm, complacent expression of eye and face is strongly indicative of a sweet and patient disposition, and, of course, kindly feeding. The eye is frequently a faithful index to the state of the health. A cheerful, clear eye accompanies good health; a constantly dull one proves the probable existence of some internal lingering disease. The dullness of eye, arising from the effect of internal disease, is, however, quite different in character from a natural or constitutional phlegmatic dullness. The state of the skin is the next point to be ascertained. The skin affords what is technically and emphatically called the touch—a criterion second to none in judging of the feeding properties of an ox. The touch may be good or bad, fine or harsh, or, as it is often termed, hard or mellow. A thick, firm skin, which is generally covered with a thickset, hard, short hair, always touches hard, and indicates a bad feeder. A thin, meagre, papery skin, covered with thin silky hair, being the opposite of that just described, does not, however, afford a good touch. Such a skin is indicative of weakness of constitution, though of good feeding properties. A perfect touch will be found with a thick, loose skin, floating, as it were, on a layer of soft fat, yielding to the least pressure, and springing back toward the fingers like a piece of soft, thick chamois leather, and covered with thick, glossy, soft hair. Such a collection of hair looks rich and beautiful, and seems warm and comfortable to the animal. It is not unlike a bed of fine, soft moss, and hence such a skin is frequently styled mossy The sensation derived from feeling a fine touch is pleasurable, and even delightful, to an amateur of breeding. Along with it is generally associated a fine symmetrical form. A knowledge of touch can only be acquired by long practice; but, after it is once acquired, it is of itself a sufficient means of judging of the feeding qualities of the ox; because, when present, the properties of symmetrical form, fine bone, good disposition, and a purity of blood, are the general accompaniments. These are the essential points of judging lean cattle; but there are other and important considerations which must claim the attention of the judge, in forming a thorough judgment of the ox. The proportion which the extremities bear to the body and to each other, is one of these considerations. The head of the ox should be small; and set on the neck as if it appeared to be easily carried by the animal. This consideration is of great importance in showing cattle to advantage in the market. The face should be long from the eyes to the point of the nose. No face can be handsome without this feature. The skull should be broad across the eyes, and only contract a little above them, but should taper considerably below them to the nose. The muzzle should be fine and small, and the nostrils capacious. The crown of the head should be flat and strong, and the horns should protrude horizontally from both sides of it, though the direction of the growth from the middle to the tip varies in the different breeds. The ears should not be large, but should stand a little erect, and be so thin as to appear translucent when exposed to the sun. The neck should be light, tapering from the front of the shoulder and neck-vein, with a gradual rise from the top of the shoulder to the head. The length of the neck should be in proportion to the other parts of the animal; but this is a non-essential point, though an apparently short neck would be preferred to a long one, because it is generally well covered with the neck-vein. A droop of the neck, from the top of the shoulder to the head, indicates a weakness of constitution, arising frequently from breeding too near akin. The legs, below the knee, should be rather short than long, and clean made. They should be placed where they apparently bear the weight of the body most easily, and should stand wide asunder. The tail should be rather thick than otherwise, as thickness indicates a strong spine and a good weigher. It should be provided with a large tuft of long hair. The position of the flesh on the carcase is another great consideration in judging of the ox, the flesh on the different parts being of various qualities. Those parts called the spare-rib, fore and middle ribs, loins, and the rump or hook-bone, are of the finest quality, and are generally used for roasts and steaks. Consequently, the ox which carries the largest quantity of beef on these points is the most valuable. Flesh of fine quality is actually of a finer texture in the fiber than coarse flesh. It also contains fat in the tissue between the fibers. This arrangement of the fat and lean gives a richness and delicacy to the flesh. The other parts, though not all of the same quality, are used for salting and making soups, and do not command so high a price as the parts just described. A full twist, lining the division between the hams, called the closing, with a thick layer of fat, a thick flank, and a full neck-vein, are generally indicative of tallow in the interior of the carcase; but it frequently happens that all these symptoms of laying on internal fat fail. The disposition to lay on internal fat altogether depends on the nature of the individual constitution; for it is often observed that those animals which exhibit great fattening points on the exterior do not fill with internal fat so well as others which want these points. On the contrary, thin-made oxen, with flat ribs, and large bellies, very frequently produce large quantities of internal fat. The first part which shows the fat in a feeding ox, is the point or top of the rump, which, in high-bred animals, is a prominent point; sometimes it protrudes too much, as the mass of fat laid on these is out of proportion to the lean, and therefore useless to the consumer. This is the part which frequently misleads inexperienced judges in the true fatness of the ox, because fat may be felt on this part when it is very deficient on most of the other points. The parts, on the other hand, which are generally the last in being covered with flesh, are the point of the shoulder joint, and the top of the shoulder. If these parts are, therefore, felt to be well covered, the other and better parts of the animal may be considered ripe. Ripeness of condition, however, can only be rightly ascertained by handling, for there is a great difference between the apparent and real fatness of an ox. The flesh of an apparently fat ox to the eye, may, on being handled by a judge, feel loose and flabby; but a truly fat ox always feels hard fat. With such, the butcher is seldom deceived, while loose handlers give no assurance of killing well.



NECTARINE.

NEAT'S-FOOT OIL. The fat obtained by boiling feet of cattle.

NEBULA. A cluster of small stars appearing like a minute cloud.

NECK, COLLAR. In plants, the space between the stem and roots, often swollen in size. The neck of a capital is the space above the shaft between the ring (*annulet*) above, and the astragal at the top of the shaft.

NECROPHAGANS, NECROPHAGA. A family of clavicorn beetles, some of which live on decomposing animal matters.

NECROSIS. A disease resembling mortification of the bony structures. In plants, the term means the rotting of the part.

NECTARY, NECTARIUM. The part of a flower which secretes honey. It is usually an appendage of the petals or disk.

NECTARINE. *Persica Vulgaris* (var). The nectarine is a variety of the peach, having a smooth skin. In India its name signifies smooth peach. The history of its origin is not certainly known, but that it is an accidental variety or sport, is made pretty certain from the fact that both peaches and nectarines have frequently been borne on the same branch. Nectarine seeds, however, produce nectarines, though occasionally the peach is produced from a nectarine seed, and vice versa. The nectarine is but little cultivated in the United States. It is shy in bearing and like all smooth stone fruits, especially liable to the attacks of the curculio. The tree is treated precisely as the peach, and its habits and hardiness are the same. There are both free stone and cling varieties. If the cultivation of this fruit is attempted, the branches should be annually shortened in and the fruit carefully watched for the curculio, and the insects regularly jarred upon a sheet from the time the fruit is the size of a hazel nut until fully grown. The cut will show the characteristics of fruit and leaf. The following is the list recommended by the United States Pomological Society, as lately revised: 1, Boston; 2, Downton; 3, Early Newington; 4, Early Violet; 5, Elruge; 6, Stanwick. The whole list is marked for New York and Michigan. 1 and 3 are of American origin, 1 being the seedling of a peach. 1 and 6 recommended for Maryland; 3 for Tennessee, and as being of superior value there; 4 and 5 for Indiana, 5 also for Pennsylvania and Missouri.

NEGATIVE SIGN. Minus, or —. It is employed to denote quantities or measures below a standard.

NEGUNDO. (See Maple.)

NELUMBIUM. A marsh or water plant, the seeds of which, of the size of an acorn, are eaten green; or preserved as sweetmeats, and have a nutty flavor. The succulent roots are also eaten raw or boiled.

NEMOCERA. A family of diptera, with filiform antennæ.

NEMOGLOSSATA. The bee tribe, and those hymenoptera which have a long, thread-like tongue.

NEMOROSE, NEMOROSA. Belonging to the woods.

NEPHRITE. A tough, greenish mineral, used to manufacture ornaments. A silicate of alumina and magnesia with iron.

NEPHRITIS. Inflammation of the kidney.

NEPTUANIAN THEORY. The theory of Werner, that geological formations were due to aqueous causes.

NERIUM. A genus of important Eastern plants. *N. antidysentericum* affords the codaga bark; *N. tinctorium*, a beautiful evergreen of India, affords some indigo from its leaves.

NEROLI, OIL OF. The distilled essential oils of orange flowers.

NERVES. The white, thread-like fibers, which, proceeding from the brain or spinal marrow, ramify throughout every part of the bodies of the higher animals. They convey impressions from and to the brain, preside over the functions of the different organs, and regulate motion and the senses. Nerves can hardly be said to be absent in any animals, although they become extremely rudimentary in many. Chemically, nervous matter consists of seven parts albumen, five fatty matter, and eighty water. The fat is peculiar, containing phosphorus. Most diseases affecting the whole body are accompanied, or commence in an impaired state of the nervous system, which presides over health. Nerves are said to be cerebral when they proceed directly from the brain; there are nine pairs of these, and they preside over the senses. The nerves arising from the spinal marrow are termed spinal nerves, and divided into cervical, dorsal, lumbar, and sacral. They preside over motion and ordinary sensation, as well as the functions of the lungs, stomach, liver, and other viscera. The great sympathetic nerve is a series of junctions between the spinal nerves, and is connected with the brain; in its course, small masses of a reddish color occur, called ganglions: it renders the functions of the different organs uniform. A plexus of nerves is a net-work formed by the union of various filaments. Nerves, or Nervures, in plants, are the ramifications of woody tissue and vessels seen upon leaves, flowers, etc. They support the cellular tissue of the leaves.

NETTED. Reticulated, marked like the meshes of a net.

NETTLE. *Urtica.* A class of plants noted for their stinging hairs, and named from the Latin *uro*, to burn. The more common species, are *U. gracilis*, the tall, wild nettle, growing from two to six feet high, and found generally in the North. It has scarcely any stinging hairs except on the petioles, and sparingly on the principal veins. *U. dioica*, is the great stinging nettle, growing two to three feet high, naturalized from Europe, very bristling and stinging; more common East than West, and found growing in waste places, *U. urens* is the small stinging nettle, also of European origin, growing one foot high. *U. purpurascens* has a slender stem, one to three feet high, carrying, in common with the leaf stalk, scattered stinging bristles, common in alluvial lands, Kentucky and South.

NETTLE-TREE. The genus *Celtis*, amentaceous trees. The principal American species is the *C. occidentalis*, the sugar or pompion berry. It is seldom twenty feet in the Middle States, but becomes seventy in the South. It is ornamental with small, white flowers, and sweet, reddish fruit.

NEURALGIA. Pain of the nerves.

NEURILEMA. The covering of the nerves.

NEUROPTERA. Insects with four netted wings.

NEUTERS. Infertile animals or plants, having neither stamens nor pistils.

NEUTRAL, NEUTRALIZATION, NEUTRALIZED. The combination of an acid with an alkali, or of two active bodies together, by which the properties of either are perfectly destroyed. The addition must be made in the proportion of their equivalents to produce neutral compounds.

NEUTRAL SALTS. Salts which betray neither an acid nor alkaline reaction.

NEWEL. In building, the space around which a flight of steps is turned.

NEW JERSEY TEA. *Ceanothus Americana.* A common marsh shrub with fragrant bunches of flowers; some used as a substitute for tea.

NEW RED SANDSTONE. The series of strata lying immediately above the coal formation. It consists of conglomerates, and contains marl, gypsum, and large quantities of rock salt.

NICARAGUA WOOD. The dye-wood of *Cæsalpina echinata,* a tree of South America.

NICHE. A recess in a wall for a statue.

NICKEL. A rare white metal, like iron. Its salts are green for the most part. It exists in meteoric stones.

NICKING AND DOCKING. Pricking. Cutting off part of a horse's tail, and making nicks on the under side, to divide the two cords, which draw down the tail. It is now in disuse.

NICOTIANIN. A fatty, volatile, azotized body, insoluble in water, formed during the fermentation of tobacco in preparing for the market, and to which its odor is due. It is poisonous, especially to insects and reptiles.

NICOTIN, NICOTINA. An acrid, soluble, volatile alkaloid found in tobacco. It combines with acids, and forms salts. It is very poisonous.

NICTITATION. Winking. The movement of the membrane covering the eyes of birds and some animals, called the *membrana nictitans.*

NIDUS. A nest. A suitable position or matrix for development. *Nidulus* and *nidulate* are derivatives.

NIGER. Black. *Nigrescent,* growing black. *Nigricans,* blackish, sooty.

NIGHT HAWK. An insectivorous bird of the family *caprimulgidæ,* so named from their supposed habit of goat sucking. Our night hawk, *Chordeiles popetue,* is wholly insectivorous, feeding entirely on insects, especially the coleoptera; also moths, caterpillars, crickets and grasshoppers. It is strictly nocturnal, but is sometimes seen pursuing its prey in dark, cloudy days. The whip-poor-will, *Antrostomus vociferus,* is also nocturnal, feeding on moths, beetles and other night flying insects ; not, as is generally supposed, upon minute insects, as midges, but on the larger noxious insects. In fact its food is pretty much the same as the night-hawk, and both should be sedulously protected.

NIGHT SHADE. A common plant. *Solanum nigrum.* An annual plant, low spreading, and much branched; flowers quite small, white, and the berries globular and black. Said to be poisonous. A plant naturalized from Europe, growing in shaded grounds and fields. It should be eradicated wherever found.

NIGHT SOIL. The contents of privies, a a mixture of urine and fæces. It was formerly supposed to be the most valuable of manures, and in the neighborhood of cities is largely manufactured by desiccating with earth into poudrette. More recently it has been found that the urine contained forms the chief constituent of value, this being one of the most powerful of manurial substances; to make poudrette at home all that is necessary, is to have the privy so constructed that the contents may be easily removed. Mix the contents with air-dried muck, or strong loam, under cover, using also the chamber lye daily carried out; as the mass becomes dry, it may be used again and again, with the contents of the privy, until it is well saturated with the nitrogen and other salts. In this form it becomes a powerful special manure. Green vitriol may be used in the privy to deodorize and fix the ammonia, and gypsum and charcoal dust, will be found valuable with the dry muck, as a desiccator.

NIMBUS. The rain cloud. It is black and near the earth.

NIPPERS. The four front teeth of the horse. The permanent ones appear between the second and third years. Pincers, forceps. (See article Horse.)

NIPPLE. A conical elevation. The extremities of the udder. Teats.

NITIDUS. Shining, polished, smooth.

NITRATE OF SILVER. In the fused state this is called lunar caustic, and much used as a caustic. It consists of one equivalent of nitric acid united with one of oxide of silver. A solution is used in the laboratory to detect the presence of muriatic acid and chlorine in solutions, with both of which it forms a white, curdy precipitate. It is also a test for organized matter, becoming black in its presence.

NITRATES. Salts containing nitric acid combined with a base, as nitrate of potash, soda, lime, ammonia.

NITRE. Saltpetre, nitrate of potash. A compound of fifty-four parts (one equivalent) of nitric acid, with one equivalent, or forty-eight parts potash. It crystallizes in six sided prisms, with two faces at the summits; is soluble in seven parts cold, and less than its weight of hot water.

NITRE, CUBIC. Nitrate of soda. It consists of one equivalent nitric acid, and one soda; is crystallized in rhomboids; is very soluble and deliquescent, requiring but three parts water, at 60° Fahrenheit, for solution. The great part of the salt in commerce is derived from Peru, where immense deposits of it occur.

NITRIC ACID. Aquafortis. The pure acid is unknown, that of the shops being a solution in water; the strongest specimens have a specific gravity of 1.5 and contain one atom of acid with two of water; it is of a yellowish tinge, smokes, and is extremely caustic, dissolving most metals. The pure acid consists of one atom of nitrogen with five of oxygen. Nitric acid is extensively employed in the laboratory as a solvent, and, from its active action on many compounds, it readily parts with a portion of its oxygen, oxidizing organic and other bodies presented to it. Its salts are soluble in water, and decrepitate on hot coals.

NITRO. A prefix to the name of bodies containing nitric acid or nitrogen.

NITROGEN. Azote, so called from its fatal effects on life when breathed, in an uncombined state. Hydrogen forms about seventy-nine parts in the one hundred parts of air. In combination with oxygen, it forms nitric acid. Combined with hydrogen it forms ammonia. In combination with oxygen it is the source of nitrogenous compounds in animals and plants; pure nitrogen is a colorless gas devoid of taste and smell. Thus we see that the air is the source of this necessary ingredient in plants and yet it is locked up, so far as the artificial elimination of it is concerned, at least from an economical point of view. In the state in which nitrogen exists in the air, it can not be assimilated by plants except through its foliage. Its only source to plants being through the roots either from geine, from ammonia, or from the nitrates, through decomposition by the action of the growing plant. It has indeed been held that plants take up nitrogen, from the air by their leaves. There is however, no real proof that such is actually the fact. Nitre consists of an alkali united to an acid composed of one part of nitrogen to five of oxygen is in fact nitrate of potash. The nitrates of potash, soda, magnesia and lime are natural products. The nitrates of oxides, and of metals are artificial products. The nitrates undergo decomposition at a high heat, thus they are converted into free nitric acid and the oxidized base, or into oxygen which escapes, and into nitrous acid, which remains in combination with the base forming a nitrite. In the laboratory it is easy to produce nitrogen The air is simply to be deprived of its oxygen. It may be done in various ways, either by leaving a piece of phosphorus several days in a bell glass over water, or by burning phosphorus in the glass standing over water, or by passing air through a tube partly filled with copper shavings, heated to a red heat. Nitric acid is the most important product of nitrogen, and the agent from which the other compounds are produced. Nitric acid when pure, occurs in brilliant transparent crystals, its composition in 100 parts being nitrogen twenty-six, and oxygen seventy-four parts. In commerce it is only found mixed with water, its most concentrated form, that of fuming acid being 85.72 parts of anhydrous acid 13.28 of water. Its most usual form in commerce is sixty per cent. of pure acid and forty per cent. of water. It is, however, of various degrees of strength, often containing two-thirds of water. Nitrous acid is an unstable compound giving off deep red fumes. It is generated by the action of dilute nitric acid upon copper shavings, deutoxide or nitric oxide being first formed which, exposed to the air, absorbs more oxygen. The lowest oxide of nitrogen is the protoxide or nitrous oxide. It has a sweet taste but no odor or color. Ammonia, one of the more important compounds of nitrogen is an inflammable gas, very pungent to the smell and acrid to the taste. It is readily and abundantly formed by decaying organic bodies, containing nitrogen, for, in the process of decay, the elements of organic matters form new groupings generally simpler than the original substances. Thus a portion of nitrogen associates with a portion of hydrogen, and ammonia is formed. In the case of heating manure, it is the pungent gas. In the decay and decomposition of human urine, carbonate of ammonia is formed. So the carbonate of ammonia is formed in the manufacture of bone black. Commercial ammonia is mostly formed by the distillation of bituminous coal, and is a bye product in making illuminating gas.

NITRO-MURIATIC ACID. *Aqua regia.* A mixture of strong nitric and muriatic acid, whereby chlorine is evolved, which dissolves gold, platinum, and other metals.

NITROUS ACID. A pungent, orange-colored, volatile acid, consisting of one equivalent nitrogen and four oxygen.

NITROUS OXIDE. Protoxide of nitrogen, laughing gas.

NOCTURNAL. Of the night. Many birds and insects prey only at night, hence are nocturnal.

NODE. A knot or lump. A bony tumor. The swelling on the stems of plants where leaves start; also called nodi. A nodal point, in physics, is a place of rest, where several forces counterbalance one another.

NODOSUS. Knotty.

NODULE. Rounded, irregular lumps or masses.

NOGGING. In building, brick-work carried between uprights of timber scantling.

NOMENCLATURE. The language employed in scientific descriptions.

NON-CONDUCTOR. A substance incapable of conducting heat or electricity.

NONESUCH. *Medicago lupulina.* The black medick.

NOOTH'S APPARATUS. A series of three glass vessels, placed vertically, for the purpose of impregnating water with carbonic acid gas. The lower vessel contains the marble and muriatic acid for the evolution of the gas; the central vessel holds the water, under the pressure of the column of water in the third or upper vessel, which is closed by a conical stopper, which serves as a safety-valve.

NOPAL. The *Opuntia cochinillifera,* a cactus on which the cochineal insect lives; native of the sandy tracts of Mexico.

NORDHAUSEN SULPHURIC ACID. Fuming strong acid obtained by the distillation of green vitriol.

NORFOLK POLLED CATTLE. This is a subfamily of the Galloway, that have long since been bred in Norfolk. They are little known in this country, and according to Youatt while they retain much of the general form of their ancestors, the Galloways, they do not retain all their excellencies. They have been enlarged but not improved by a southern climate and a richer soil. They are usually red; some, however, are black, or either of these colors mixed with white, with a characteristic golden circle about the eye. They are taller than the Galloways, but thinner in the chine, flatter in the ribs, longer in the legs, somewhat better milkers, of greater weight when fattened, but not fattening so kindly, and the meat not quite equal in quality.

NORMAL. Regular, straight, usual.

NORMAN HORSE. (See French Horse.)

NORWAY MAPLE. (See Maple.)

NOSE-BAG. A bag containing corn or oats to be tied to the horse's nose.

NOSE-BAND. That part of the headstall of a bridle which comes across the nose.

NOTCHED. Crenate.

NOTCHED-BOARD. In building, the board which receives the ends of the steps of a staircase.

NOVACULITE. Home stone.

NUCLEUS. The point around which crystals or organized structures are developed; the origin. In botany, the upper, pulpy mass of an ovule; the interior of a seed. The shield of lichens.

NUCULA. A fruit like the acorn, or a one-seeded, hard seed-vessel.

NUDUS. Naked.

NURSERY. In horticulture, a nursery is a field or farm used exclusively for the propagation of trees and plants, and the cultivation thereof until they are of sufficient size for transplanting where they are to stand permanently.

Until within the last seventy years but little attention was paid to the rearing of nursery stock for sale, as a special industry, in the United States, and it is only within the last forty or fifty years that the great nurseries East and West have had a beginning. A competent authority states that very little attention was paid to the raising of fruits previous to the Revolution, except for the manufacture of cider. The first apples were raised upon Governor's Island, in the harbor of Boston, from which, on the 10th of October, 1639, ten fair pippins were brought, there being not one apple or pear tree planted in any part of the country but upon that island. The first nursery of young trees in this country was that planted by Governor Endicott on his farm at Salem, now Danvers, in 1640, and it is related that he sold five hundred apple trees for two hundred and fifty acres of land. The systematic cultivation of fruit was not common in this country previous to the Revolution. Orchards were set out upon many farms, but they were designed chiefly for cider. Much greater care, however, was taken to raise good fruits in New York, New Jersey, and Pennsylvania than in New England, and several noted orchards and nurseries existed there in the latter part of the last century and the early part of the present, but they were the exception to the general rule even there. Choice varieties of apples, pears, peaches and cherries were known only to a few careful cultivators, and the number of varieties of these was quite limited as compared with the present day. Cider was plenty, but its quality was much less regarded than its quantity. It is stated that so late as 1825 there was not a nursery for the sale of apple and pear trees in New England. Trees had to be bought in New York or New Jersey, or imported from abroad. The first horticultural society in the country was established in 1829. The orchard products, according to the census of 1870 were $48,000,000, and the general culture of fruit has since rapidly progressed. We have now nurseries established for growing certain given varieties of trees, as forest trees, and even evergreen trees solely. One nursery in Illinois, devoted solely to evergreens, has disposed of over 20,000,000 in one year. As a rule however, the nurseryman grows or deals in a variety of trees and plants, and as in the case of one of the great nurseries of Rochester, N. Y., there is hardly a plant of use or ornament, whether native or exotic, hardy or to be cultivated only under glass, but that may be obtained. The same may be said of one of the great Bloomington, Ill., nurseries. In preparing the nursery grounds, the most important point to be attended to in the West is thorough drainage by means of tile. One of the most successful nurserymen in the West, located at Springfield, Ill., stated to the writer that the measure of his great success was in first thoroughly tiling his land, dry and wet alike, to a depth of three feet. Thus, there are no waste places; there was also no hunting after particular locations for particular plants, no weak places in the rows, and comparatively few inferior or cull stock, and the subsequent expense of cultivation is lightened and the growth forwarded to fully reimburse the interest on the cost of the permanent investment and wear of the drainage, this last being in carefully laid tile hardly to be estimated. It will hardly pay the general farmer to raise his own nursery stock, since he can buy his plants and trees much cheaper than he can grow the seedlings and graft or bud them. The same may be said of ornamental and forest trees, both deciduous and evergreen. In the case, however, where quantities of forest trees, or even where small groves and wind breaks are to be planted, it is altogether better that the trees be bought, quite young, and planted in nursery rows, to remain there until of a size for final transplanting where they are to stand. Thus, seedling conifers from four to twelve inches high, and deciduous trees one or two years old, and nursery stock either recent grafts or of one year's growth, may be ordered and planted out, the evergreens in rows two feet apart and pretty thick in the rows. As they begin to crowd each other in the row, take out every other one until they stand two by two feet. Then take out every other row, and again every other plant in the remaining rows. Those left will make specimen plants for various ornamental purposes. Deciduous seedlings should be planted four feet apart, as to the rows, by twelve inches in the row, thinning out as may be necessary, as heretofore directed Eventually, they may stand sixteen by sixteen feet, and these may be allowed to grow up into a grove, or the wind break may be planted thickly and thinned out as necessary, leaving enough to stand for permanent growth. The idea in all this is that trees and plants while young can be cultivated and taken care of more economically in compact bodies than when planted out at the distances at which they are finally to stand. One plant will also support and act as a nurse to another if not too much crowded. The pruning, pinching, and training is more easily performed, and they may stand in the home nursery much longer and be transplanted far more safely than direct from the commercial nursery rooms, and for the reason that they will not have to be carried long distances. Thus by buying quite young stock (maiden trees) they may stand until quite of large size, four or five years for apples and pears, three to four years for plums and cherries, and be safely transplanted with an abundance of fibrous roots, especially if they have been root-pruned the June previous to being finally transplanted. This is done by thrusting a sharp spade deeply down to cut the leading roots at a distance of eighteen inches to two feet from the stem of the tree, according to size. Thus, they will be found the succeeding spring to be furnished with an abundance of fibrous roots. It would be better that this root pruning be done two years before the final transplanting, when the roots may be cut from fifteen to eighteen inches from the stems of the trees. Thus a five or six year old tree may be transplanted and with ordinary care will scarcely be checked in growth. In relation to the home nursery and training, Dr. Warder, the veteran and venerable pomologist, says: Trimming should be practiced in the nursery with a definite object in view, and not at random; much less with any expectation of increasing the height of the trees by trimming them up. The object in pruning nursery trees should be to develop them in every part, to produce a stout, stocky, sturdy little tree, one that may be turned out upon the bleak prairie, and be able to withstand the blasts. To produce this result, the leaves should never be stripped from the shoots to make them extend their growth, for the sake of making more leaves; the nurseryman should know the value of leaves, as constituting the great evaporating surface that plays a most important part in causing the ascent of the crude sap. and also in its elaboration after it has been taken up into the organization of the plant. Leaves should be carefully preserved, and in the trimming, which is necessary, this should be borne in mind. To make vigorous, stocky trees, the side branches should be encouraged rather than pruned off. The tops may sometimes need to be pinched, to force out the laterals, and to encourage their growth; if two shoots start together as rivals, one of them should be topped or cut back, or twisted and broken, but not cut off at its origin, unless there be plenty of lateral branches or twigs to furnish the tree. When these become too long, they may be spurred-in, either in the fall and winter when cutting grafts, or in the summer, during the growing season. Whenever it becomes necessary to trim off any of these laterals, it is best to do it at mid-summer, as the healing of the wounds made at this period is very rapid. Heading off the nursery trees is to force them to branch uniformly the second year, to form their heads at the right place; this is to be done toward spring, and is applicable especially to those varieties that are prone to make a single shoot the first year without branching, and which have not been pinched in or headed during the previous summer to force out side branches. Cherries, plums, and pears, and some apples, are very apt to make this kind of growth. It should have been premised that all nursery trees ought to be grown to one main stem, or leader, from which all the branches arise, and to which they should all be made to contribute their quota of woody fiber. It has been asserted that the wood of a tree, instead of being a cone, as its stem appears to be and is, it should be a column of nearly equal size from the bottom to the top; that is, the mass of all the branches taken together, should equal the diameter of the trunk at any point below. A well-grown, stocky nursery tree, with its abundance of lateral branches approximates this idea; but the main stem of such an one is very perceptibly a cone, rapidly diminishing in diameter from the collar upwards. The age of trees for planting depends so much upon the views of planters, that the nurseryman can not always control the period at which he shall clear a block of trees. Peaches should always be removed at one year from the bud. Plums and dwarf pears will be ready to go off at two years from the bud or graft; so with apples and cherries. But many persons, purchasers and sellers, prefer larger trees, and they recommend that the trees should remain one, two, or even three years longer in the nursery. Others, a new school of planters, prefer to set out the maiden tree, in most of the species above named, except some very feebly growing varieties, that will scarcely have attained sufficient size to risk in the orchard. The nurseryman should beware of keeping his trees too long on his hands; they may become unprofitable stock, and are sure to require much more labor in the digging and handling. The purchaser is his own master, and his tastes and wishes must be consulted; if he wants large trees, by all means let him be indulged; he will have to pay in proportion, he will have more wood for his money, more weight to carry, or more transportation to pay for, more labor in planting, and vastly increased risk of the life of his trees; but, let him be indulged with his five-year-old trees, while his neighbor, for a smaller sum invested, with less freight, less wood, less labor, and infinitely less risk, will plant his maiden trees, and five years after will market more fruit. The nursery orchard, as practiced by A. R. Whitney, of Illinois, one of the largest orchardists of the country, is well worthy of imitation by all those nurserymen, who desire also to become fruit-growers. In laying off the blocks of nursery stock, the varieties that are wanted for the orchard, should be planted in such a manner that they shall be in every fourth row, so that the orchard trees will stand in rows sixteen to twenty feet apart, according as the nursery-rows are four or five feet wide. In cultivating and trimming these rows in the nursery, a plant is selected, every twelve or sixteen feet, which is to remain as the orchard tree when the block shall be cleared. A good tree is selected, and special care in the pruning is bestowed upon it to secure the desired form, and low branches; if necessary, the tree on either side of it is removed, to give it room. By the time the block is cleared, these orchard trees are often in bearing, and while his customers are struggling to save their trees, and nursing them after their transplanting, the nurseryman will have become an orchardist, and is enjoying his fruits. The nursery will have become an orchard — one rather closely planted to be sure—but the trees can be dwarfed by root pruning with the plow, they shelter one another from the prairie blasts, and when too thick, alternate trees may be removed to the wood-pile, and thus cheer the owner on a winter's day. Winter-killing is a serious evil in the nursery, as by it whole rows and blocks of certain varieties are sometimes destroyed, or very seriously injured. It has been observed to be most marked in its effects upon those sorts of trees that make the most vigorous and sappy growth, as well as that class which continue to grow late in the season. Such varieties have very naturally acquired the epithet of tender, especially as orchard trees of the same kinds, even in a bearing state, have been similarly affected; in some sections of the country, these kinds have been thrown out of cultivation. The bark looks shriveled and withered, the twigs seem dry when cut, and resist the knife; when thawed by the fire, or on the return of spring weather, the bark seems loose, and the inner bark, instead of being greenish-white, becomes brown, and the whole tree looks as though it was dead. In old trees, large portions of the bark start from the stem and large limbs, and hang loosely for awhile and then fall off. The buds alone retain their vitality, and upon the return of spring they sometimes succeed in establishing the necessary connection with the soil, and restore the circulation of the sap; the results are the deposit of the usual annular layer of woody matter, which encases the dead portions within, that become like a sequestrum of dead bone in an animal. The best treatment for the trees that have been winter-killed, is to cut them back very severely, in the hope of producing a vigorous wood-growth the next season, to repair the injury. A partial winter-killing often affects small nursery trees, especially on low and wet, undrained soils; the plants recover, but for years they have a black place in the heart which embraces all of the wood-growth that was affected—all their wood at the period of the disaster. This is enclosed and surrounded by clear healthy wood; but such trees are not desirable, they are so fragile, as to be easily broken. The best preventive for winter-killing in the nursery, is to encourage the early ripening of the wood, and to drain the land, is one of the best means of producing this effect, another is the cessation of culture at midsummer, and the sowing of oats very thick at the last cultivation, has been practiced, and, it is thought, with excellent effects. The rank growth absorbs the superfluous moisture, robbing the trees, and afterward forms a good protective mulch during the winter. The objections to it are, that it encourages the mice, which, by girdling the trees, effectually winter-kills them. Many nursery and orchard trees often present a black discoloration of the bark, which is quite unsightly, and excites alarm for the health of the tree. This is often caused by trimming at unfavorable periods; in the spring pruning of bearing trees, the large stumps sometimes bleed, but in the nursery trees it arises from cutting them, and especially in the barbarous trimming up, during severely cold weather, when they are frozen.

NUTS. In a botanical sense, a nut is the fruit of a tree or shrub, consisting of a hard shell enclosing the germ and its envelopes, called the kernel. Thus the hickory, walnut, hazel, chestnut, beech, and oaks bear nuts. The seed of the peach, plum, cherry, almond, olive, etc., are termed stones or pits, (drupes,) and those of the apple, pear, orange, lemon, etc., are pips. Thus nuts are kernels contained directly in a more or less hard shell; drupes, are nuts enveloped in a pulpy pericarp, or fleshy covering without valves; pip fruits are those fleshy fruits containing the seeds either directly in the pulp, or else in scaly compartments in the middle of the fruit. In mechanics a nut is a small block of wood or metal containing a concave or female screw.

O

OAK. Trees of the genus *Quercus*, the most valuable of any genus of forest trees, remarkable for their close grain, durability, firmness, and toughness of timber; noted also for their majestic size, and handsome appearance. The white oak grows naturally in a rich, moist, loam, or rich sandy soil underlaid with clay, also on any moist, strong, clay soil. The bur oak (upland) grows on rich, rather dry soils called barren, and the swamp bur oak, on rich moist bottom lands. The barren scrub oak, and the black oak is found on the provost, sometimes on sands. The classification of American oaks, and including the European introduced species, by Michaux, are divided into two divisions as follows: White oak (*Quercus alba*), seventy to eighty feet high. Common European oak (*Quercus robur*), sixty to eighty feet high. European white oak (*Quercus robur pedunculata*), sixty to eighty feet high. Mossy-cup oak (*Quercus olivæ formis*), seventy to eighty feet high. Over-cup white oak (*Quercus macrocarpa*), seventy to eighty feet high. Post oak (*Quercus obtusiloba*), thirty to fifty feet high. Over-cup oak (*Quercus lyrata*), sixty to seventy feet high. Swamp white oak (*Quercus bicolor*), sixty to seventy feet high. Chestnut white oak (*Quercus prinos*), seventy to eighty feet high. Rock chestnut oak (*Quercus Montana*), thirty to forty feet high, Yellow oak (*Quercus acuminata*), sixty to seventy feet high. Small chestnut oak (*Quercus chinquapin*), a shrub of three to four feet high. Live oak (*Quercus virens*), evergreen, forty to sixty feet high. Cork oak (*Quercus suber*), Spanish tree. Willow oak (*Quercus phellos*), thirty to sixty feet high. Laurel oak (*Quercus imbricaria*), shingle oak, forty to fifty feet high. Upland willow oak (*Quercus cinerea*), evergreen Southern, twenty feet high. Running oak (*Quercus pumila*), two feet high. Second Section.—Leaves lobed. Bartram oak (*Quercus heterophylla*), said to be found only on one plantation. Water oak (*Quercus aquatica*), thirty to forty feet high. Black Jack oak (*Quercus ferruginea*), small, barren oak. Bear oak (*Quercus banisteri* var. *ilicifolia*), two to nine feet high. Barren scrub oak (*Quercus Catesbæi*), fifteen to thirty feet high. Spanish oak (*Quercus falcata*), seventy to eighty feet high. Black oak (*Quercus tinctoria*), sixty to seventy feet high. Scarlet oak (*Quercus coccinea*), eighty feet high; produces brownish ink galls. Gray oak (*Quercus ambigua*), a hybrid, seventy to eighty feet high. Pin oak (*Quercus palustris*), forty to sixty feet high. Red oak (*Quercus rubra*), seventy to eighty feet high. To this list may be added the Southern oak, *Q. Michaux*. Others have also been added, but the list we have given compose the important species.

OAK APPLE. Spongy excrescences on the young branches of various oaks, and produced by insects of the genus *Cynips*, are called oak apples. When they become hard they are called oak galls, and are used in the manufacture of ink and for other purposes. They contain a large amount of tannin.

OAK INSECTS. The oaks are subject to the attacks of various insects, including the leaves, the young wood, the inner bark, and also boring into the solid wood. Of the latter the borers, especially the water borers, are particularly destructive to the timber. The oak twig pruner, *Stenocorus putator*, (*Elaphidion villosum*,) deposits an egg in the tender twig, which hatching the grub subsists upon the pith until fully grown. It then gnaws away the wood, and retiring backwards, waits until the branch falls to the ground, when it is in due time transformed into the perfect insect. Sometimes, branches several feet in length and an inch in diameter are thus severed. Their destruction is easy by collecting and burning the fallen branches. The same means will apply to all the twig pruners. The following is a list of insects the larva of which attack the wood and dead leaves of the oak, which with the succeeding will be of interest to many readers: *Chrysobothris femorata*, wood; *Chrysobothris calcarata*, white oak wood; *Chrysobothris dentipes*, wood; *Agrilus*, Europe, some, in wood; *Throscus*, Europe, some, in wood, wainscoting; *Eucnemidæ*, wood; *Fornax*, stumps; *Alaus ocu-*

latus, wood; *Alaus myops*, wood; *Ptilodactyla elaterina*, wood; *Prionocyphon discoideus*, hollow stumps, in water; *Dictyopterus sanguineus*, Europe, under bark; *Tillus ambulans*, wood; *Cistela ceramboides*, Europe, in oak; *Lagria hirta*, Europe, dead leaves; *Pyrochroa coccinea*, rotten wood; *Synchroa punctata*, rotten wood; *Lucanus dama*, wood; *Platycerus quercus*. wood; *Passalus cornutus*, wood; *Lymexylon navale*, Europe, ship timber and wood; *Lymexylon sericeum*, wood; *Hylocœtus Americanus*, wood; *Ptilinus pectinicornis*, Europe, wood. Insects attacking the foliage are as follows: *Macrodactylus subspinosus*, foliage; *Lachnosterna fusca*, foliage; *Lachnosterna micans*, foliage; *Lachnosterna hirtacula*, foliage; *Holotrichia crenulata*, foliage; *Trichestes tristis*, foliage; *Polyphylla variolosa*, foliage; *Cotalpa lanigera*, foliage; *Osmoderma scabra*, foliage. The following insects attack the stumps or work under the bark: *Centronopus calcaratus*, stumps of black oak; *Xylopinus saperdoides*, stumps of black oak; *Helops micans*, under bark; *Pseudoclerus ichneumoneus*, under bark, probably destroying other insects. The oak also suffers from the attack of phylloxera, principally inhabiting the leaf galls, but found generally on the hickory; as the American oak phylloxera, *P. Rileyi*, which, says Dr. Riley, is found on the under side of the white and post oaks, in the wingless state. Of insects not given in the previous list attacking the oak, Dr. Thomas gives the following: *Tremex columba*, *Xylentes robiniæ*, *Pandeletrius hilaris*, *Lucanus elephus*, *Phyllophaga fracerna*, *P. pilosicollis*, *P. fusca*.

OAT. *Avena sativa*. The native country of the cultivated oats like most of our cultivated grains is uncertain. It was in earlier times, cultivated extensively as food for man, and of late years, since improved processes in hulling and preparing the grain have been invented, its use as a most healthy and nutritious food is yearly increasing. The best and heaviest oats are raised in cool and moist climates; Scotland and Friesland, having long been noted for the superior weight and quality of the crop. In the United States, Canada, Wisconsin, and the Red river country of the North are eminently adapted to the cultivation of the crop. Oats are said to have been cultivated in Massachusetts as early as 1602. As in England their great use is as food for horses, than which there is no other grain that alone can take the place, where fast work is demanded. Skinless oats, *Avena nana*, have from time to time been introduced under various names, but they shell so easily and suffer from so many contingencies that their cultivation is not profitable. Oats like a firm, strong, moderately dry clay or loam, though they may be successfully cultivated on lighter soils, if not too dry, than for most other cereals. Excelsior, White Shonen, Potato oats, New Brunswick, White and Black Swedish, Red, or rust proof oats, (for the South,) Hopetoun, Yellow, (remarkably early,) Wythe, King William, Goochland, Wilkes' Blount, Clark, Sandy, Board of Trade, (probably White Norway,) Tartarian, Poland, White Dutch, Surprise, and Probsteir, are all varieties that have succeeded well. These varieties are not really new as to the list, but new, or comparatively so, to the United States. Among the varieties that have done well generally, may be mentioned, Potato, Poland, Surprise, White Shonen, Tartarian, Somerset, and Probsteir. The average yield of oats for the United States may be stated at thirty to thirty-five bushels. Upon good land, well prepared, and in good seasons, the yield will average forty bushels, and in particular instances the crop will give eighty and even 100 bushels per acre. As an instance of what may be done by manuring on thin soil, at the Massachusetts Agricultural College, on a rocky, drift soil, a plot without manure gave fifteen bushels per acre, with manure the yield was sixty-two bushels per acre. In relation to the value of sowing clean seed, an experiment at the Agricultural College of the University of Wisconsin, made by Prof. Daniels, reports that, repeating an experiment made in 1871, he sowed May 24, 1872, two adjacent plots, each of 112 square rods, with Surprise oats, fifty-four quarts to each plot. The seed on one plot had been well cleaned from chaff and light grain, and the seed on the other plot was sown as taken from the bin; weight of the cleaned seed, sixty-six and three-quarter pounds, and of the uncleaned, sixty-two and one-half. The following table summarizes the results for the two years:

Preparation of seed.	Weight of product per bushel, pounds.		Yield per acre, bushels.	
	1871.	1872.	1871.	1872.
Cleaned	35.50	25.00	48.25	17.50
Uncleaned......	33.50	25.00	43.75	15.30

In the prairie region of the West oats should always be sown on fall plowing, and as early in the spring after wheat sowing, as the soil is dry and in good condition for working. Late sown oats are as a rule light from the heat and drought of the advancing season. Nevertheless oats should not sprout until all danger of extreme frost is over. Yet we have never had oats killed if sown at any time after the frost is out and the ground settled in spring.

OBESITY. Extreme or morbid fatness.

OBJECT GLASS. The glass, or lens, of the telescope nearest the object.

OBLATE. Somewhat spherical, but flattened in the perpendicular axis, as an orange, the world.

OBSIDIAN. A black, glassy, compact lava, consisting of potash and soda, seven to ten per cent.; silica 77.50; alumina 11.75; iron 1.25.

OBTUNDENTS. Mucilaginous, oily, or bland substances, which reduce the acrimony of other medicines.

OCCIPITAL BONE. The bone which forms the back portion of the skull, to which the spinal column is attached.

OCHRE. Peroxide of iron mixed with clay; the color is very durable.

OCHREA. The leaf-stems which clasp or surround the stem, as in the case of some grasses.

OCTAGON. A superficial figure, with eight sides or angles.

OCTAHEDRON. A solid, with eight regular sides; it is one of the most common figures of crystals, and may be a derivative from the cube or tetrahedron.

OCTANDRIA. The Linnæan class, in which the flowers contain eight stamens.

ODERITE. A species of black mica.

ODOMETER. A wheel, the axis of which turns a graduated scale, so that the distance over which it passes on a road is recorded in feet and miles. It may be attached to a carriage wheel, or to that of any vehicle.

ODONTOLOGY. A treatise on the teeth.

ODORIN. A very concentrated empyreumatic oil, obtained by rectifiying oil of bones.

ŒDEMA. Puffiness of a part of the body, produced by a dropsical effusion or collection of watery fluid.

ŒNANTHIC ETHER. A volatile oily body, to which the peculiar vinous flavor of wine is owing; by boiling with potash it becomes converted into œnanthic acid and alcohol.

ŒSOPHAGUS. The gullet or swallow.

ŒSTRUS. The genus of Gad Flies. (See Bots.)

OFFSET. In building, the superior surface left uncovered by the continuation upward of a wall where the thickness diminishes, forming a ledge.

OFFSETS. In surveying, short distances from the chain-line, usually measured with a rod, called an offset-staff, the most convenient length for which is six feet 7.2 inches, being equal to ten links of the surveying chain. In gardening, young radical bulbs, when separated or taken off from the parent roots, are so called. One of the chief methods of propagating plants is by offsets.

OFFSPRING. (See Breeding, Generation, etc.)

OGEE. In molding, is a line resembling the italic *f*.

OGIVE. The pointed arch.

OIDIUM. (See Fungus.)

OIL. The oils consist principally of carbon and hydrogen, they, however, have a great affinity for oxygen, and if exposed to the air soon absorb oxygen and thus become rancid, since besides oleine they contain more or less of other matter. Hence, the reason why fats so soon become putrid, so oils when oxydized either become rancid or are converted into resins. The fluid fats, oils of vegetables and animals, agree very closely as to their structure, as the following table will show, the constituents being those of a well known vegetable and an animal oil:

	Carbon.	Hydrogen.	Oxygen.
Olive oil consists of	77.2	13.3	9.5
Spermaceti "	78.9	11.8	10.2

Oils are divided into expressed or fixed oils, which are also subdivided into drying oils and common oils, and into distilled or essential oils. The common fat oils are like almond and olive, bland, preserving their flavor for a time, but at length becoming rancid; palm oil is solid. The drying oils are like linseed, hemp seed, nut oil; they attract oxygen readily from the air, evolving heat, and become solid. The essential oils impart to flowers and aromatic bodies their odor; they are very volatile, and are obtained by distilling the leaves or flowers with water. All vegetables contain a proportion of oil of some of these varieties, which may be obtained by digesting them in ether and alcohol; it is, however, frequently below one per cent., while in other cases, as the nut, it is more than sixty per cent. In provender, the fattening quality is closely related to the percentage of common oil. The following table shows the per cent.:

Product.	Per cen
Common maize	8 to 12
Rice	0.8
Oats	5.5
Rye	1.8
Rye flour	3.5
Hard wheat	2.6
Wheat flour	2.1
Fine bran	4.8
Coarse bran	5.2
Dry clover	4.0
Dry lucerne	3.5
Meadow hay	3.8
Oat straw	1.1
Bean meal	2.1
Beans	2.0
Peas	2.0
Lentils	2.5
Potatoes	0.08
Mangel-wurzel	0.1
Carrots	0.17
Oil-cake	9.0 to 15

M. Payen found that the oil was everywhere present in the seeds of gramineous plants. The embryo contains much, the husk less, the farinaceous portion still less; but maize and oil-cake contain about nine per cent., whence the universally admitted superior fattening power of these two articles, so often practically proved. The plants principally cultivated for oil, are the olive, linseed, castor, bean, rape, bene-plant, pea-nut, sunflower, etc. Corn is also worked for its oil to some extent. The principal animal oils, are procured from the fat of swine, the whale, the cod, and other fish, also from seals and other marine animals. The residue, both fish and animals, after the oil is expressed, makes a most valuable manure, and the residue of many of the oil bearing seeds are valuable for fattening animals, as that of linseed, the pea-nut, while the residue of all are valuable as manure. When the cotton seed of the South comes generally to be used in this way, it will add greatly to the productiveness of the soil. Wax is a substance nearly allied to the oil producing fats. In fats, oils, and wax, from various countries, now in the Museum of the Department of Agriculture at Washington, we find the following, which include a number of essential oils: There are about half a dozen samples of vegetable tallow and wax in this series. One specimen of the last named, the product of *Myrica jalapensis*, is received from Mexico. The vegetable wax of China and Japan is produced from the fruit of several trees belonging to the genus *Rhus*. The most important of these is *Rhus succedanea*, and is grown extensively. *Rhus vernicifera*, the lacquer tree, also yields a wax, differing only in a slight degree from that of the wax-tree mentioned above. *Rhus sylvestris*, or the wild wax-tree is also worthy of mention. Vegetable tallow is produced in Japan from the *Cinnamomum pedunculatum*. Other specimens of vegetable tallow and wax are from the valley of the Amazon. The oils are quite numerous, and, where it has been possible to do so, the vegetable products from whence derived are shown with them. Linseed and the more common oils have been received from various countries. The Russian collections included oils of anise, mustard, hempseed, walnuts, sunflower, wild rape, camline seed and poppy, with a few specimens of the refuse or oil cake. Oils of Japan are represented by rape-seed oil, which is used for illuminating purposes, together with fish oil in Japanese households. The South American collection is quite interesting, and includes gingelly oil, (*Sesamum indicum*), cocos oil, from the cocos-palm, secua oil, (from a cucurbitaceous plant), seje oil, from another species of palm, crab oil, from *Carapa guianensis*, ground-nut oil, castor oil, etc. Linseed, ricinus, and cotton-seed oils are shown from our own country, the last named in connection with its principal manufacture, that of soap, a full series of which is shown. A valuable collection of essential oils was purchased for exhibition at Philadelphia, and these have since been added to the museum collections. Among them may be mentioned oils of hemlock, wintergreen, wormwood, golden rod, peppermint, spearmint, sassafras, pennyroyal, bergamot, cedar, oil of neroli, etc., the last named from flowers of *Citrus aurantiacum*, oil of sweet birch, (bark of *Betula lenta*), and oil from roots and stems of several species of *Spirœa* are shown. Among the animal products in this subsection are many specimens of beeswax, both native and foreign. A few animal-fats are also shown from South America; candles and soaps are also included in this group, limited collections of which were received from various localities. The mineral products are represented by series of coal-oils and petroleum, principally from our own country. Specimens of raw and crude paraffine are also exhibited, with some of the products of petroleum, as benzine, naphtha, etc. In this connection may be briefly mentioned a number of specimens of water-proof goods, canvas, leather, wood, etc., rendered so by paraffine in solution. They are impervious to water while freely admitting air.

OIL-CAKE. The remains of seeds, especially linseed, after expression for oil. Linseed and several other oil-cakes are used for fattening. It is remarkably rich in oil, containing often fifteen per cent., and ranks high as nutriment. Rape, mustard, hemp, castor oil, and other cakes are admirable manures. The Flemish mix them with their fluid manure.

OIL, FUSIL. A volatile aromatic oil formed in the fermentation of potatoes or grains where hops are not employed, and which yield an alkaline mash; it comes over in the last portion of the distillation for the alcohol; when concentrated, it is oily and very nauseous.

OIL OF SPIKE. (See Lavender.)

OIL OF VITRIOL. Sulphuric acid.

OIL OF WINE. Two liquid oily bodies, as well as the œnanthic ether, are known by this name; the former arises from distilling ether off caustic lime, and are sulphates of the oxide of ethyl.

OKRA. *Hibiscus esculentus.* A plant producing handsome flowers, and mucilaginous pods, valuable for soups, stews, etc., much esteemed at the South, and also in the West, being both healthful and nutritious. It is a principal ingredient of Gumbo which may be called the national dish of the South and of France as well, where it is also highly prized and from whence the dish, known South as Gambo, originally came; the French residents of Louisiana and other Southern States using it largely in many of those delicious dishes, the making of which came from their ancestors. Being as tender as the tomato, the seeds should not be planted until after the middle of May, in the North, or not until corn is up and of a healthy color. It is better, like Lima beans, if sown in troughs by nailing strips of siding as a back against the edge of fencing, each sawed three feet long. Thus the back of one trough makes the front of another. When six inches high, or when the nights are permanently warm, transplant three feet by three, in very rich soil, having two or three plants in a place. Thus you may often have okra to cut by the first of August, or even the middle of July, and thence forward until frost comes. The pods should be taken when two or three inches long and while yet tender, since, if left they soon become stringy. The ripe seeds are sometimes used to mix with coffee, and really is one of the best adulterations known, if a healthy substitute may be called adulteration.

OLEACEÆ. The family of trees and shrubs containing the olive, ash, and privet.

OLEANDER. *Nerium oleander.* A beautiful evergreen, with large, rosaceous flowers. It requires shelter in the green-house, or in a dry light cellar in winter, and is propagated with ease by cuttings kept moist. The leaves, however, are poisonous if eaten by animals, and children should be warned against eating them. The Oleander is peculiarily subject to "Mealy bug" when kept during winter in living rooms with their dry atmosphere, and hence should be wintered in a cool, dry cellar.

OLECRANON. The bone of the elbow. A process of the ulna.

OLEFIANT GAS. An inflammable gas, condensing spontaneously into a fluid oil, with an aromatic odor. It consists of two atoms carbon and two hydrogen.

OLEIC ACID. The acid of oleine (*elain*), or the fluid portions of fats, separated by alkalies from the glycerine.

OLEOMARGARINE. A preparation of the fat of neat cattle, much used of late years for making fictitious butter, and for adulterating butter and cheese. When prepared in a cleanly manner, and from healthy fat, it is nearly identical in its composition with true butter, and fully equal in nutrition, but lacks, of course, the aroma which is sought to be supplied in some respects, in various ways. Strict laws have been passed in some of the States, against its sale except under its true name. Yet large quantities are palmed off on the unsuspecting, and many dishonest dealers and makers of butter and cheese employ its use. Recent analysis of several samples of butter from various sources and also of three samples of oleomargarine, by the chemist of the Department of Agriculture, will show the near identity of these different fats. The large quantity of sugar in the New York butter and in samples of oleomargarine, No. 7 and 8 are undoubtedly due to artificial means. The chemist, in his report adds: That the small quantity in the other samples may be due to the product of decomposition in the butter analyzed, which products deported themselves in a manner similar to sugar in their effects upon the reagents used in the analysis. The butters analyzed included the following, viz: One specimen each of Danish, Swiss, and French butter, one specimen each of Iowa butter of second quality, New York dairy butter, and oleo margarine bought in

Washington markets. Also two specimens of oleomargarine received from House Committee for District of Columbia.

No.	Name.	Fats.	Caseine.	Salt.	Sugar.	Water.	Total.
1	Danish	90.94	1.46	2.75	.52	4.17	99.84
2	Swiss..........	87.73	1.91	2.50	.65	6.35	99.14
3	French	87.36	.86	4.74	.18	6.80	99.94
4	Iowa...........	86.09	1.82	2.76	.13	9.05	99.85
5	New York	83.92	2.23	4.10	1.82	7.66	99.73
6	Oleomargarine	84.92	1.19	6.65	.60	5.89	99.25
7	Oleomargarine	84.72	.69	6.21	1.33	7.19	100.14
8	Oleomargarine	86.28	.59	5.05	1.26	6.85	100.03

In animal fats the fatty acids insoluble in water form from 93.5 to 96 per cent., while in true butter the insoluble fatty acids average from 85.5 to 87.5 per cent. of the butter fat, and never exceeds 89.6 per cent. Hence, since in the sample of oleomargarine No. 6 the fatty acids equal 95.96 per cent. of the fats, it will be seen that this sample of oleomargarine was made from animal fats to which had been added a little milk in the process or manufacture. In washing a true butter with water, the water becomes milky, and a portion of these washings under the microscope show a vast number of fat globules present in the buttermilk contained in the butter. The specimens of oleomargarine No. 7 and 8, on the contrary, give a nearly clear water by washing, and this water is almost entirely destitute of fat globules, except that, since milk is used in their manufacture to a limited extent, there was found a comparatively small number of fat globules in the washings of these specimens of oleomargarine. In relation to the history and manufacture of oleomargarine, as practiced in New York, and given in the Transactions of the American Dairymen's Association, for 1878, we quote as follows: About the year 1870, we begin to read of the application for and the granting of patents for improvements in the processes of refining oils and fats; very modest in their pretensions at first, but growing bolder and more startling in their claims with their order of succession. The first process was patented by H. W. Bradley, January 3, 1871. His specifications claim that his invention relates to a new composition for lard, butter or shortening, whereby a very cheap lard or butter is manufactured, superior to ordinary shortening, and answering the purpose of lard, butter or cream for culinary and other purposes. The product manufactured was composed of beef or mutton tallow, refined vegetable oils, and lard or stearine. This is a very modest claim. The next process proposed was patented by one Perouse, November 2, 1871. His claim had the one object, to enable the application of fine fats (especially beef fat) to alimentary and culinary purposes, and make such fat take a position between lard and butter, give it a good appearance, smell and taste, and also give it digestible qualities far superior to the freshest butter or lard. The product made by this patent was a mixture of beef fat, carbonate of soda, chloride of alumina and sodium, and bore no resemblance to butter. The next process patented worth considering was by Paraf, in April, 1873. The specifications and claims in this patent approach nearer to the true process for the manufacture of artificial butter. The product manufactured under Paraf's patent was called oleomargarine because butter was at one time considered to be a compound chiefly composed of oleine and margarine, but later investigations show margarine to be a mixture of palmatine and stearine. Paraf, started a large company called the Oleomargarine Manufacturing Company, in New York city, having for its object the manufacture of the oleomargarine, so-called. The product manufactured by Paraf's patent resembles butter when seen at a distance, but, on examination with a microscope, was seen to have a distinct grain, which was very distinguishable on tasting; it possessed no odor or flavor of butter, and, after keeping a short time, lost its color, and acquired the odor of beef suet, from which it was made. The next process, and it is one similar to Paraf's, was first patented in England, by Mége, in 1869, and afterwards in this country, in 1873, and finally re-issued May 12, 1874. This re-issue contains all the valuable points in both the English and American patents, and is now the property of the United States Dairy Company. These patents cover two principal operations in the manufacturing of butter from the fat of animals, viz: First, the extraction of the oil at a low temperature; and second, the converting of the oil, by churning with milk, into butter. Prof. Mott was employed by the United States Dairy Company, to make a series of experiments for the perfecting of the artificial product at their factory in Brooklyn, during a period of several months. He became satisfied that good butter could only be made by the use of the oil rendered at a very low temperature—below 125° Fahr. Whenever made at a higher temperature the oil, or the butter made from it, would smell like tallow after standing a few days, which smell would be sufficient to repel any butter buyer from purchasing it. This smell is occasioned by using oil rendered at a temperature above 125°, being tainted by the decomposition of the animal membranes. In conducting his experiments his object was to make a product containing no element foreign to the very best of butter. His first discovery was a process by which he was enabled completely to remove the grain from the artificial product of butter. This process is described in his true process of making artificial butter. How to introduce into this product the true odor and flavor of butter, without injuring its texture, was a problem of considerable difficulty, but after working at it for three months, it was finally discovered. Another patent is yet to be considered—that of Garret Cosine, dated February 15, 1876, for improvement in processes for making artificial butter. The object of this patent is to make two products, one for winter and the other for summer use. The winter product consists of oleine and fruit, or nut oil, flavored with milk and salt. The summer product is similar to that made by Paraf, and not salable in market. This patent of Cosine's is the most startling yet out, for even the nutty flavor of Jersey butter is attempted. With respect to the temperature stated by Brande for the melting point of fat being 100° Fahr., Prof. Mott found that he must evidently refer to fat freed from its membrane, as the fat can not be practically separated from its membrane under a temperature of 109° Fahr., and then only in very exceptional cases. As in the manufacture of natural butter, when a good product is to be obtained, the first and most important principle to be observed is entire cleanliness. Mott's process for making oleomargarine is as follows: The fat, on arriving at the factory, is first weighed, and then thrown into large tanks containing tepid water, care being taken to place all pieces that are dirty or bloody in a separate tank to be washed. The fat in the tanks should be covered with tepid water and soaked for an hour, when the water is drawn off and the fat thoroughly washed in cold water; then covered again with fresh cold water and allowed to stand an hour longer; the water is then again removed, and the fat thoroughly washed for the last time with fresh cold water, when it is ready for the next operation, which is the disintegrating or chopping process, which is done by passing it through a meat hasher or chopper, where it is cut by means of revolving knives very fine, and forced through a fine sieve out of the machine into a tub. In the melting process, the fat is next removed to the melting tank, care being taken to drain off all the water remaining. It is heated by means of water surrounding the tank, until the temperature reaches 116°, when the steam which heats the water is turned off. The water surrounding the tank being much warmer than the melted fat, increases its temperature to about 122° to 124°, when the fat is completely melted. During the whole operation of melting, the fat must be constantly stirred to maintain an even temperature. The adipose membrane, called scrap, settles to the bottom, and a clear yellow oil floats on top. The melting process, when conducted rightly, takes two or three hours. The oil should then stand at least twenty-four or thirty-six hours to granulate, and the temperature of the room should be 80°. This is a very important operation, and must not be hurried, otherwise the stearine in the oil will not have time to crystallize. For the pressing process, the refined fat is removed to the press room, which should be of a temperature between 80° and 90°. It must not be so solid that it can not be easily worked with the fingers. It is next packed in cloths set in moulds, to form packages four inches wide, eight inches long, and one and one-half inches thick. These packages are then placed upon galvanized iron plates in the press at equal distances apart, and piled one above another until the press is filled. They are first subjected to a slight pressure, which is increased gradually until the oil begins to flow slowly. The oil is received in tin vessels, and the pressing is continued until no more oil can be obtained. The pressure is then removed, the plates unpacked, when cakes of pure white stearine, about eight by five inches long, and one-fourth of an inch thick appear. The stearine is now ready for sale, while the oil obtained from the press is removed to a cool place until it reaches a temperature of 70°, when it is ready for the next operation. The percentage of butyrine, caprine, caproine, etc., (essential oils of butter,) contained is so very small, (being derived from the milk in the last churning process,) that it is not sufficient to make the butter become rancid when decomposed; but quite sufficient, says Prof. Mott, to give to the butter the so much prized flavor and odor. The analysis of Prof. Mott of the two compounds shows that natural butter contains 7.6 per cent. of those flavoring oils, while the artificial butter contains only .26 per cent. of them; and this small portion, which is obtained from the milk in the process of churning, has not much effect upon the taste; and can not be expected to have. The oil at the proper temperature of 70°, is taken to the churning room; 100 pounds of oil are put into the churn at a time, with from fifteen to twenty pounds of sour milk. About two and a half or three ounces of a solution of annatto, to which has been added from one-half to three-fourths of an ounce of the bicarbonate of soda, must now be added, and the whole churned twelve or fifteen minutes, until milk, coloring matter and oil are thoroughly mixed together, when the whole mixture is withdrawn from the churn, through a hole in one end, and allowed to fall into a tub containing pounded ice. As the oil flows on the ice it must be kept in constant motion until the tub is filled with solidified oil. Crystallization is by this simple process completely prevented. The solidified oil, which now has an orange color, is left two or three hours in contact with the ice in the tub, when it is dumped upon an inclined table, where it is crumbled so that the ice may melt and leave the oil, which is crumbled by hand fine, and about thirty pounds at a time again introduced into the churn, with twenty or twenty-five pounds of churned sour milk, and churned for fifteen minutes, when the solidified oil takes up a certain percentage of the milk, as also the flavor and odor, which were washed out by the ice after the first churning, and pure butter (?) is produced. This is now removed to the working table, where after draining it is salted to the extent of three-quarters to one ounce of salt to the pound of butter. After proper working it is packed in firkins and is ready for sale. The following tables give the percentage of fat, oil and butter realized in the manufacture of oleomargarine. Percentages by the melting process in 100 parts:

Refined fat	78.63	per cent.
Soap grease	4.31	" "
Scrap membrane	17.06	" "
Total	100	

By the pressing process, in 100 parts of refined fat:

Oil	76.31	per cent.
Stearine	23.69	" "
Total	100	

Per cent. of oil from 100 parts of caul fat:

Oil	60.00	per cent.
Stearine	18.63	" "
Scrap and soap grease	21.37	" "
Total	100	

By the churning process, in 100 parts oleomargarine butter:

Oil	83.00	per cent.
Salt, milk, etc	5.00	" "
Water	12.00	" "
Total	100	

Cost of manufacture per pound of butter:

This will equal the expenses per day, minus the amount realized by the sale of other products; thus if the expenses per day are	$96.25
And the receipts from other products sold are	15.66
Will leave the cost of the manufacture of the butter at	$80.59

This for 500 pounds, is equal to 16.1 cents per pound. This calculation is based upon paying ten cents a pound for the fat, and selling the butter made at twenty-five cents per pound. Prof. Arnold gives the composition of butter as follows: The fatty matter which enters into the composition of the butter globule consists of four varieties. The hardest of them is stearine, which, when separated, is a hard, white, flaky appearing fat. The second in consistency is palmatine, which resembles palm oil; most of the coloring matter in butter is connected with this fat. The third is called oleine, from its thin, oily consistency. The fourth consists of essential oils of the food of the cow, and which probably are as numerous as the varieties of food she consumes. These constitute the fats of which butter is made. Their origin is not perfectly clear; they are all ultimately derived from the food of the cow, but how much of them are elaborated in the body of the animal out of other elements of food is not well established. Their characteristics change with the condition and quality of the food, and with the constitutional peculiarities of cows. The fats from different cows living on the same food are often quite unlike, and in the same cow they change their qualities, such as color, density, odor and flavor, with the variations in food, as to its age, succulence and abundance or scarcity of fat in it. Young food generally gives a higher flavor and color to these fats than that which is mature or approaching maturity. The percentage of these essential oils which enter into the composition of butter is very slight, amounting, on an average, to about two per cent. They are very variable in butter, by reason of feed and faulty making. The following is an analysis of the fats of butter by Prof. Mott, giving the constituents in natural and artificial butter:

Constituents.	Fats from Natural Butter.	Fats from Artificial Butter
Palmatine..................	20.33	22.32
Stearine..........................	42.77	46.94
Oleine............................	27.71	30.42
Butyrine. Caproine. Caprine.. Capryline } Essential or Vegetable Oils.......	9.19	.32
Total..........................	100.00	100.00

OLERACEOUS. Of the nature of culinary vegetables or pot herbs.

OLFACTORY NERVES. The first pair proceeding from the brain, and distributed in the nose. They constitute the sense of smell, and in some animals are most highly developed.

OLIBANUM. A fragrant Eastern gum resin. Frankincense.

OLIVE. The Olive has been successfully cultivated for many years on the coast of South Carolina, Georgia, Florida and Alabama; so far, however, more in an amateur way than with a view of reaping profit from pressing the oil. The olive, *Olea Europæa*, has always held rank as the most important oil-producing plant, until of late years, scientific horticulture and improved processes for expressing oils from various substances has rendered it less and less necessary for culinary use, and has furnished far cheaper substitutes for burning. Its history is given as follows: Homer mentions green olives in the garden of Alcinous and Laërtes, which were brought by Cecrops, the founder of Athens, to Greece. Minerva is related to have planted it with her own hand upon the consecrated locality of her citadel, by thrusting her spear into the ground. No temple or sacred place dedicated to her was without its olive tree. The olive belongs to the fruits which were promised to the Jews in Canaan. This tree was first brought to Italy in the year 571 before Christ, and at the time of Pliny had been carried over the Alps to Gaul and Spain. At the time of Cato, the Romans were acquainted with only nine kinds of olives, which, however, at the time of Pliny, had increased by cultivation to twelve. The cultivated olive tree, was distinguished from the wild olive by the ancients. Willkom is of opinion that the olive tree is indigenous in various parts of the Mediterranean region, Spain, and also in the southern portions of the Peninsula. He states that the olive forest of forty square miles at the foot of the Sierra Morena, to the south, between Andujar and Cordova, may have been entirely planted by hand. He is also of opinion that the olive forest, three leagues in length, situated further south, between Seville and Utrera, to the left of the Guadalquivir, consists of olive trees run wild, having small globular fruit possessing but little oil. He thinks that this forest could only have sprung up in consequence of the driving away of the Moors, or from the neglect of former olive plantations, as has been the case in other instances. He thinks himself, however, safe in stating that the hedges and forests of olives in the southern part of Spain may have arisen from indigenous plants. The wild olive tree forms forests and groves, not only in the plains of Seville, where it has certainly arisen from the running wild of originally cultivated olive trees, but in the mountains also, as in the Serrania da Ronda, etc. It is most frequently met with in wild sandstone mountains, rising to a height of 4,000 feet along the Straits of Gibraltar, between Algesiras and Alcalá de los Gázules, where, from 2,000 feet and upwards, it forms a principal constituent of the indescribably magnificent foliage which covers that mountain. Some early attempts were made to introduce the olive into the United States, and it would undoubtedly flourish on dry or rocky soils from southern Tennessee south. On page 685 is an illustration showing an olive branch and fruit, with blossom at the right. Mr. Jefferson, writing from Paris in 1787, remarked that, although the olive was a tree the least known in America, it was the most worthy of being known. Of all the gifts of heaven to man, said he, it is next to the most precious, if it be not the most precious. Perhaps it may claim a preference even to bread, because there is such an infinitude of vegetables which it renders a proper and comfortable nourishment. In passing the Alps at the Col de Tende, where they are mere masses of rocks, wherever there happens to be a little soil there are a number of olive trees and a village supported by them. Take away these trees, and the same ground in corn would not support a single family. A pound of oil, which can be bought for three or four pence sterling, is equivalent to many pounds of flesh by the quantity of vegetables it will prepare and render fit and comfortable food. Without this tree the country of

OLIVE BRANCH AND FRUIT.

Provence and territory of Genoa would not support one-half, perhaps not one-third, their present inhabitants. The nature of the soil is of little consequence, if it be dry. The trees are planted from fifteen to twenty feet apart, and, when tolerably good, will yield fifteen or twenty pounds of oil yearly, one with another. There are trees which yield much more. They begin to yield good crops at twenty years old, and last till killed by cold, which happens at some time or other, even in their best positions in France But they put out again from their roots. In Italy (I am told) they have trees two hundred years old. They afford an easy but constant employment through the year, and require so little nourishment, that if the soil be fit for any other production, it may be cultivated among the olive trees without injuring them. Wherever the orange will stand at all, experience shows that the olive will stand well, being a hardier tree. The olive is a low, branchy, evergreen tree, rising from twenty feet to thirty feet, with stiff, narrow, bluish-green leaves. The flowers are produced, in small axillary bunches, from wood of the former year, and appear in June, July, and August. Near Terni, in the vale of the cascade of Marmora, is a plantation above two miles in extent, supposed to be the same plants mentioned by Pliny as growing there in the first century. With protection from severe frost, Miller says, it may be maintained against a wall in the latitude of London. In Devonshire some trees have stood the climate for many years. It is to be hoped that the cultivation of the olive may be extended in the South. It would add one more means of revenue, and upon soils unfit for other crops. It is hardly probable that the pressing of the oil would be profitable, but the pickled fruit would be much superior to that imported. The following is the process of pickling in France: For each pound of the fruit, take a pound of good strong ashes, (those from the hickory wood are the best,) and an ounce of good slaked lime; mix the lime and ashes with water, until a soft paste or mortar is formed, into which stir or imbed the olives, and finish by covering the whole mass with a layer of dry ashes. Let them remain in this state until all the bitumen is extracted, which may be known by the stones slipping readily out of the pulp, when squeezed between the fore finger and thumb, for which purpose a few may be tried once an hour, or oftener, if desired. The length of time required for this, however, will depend entirely upon the quality of the ashes and lime, and may vary from two or three hours to as many days. As soon as the olives have been deprived of their bitterness, they must be cleanly washed, and put to soak in fresh water, which must be changed about once an hour, for twenty-four hours, when the taste of potash will have been removed, and the water cease to be discolored. The olives must then be put into bottles or jars, and a strong brine put over them, made from good alum, or other pure salt. This brine will generally require to be changed several times, in consequence of becoming ash-colored, after which, the bottles must be sealed air-tight; and, if kept in a cool, dry, dark place, the olives will keep good for years. Olives carefully cured after this plan, will be found less salt than those pickled in France, which are usually sold in this country, and will retain much of the nutty flavor of pure olive oil. We append a list from a late Spanish work on olives, of varieties, their uses, and adaptation to climates.

SPANISH VARIETIES EARLY MATURING FOR COLDER LOCALITIES.

Var. *Promiformis.*—Manzanillo; (French, *Ampoulleau.*)—Fruit above an inch in diameter, spherical, shining black.

Var. *Regalis.*—Sevillano: (French, *Pruneau de Catignac.*)—Fruit about an inch in diameter, ovate-spherical, blunt, bluish-black.

Var. *Bellotudo* or *Villotuda.*—Fruit about an inch long, egg-shaped: pericarp outside dark red, inside violet.

Var. *Redondillo.*—Fruit ovate-spherical, nearly an inch long; pericarp outside bluish-black, inside whitish. A rich yielder.

Var. *Ovalis.*—Lechin; Picholin; Acquillo; (French, *Saurine.*)—Fruit broad-oval, two-thirds of an inch long. A copious yielder.

Var. *Argentata.*—Nevadillo blanco; Doucel; Gorzalena; Moradillo; Ojiblanco; Olivo lucio. Fruit broad-ovate, an inch long, very blunt, not oblique. Quality and quantity of oil excellent.

Var. *Varal blanco.*—(French, *Blanquette.*)—Fruit ovate, globular, three-fourths of an inch long, neither pointed nor oblique, outside blackish-red.

Var. *Empeltre.*—Fruit ovate, an inch long, equable. Rich in oil of excellent quality, also one of the best for pickles. Outside violet, inside white.

Var. *Racimal.*—(French, *Bouteillan*, *Boutiniene*, *Ribien*, *Rapugette.*)—Fruit violet-colored, globose-ovate, about an inch long, neither pointed nor oblique. Bears regularly also on less fertile soil, and is one of the earliest to ripen.

Var. *Varal negro;* Alameno; (French, *Cayon*, *Nasies.*)—Fruit violet-black, spotted, globose-ovate, nearly an inch long, somewhat pointed. Bears richly.

Var. *Colchonudo.*—Fruit spheric, outside red, inside white, one inch in diameter, slightly pointed. Produces a large quantity of good oil.

Var. *Ogillo de Liebre.*—Fruit nearly spheric, outside violet-black, about one inch long, somewhat oblique

Var. *Carrasquena.*—(French, *Redouan de Cotignal.*)—Fruit black-red, almost spherical, slightly oblique, about an inch long Valuable both for oil and preserves.

Var. *Hispalensis.*—Gordal; Ocal; Olivo real..—Fruit black-gray, oblique, spherical, measuring fully an inch. Rather a large and quick growing tree. Fruit used in the green state for preserves, not used for table-oil.

Var. *Verdejo.*—Verdial. (French, *Verdal; Verdan.*)—Fruit black-violet, oblique spheric, pointed, about one inch long. Furnishes good oil, and resists best of all the cold.

SPANISH VARIETIES OF LATE MATURING FOR WARMER LOCALITIES.

Var. *Maxima.*—Madrileno, Olivo morcal.—Fruit over an inch long, cordate-globose, strongly pointed. Valuable for preserves.

Var. *Rostrata.*—Strong and tall plant, very hardy. Fruit black-reddish, over an inch long, oval, much pointed. Good for oil.

Var. *Ceratocarpa.* (French. *Odorant; Luquoise.*)—Fruit fully an inch long, oval, pointed.

Var. *Javaluno.*—Fruit black-gray, over an inch long, egg-shaped, somewhat oblique, gradually pointed. Rich in good oil.

Var. *Picudo.*—Fetudilla.—Fruit fully an inch long, egg-shaped, blunt at the base, pointed at the apex, with black-gray pulp. Good both for oil and preserves.

Var. *Nevadillo negro.*—Fruit egg-shaped, fully an inch long, with turned pointed apex. One of the richest of all varieties in yield, and ripens moderately early.

FRENCH VARIETIES MERGING INTO THE SPANISH KINDS.

Var. *Angulosa.*—Laurine.—For preserves.

Var. *Rouget.*—Marvailletto.—Produces a fine oil.

Var. *Atrorubens.*—Salierue. Saverne —Fruit dusted white. Furnishes one of the best of oils.

Var. *Variegata.*—Marbee. Pigale. Pigau.—Purple fruit, with white spots.

Var. *Le Palma.*—Oil very sweet, sparingly produced.

Var. *Atrovirens.*—Pointue. Punchuda.—Fruit large, with good oil.

Var. *Rubicans.*—Rougette.—Seed small, yield annual and large.

Var. *Alba.*—Olive blanche. Blancane. Tierge.—Productive, but inferior.

Var. *Caillet Rogue.*—Figanier.—Tree small. Fruit large, red. Oil good and produced in quantity.

Var. *Caillet Blanche.*—Fruit almost white, produced annually and copiously, yielding a superior oil.

Var. *Raymet.*—Fruit large, reddish. Oil copious and fine. This variety prefers a flat country.

Var. *Corignac.*—Fruit middle-sized, blunt. Oil obtained in considerable quantity, and of excellent quality.

Var. *Bermillaon:*—Vermillion.—Yields good table-oil. Tree very hardy.

OLIVILE. An amylaceous body obtained from the gum of the olive tree.

OLIVINE. A green, volcanic mineral. A silicate of magnesia and iron.

OMBROMETER. A rain gauge.

OMENTUM. The membrane or caul that lies over the intestines, and becomes loaded with fat.

OMNIVORES, OMNIVOROUS. Eating animal and vegetable food.

OMPHALODIUM. The point in the hilum or scar of a seed through which the nutritious vessels pass.

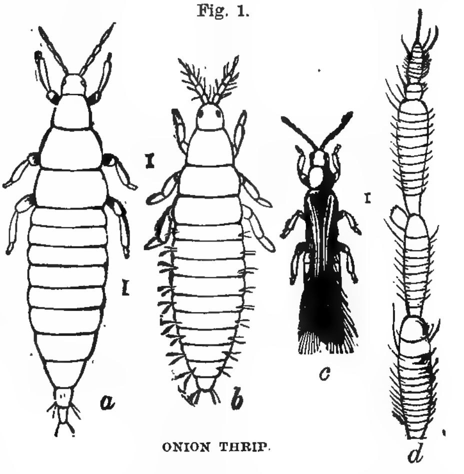
ONION. *Allium cepa.* The onion is one of the oldest cultivated as it is one of the most celebrated of ancient vegetables. In Egypt, it attained great excellence and mildness, probably from the steady heat, and constant moisture of irrigation in connection with the rich alluvial soil of the Nile. The Israelites in their wanderings in the desert, lamented the loss of onions as one of their privations. Of the Egyptians and their worship of the allium tribe, Juvenal wrote:

> Now Egypt, mad with superstition grown,
> Makes gods of monsters, but too well is known,
> 'Tis mortal sin an onion to devour,
> Each clove of garlic has a sacred power.
> Religious nation. sure! and blest abodes,
> Where ev'ry garden is o'errun with gods!

The onion is cultivated extensively in every civilized country, and forms a considerable article of transport from one place to another. Besides the general cultivation, vast quantities are grown along the Mississippi river in Iowa, for transportation South. In the Eastern States, especially in Connecticut, large quantities are grown for export. There are a great many varieties, but the Danvers Yellow and Large Red are principally cultivated for their keeping qualities, and the Silver Skin for pickling. The Yellow Strasburgh is also a valuable variety in general cultivation, but the two first named are preferred for shipping. The crop requires a rich, deep, mellow soil, heavily manured. It is better that they be sown as early in the spring as the ground can be worked on fall plowing. Three to four pounds of fresh seed is the usual quantity sown per acre, in drills eighteen inches apart, and half an inch deep. The cultivation is entirely by hand machines and superficial, working close to the crop. When the plants are three inches high, thin to two inches apart. Keep free from weeds, and as the bulbs begin to form, draw the earth away rather than to the bulbs. Never cultivate deeply, as it will injure the surface roots. As the crop gains size the tops gradually die down, and early sowings generally ripen in the West, in August. When the tops are entirely dry, the onions are collected into thin windrows, with spaces between to dry for a few days. When dry, the tops are pulled off, the bulbs cleaned of the rough skins, when they are ready for market. If the onions are to be stored for winter, they should be kept in a cool airy place, in thin layers, until late in the autumn, they are then carried to a cold dry cellar, and stored on racks, in layers six or eight inches deep. They may also be saved in heaps, out of doors, by piling in a dry place, just before hard frosts set in, covering carefully with hay, and then with earth, just so they will freeze slightly. Thus they should not be touched until the frost draws out of them naturally, when they must be immediately sold.

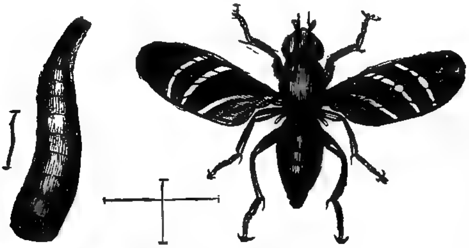
ONION, INSECTS INFESTING. Within the last ten years the onion crop of the United States has been seriously infested with insects, especially with the maggot, the larva of a European fly, and also a native species, which seem to have multiplied rapidly from some unknown cause. A minute Thrip, *Limothrips tritica* has also made its appearance. The cut,

Fig. 1.



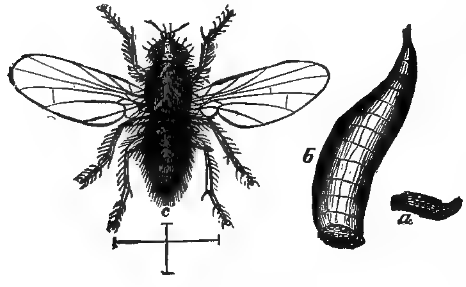
ONION THRIP.

Fig. 2.



NATIVE ONION FLY.

Fig. 3.



IMPORTED ONION FLY.

Fig. 1, shows the insect in its several stages, magnified, the hair lines showing the natural size. The figures *d*, *b*, show larvæ; *a*, male; *b*, female, and the figure at the right shows the antenna very highly magnified, as will be readily understood, when we recollect that the adult is less than an eighth of an inch in diameter; *c*, perfect insect. Of the onion fly, there are two species, the Native Onion Fly and maggot, (*Ortalis flexa*) shown at Fig. 2, enlarged, the hair line natural size. Fig. 3 shows the European Onion Worm, (*Anthomyia ceparum*), imported into the United States over forty years ago; *a*, natural size; *b*, maggot, and *c*, the fly magnified, the hair lines giving the natural size. The report on the Rocky Mountain Locust, and other injurious insects, for 1877, describes both species. The following is partly taken from the reports of Dr. Fitch, New York. Speaking of the imported fly, we find that in June, as soon as the young seedling-onions are only an inch or two in height, these insects commence their depredations and continue them through the whole season, getting their growth and coming out in their perfect state one after another, whereby some of the flies are liable to be always present in the garden, in readiness to deposit their eggs; and maggots of widely different sizes are commonly met with in the same onion. The eggs or fly-blows are loosely placed upon the onion slightly above the surface of the ground, some being dropped along the thin edge of the sheath or white membraneous collar, which is formed by the base of the lower leaf clasping around the stalk, and others are crowded into the crevices between the bases of the leaves, slightly above where they issue from this sheath. From two to six or more eggs are usually placed on particular plants here and there through the bed. They are perceptible to the eye, being white and smooth, four-hundredths of an inch (0.04) long, and a fourth as thick and of an oval form. When the minute maggot hatches from the egg, it works its way downward inside of the sheath, its track being marked by a slender discolored streak, till it reaches the root, on which it feeds till it is wholly consumed, only the thin outer skin remaining. After eating the bulb of one plant they attack the next, until sometimes a third or a half of the bed is destroyed. The maggot attains its growth, in summer, in about a fortnight, and changes to a pupa either in the cavity in the onion, or in the wet, slimy earth which is in contact with the onion. It here ceases to move, it becomes contracted and shorter in length, its skin hardens and changes to a tarnished yellow and finally to a chestnut color with a stain of black at each end. This is the pupa-case, and the true pupa is inside. In this condition it lies about two weeks before the fly escapes. As a preventive measure worth trial the seed should be sown two inches deeper than usual, so that the fly can not so readily get to it to lay its eggs. Sow also on ground on which straw has been previously burned Rotation of crops is also a most important preventive measure. When the roots are infested pour boiling water along the drills near the roots, or even on the plants, going over the bed four times during one season. The diseased onions should be pulled up and burned. Fitch recommends cultivating the onions in hills, scattered among the other vegetables in the garden. With only three or four seedlings in a hill it is evident that the young worms could nowhere find a sufficient amount of food to nourish them to maturity. Having consumed all the young plants in one hill, they will be unable to work their way through the ground to come at another hill except it be by the merest chance, and will thus perish. The Black Onion Fly was first found to be destructive to onions in Illinois by Dr. Henry Shimer, who writes as follows regarding it. In the latter part of June I first observed the larva or maggot among the onions here; the top dead, tuber rotten, and the maggots in the decayed substance. From them I bred the fly. They passed about two weeks in the pupa state. At that time I first observed the flies in the garden, and now few are to be found. Their favorite roosting place is in a row of asparagus running along the onion-ground, where they are easily captured and destroyed, from daylight to sunrise, while it is cool and wet. During the day they are scattered over the ground and on the leaves and stalks of the onions, and not easily captured. Their wings point obliquely backward, outward, and upward, with an irregular jerking, fan-like movement; flight not very rapid or prolonged. All that I observed originated in one part of the bed, where they were doubtless deposited by one parent fly. Two broods appear in a season.

OOLITE. Roe stone. A limestone of the secondary epoch, the parts of which are rounded so as to resemble a fish roe. Oolitic is a derivative.

OPAL. An iridescent, silicious mineral, of a rich brown color, tough consistency, and smooth, uniform texture; its peculiar narcotic smell should be strong and fresh; its taste bitter, warm and somewhat acrid.

OPERCULUM. A lid or covering. The

coverings of the theca of mosses. In zoology this term is applied to the apparatus supported by four bones, which protects the gills of fishes; also to the horny or calcareous plate which closes the aperture of univalve shells; and to the four calcareous pieces which defend the entrance to the tube of Balanites, or bell-barnacles.

OPHIDIANS, OPHIDIA. The order of reptiles resembling snakes.

OPHTHALMIA. (See Eyes, Inflammation of.)

OPIUM. (See Poppy.)

OPOBALSAM. Balm of Gilead. A fragrant gum resin, from a species of Amyris.

OPODELDOC. A liniment of soap and camphor.

OPOPONAX. A gum resin of a bad odor from the *Pastinaca opoponax.*

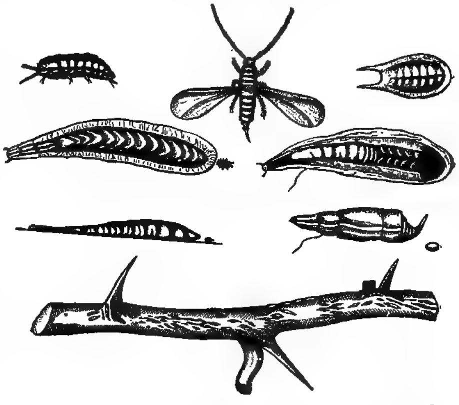
OPOSSUM. The genus *Didelphys* of marsupials, peculiar to the American continent.

OPTIC NERVES. The second pair from the brain. They enter the back of the eyes and form the retina.

OPTICS. The science which investigates the property of light, and all that relates to vision.

ORACH. *Atriplex hortensis.* A hardy annual plant, the leaves of which have a slightly acid taste, which in some portions of Europe are, with the footstalks, boiled as we do spinach. It should be sown early in spring, in deep, rich, moist soil, in drills two feet apart, and kept free from weeds until the leaves are of size for boiling. It is but little cultivated in the United States.

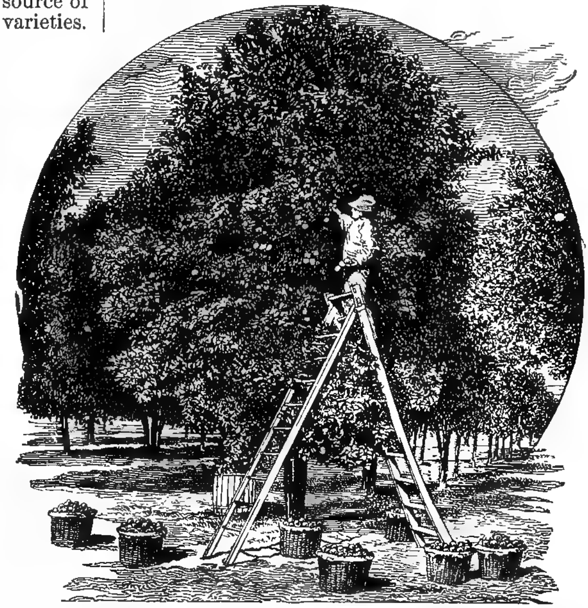
ORANGE. *Citrus aurantium.* The orange, originally a native of the warmer portions of Asia, is now generally disseminated and grown in all countries where the winter frosts are not severe enough to kill the trees. In the United States, South Carolina and Georgia, the Gulf States and Southern California comprise the northern limits of cultivation. It is especially cultivated with a view to profit, in Portugal, Spain, France, Italy, Greece, Turkey, Syria, Egypt, northern and southern Africa, India, China, Japan, and on many of the islands adjacent to these countries; also in the Azores, the West Indies, Brazil, and the warmest portions of the United States. The first distinct notice of the orange on record is that made by Avicenna, an Arabian physician, who flourished in the tenth century. It is stated by Gelesio, a modern Italian author, that the Arabs introduced this fruit into Europe by two routes—the sweet oranges through Persia to Syria, and thence to the shores of Italy and the south of France, and the bitter ones by Arabia, Egypt, and the north of Africa to Portugal and Spain. It was the opinion of this writer, who described forty of the principal kinds, cultivated in Italy, that they were all derived from the same species—an opinion which appears to be corroborated by the circumstance that the whole citrus family is prone to change, from a difference of soil and climate, as well as from a tendency to sport, when cultivated from seeds, after the manner of most of our orchard fruits. In many parts of the West Indies and South America, for instance, the whole orange tribe is found growing wild, springing up spontaneously from the seeds of the trees originally planted by the Spaniards, varying in size and every gradation from the lime to the shaddock. In Florida, it has long been cultivated. Bartram mentions a famous orange grove in Florida, which was found in 1781, when the surveyor ran the lines near New Smyrna, north for forty miles along a ridge; and further stated that extensive groves were found as far north as latitude 28°. Dr. Baldwin, in 1817, mentions trees thirty feet high, and says: You may eat oranges from morning till night, at every plantation along the shores, while the wild trees, bending with their golden fruit over the water, present an enchanting appearance. These were the remains of the trees, or the wildings, from those planted by the early Spanish settlers. The cultivation of the orange is steadily extending in Florida and California. In other Southern States its cultivation is not extending, although there is no doubt that it might be profitably extended along the coast line of southern Texas. In the planting of orange groves, in Florida, water protection is sought to the northwest. If this can not be had, ridges are selected, since these are less liable to spring frosts than lower situations. The North is now cheaply and amply supplied with oranges from Florida, and in California the cultivation of this noble fruit is steadily increasing Besides blight, and fungus, there are a number of insects attacking the orange. The blight is often very destructive. There are no certain remedies for this disease. The trees die back somewhat, as is the case with pears. It has been recommended to cut below all diseased parts and re-bud. Drainage and careful cultivation would seem to be the most rational course to pursue. One of the most noxious of the insects attacking the orange is the Orange-tree Mussel Shell Louse, (*Aspidiotus Gloverii*). The illustrations show the insect in its various stages of transformation up to the perfect fly. The natural remedies are, as in the case of the Apple-tree Bark Louse, scraping them off, and at the time in summer when the young are active, washing the branches with strong soap suds.



ORANGE, WILD. *Prunus Caroliniana.* A kind of cherry evergreen, and growing to the size of a small tree; the fruit is not edible, but the tree is much esteemed on the Southern seaboard as an ornamental plant. It is a native of Florida.

ORBIT. In birds, the skin which surrounds the eye; the bony cavity in which the eye is set.

ORCHARDING. One of the first necessities in settling a new country, is to prepare for and set out an orchard. Few, however, either do so systematically, or when they do set one, care for it as it should be. Hence the idea of some that fruit will not do well in many portions of the country, even in localities where there are great commercial orchards yielding bountifully. The reason of the failures in making the farm orchard productive is, first, accurate knowledge as to varieties adapted to the soil and climate. This can only be learned by experience, close observation, or inquiry from some responsible and practical man. Fortunately there are such in almost every neighborhood. Another source of failure is the planting of too many varieties. Once the farmer finds the varieties adapted to his location, let him select the best of these, and then if he wishes to experiment with special varieties, do it with individual trees, or else by grafting a limb with the variety desired. Very often a variety that is a shy bearer will bear abundantly for years if grafted on another variety. The experiment will cost but little time and labor. The laying out of the orchard is also important. In commercial orchards particular varieties should be placed in blocks, and also those varieties which ripen in succession in the order of ripening. The commercial orchardist, however, understands this, and also the profit in planting but few varieties. With the farm orchard the same general rule should be adopted, but as this is simply to supply the family's daily use, the earlier varieties of fruit should be placed next the house, and the general supply for winter use farther away. Suppose the fruit garden (that is the proper name) to comprise two acres, and this is not too much, then the first rows may be strawberries, planted three feet apart as to the rows; then currants and gooseberries, four feet between rows; next raspberries, five feet between rows; next blackberries, six feet between rows; grapes, eight feet between rows; quinces, eight feet; peaches, twelve feet between rows; cherries, sixteen feet between rows; plums, nectarines, and apricots, the same distance, if you choose to try them. Next come pears, ten feet should be allowed for dwarfs, and twenty feet for standards; apples, twelve feet for dwarfs, and thirty feet for standards. A single row of strawberries, of raspberries, and of blackberries, of currants, and of gooseberries across a two acre plot will be ample for any family for using fresh, and for canning. A single row of peaches, one row of cherries, and one-third of a row each of plums, nectarines, and apricots, will be sufficient. We do not advise their planting at all, since the labor of destroying the curculio will, probably, amount to more than the worth of the fruit; nevertheless this must be left to the discretion of the planter. One row of dwarf pears, and one row of standards, will be enough. In prolific years you may have some pears to sell. If blight do not attack the trees, they will well pay the investment, in the satisfaction of having the fruit. The rest of the orchard may be planted to apples, perhaps one row of dwarfs, the balance standards, or the row of dwarf apples may be placed next the dwarf pears. We had forgotten the grapes. Allow two rows for these, one full row for Concords, and another row for such varieties as you may wish to experiment with. When plants are wanted by the acre, to find the required number multiply the distance at which they are to be set by itself, or the distance one way by the distance the other, and divide into 43,560, the number of feet in an acre. For instance three multiplied by four gives twelve. This divided into 43,500 gives 3,625. The number of plants contained in an acre. So, we may find the number of plants required for any distance not given in the table. The following table will show the number of trees in an acre at various distances:



GATHERING APPLES.

Distances apart.	No. of Plants.	Distances apart.	No. of Plants.
1 by 1	43,560	7 by 7	888
1½ " 1½	19,360	8 " 8	680
2 " 1	21,780	9 " 9	537
2 " 2	10,890	10 " 10	435
2½ " 2½	6,969	11 " 11	360
3 " 1	14,520	12 " 12	302
3 " 2	7,260	13 " 13	257
3 " 3	4,840	14 " 14	222
3½ " 3½	3,555	15 " 15	193
4 " 1	10,890	16 " 16	170
4 " 2	5,445	17 " 17	150
4 " 3	3,630	18 " 18	134
4 " 4	2,722	19 " 19	120
4½ " 4½	2,151	20 " 20	108
5 " 1	8,712	24 " 24	75
5 " 2	4,356	25 " 25	69
5 " 3	2,904	27 " 27	59
5 " 4	2,178	30 " 30	48
5 " 5	1,742	40 " 40	27
5½ " 5½	1,417	50 " 50	17
6 " 6	1,210	60 " 60	12
6½ " 6½	1,031	66 " 66	10

Strawberries may be set as close as twelve inches in the row; two feet, however, is better, if they are to be allowed to make runners. Raspberries may be planted three to three and one-half feet, and blackberries three and one-half to four feet in the row. Currants and gooseberries, should have three and one-half to four feet of space in the row. Grapes may be planted as close as six feet in the row. The other fruits may be planted in the rows at half the distance the rows are apart, the supernumerary trees to be removed before they begin to crowd each other. In this plan for a home orchard the small fruits, including grapes, will occupy one-ninth of the plot. If you allow a single row to be filled with plums, nectarines and apricots, thus, these with the peaches, cherries and pears, (dwarfs and standards,) will occupy nearly one-quarter of the field, or accurately, five-eighteenths, leaving you about one and a quarter acres for apples. The orchard rows at the same time being long enough to afford every facility for horse cultivation. For small families, and for village gardens this must be modified, yet the same general plan may be adopted. It should hardly be necessary to say that the home orchard must receive good cultivation, that is, it must be kept free of weeds. The cultivation, however, should not be deep, simply deep enough to keep the surface friable, but without disturbing the roots. If weeds appear after the first of July they must be pulled by hand, or taken up with the hoe among the vines and bushes. Among the trees they may be mown if necessary, since late cultivation is injurious to fruit trees, vines and bushes. If an orchard is to be laid out for a given variety of fruit, the system of squares will be found most practicable. The quincunx form has been widely recommended. Practically it has little advantage, except in situations where it becomes necessary to take advantage of every inch of ground. Hence, the true quincunx, where each plant is exactly equidistant from its next neighbor, is scarcely ever practiced. To lay out an orchard in true quincunx form each tree, must be surrounded by six other trees at equal distances. This will give the greatest possible number of trees upon the ground. Lay out the ground by furrows according to the width of the rows apart, and then run furrows one way, half way between the lines. Thus you will get the correct space for the trees. Now set stakes at every space along the two outside lines and a row of pegs to indicate the first diagonal furrow, plow this and so continue with each additional one until the whole orchard plot is marked. To lay out an orchard square, all that is necessary is to furrow it out both ways, according to the distance of the trees apart. Where the furrows cross will be the points at which the trees are to be set. Now plow two furrows apart both ways, and if the orchard has been deeply plowed over the whole ground previously, a very little sighting each way will enable you to get the true position of each tree. It should be unnecessary to say that this plowing and marking out should be done in the fall previous to planting, and if the field has been in some crop requiring very deep cultivation and manuring for a year or two previous, it will be found to be so much the better. In the case of the home orchard, when a variety of fruit is to be raised, of course the rows will run but one way, and the subsequent cultivation must be only one way. The remarks on laying out an orchard apply solely to those intended for only one kind of fruit, and particularly to the stone and pip fruits When the ground is level or nearly so it is not difficult to get the trees exactly in line. If the ground is uneven or hilly, it will be found very difficult in practice. That they be in exact line, however, matters but little, since it is quite evident they will not keep in line, from inequalities in growth, but if trained to pretty low heads—absolutely necessary in the West—the tops will soon cover any imperfections. In the home fruit garden, however, the trees, bushes and vines should stand in exact lines one way, and be kept so by staking. In the general orchard, the trees should be staked until they get firm root, and thereafter if a tree inclines to get too much out of line, it may be brought back by judicious staking. The best site for an orchard is undoubtedly one facing north or north-

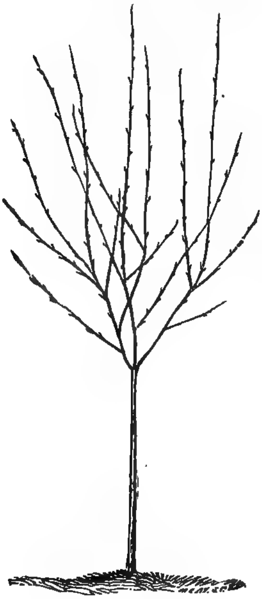


Fig. 1.

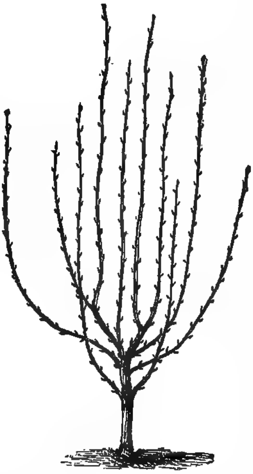


Fig. 2.

Fig. 3.

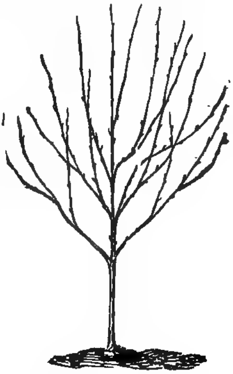


Fig. 4.

east, rather than south or southwest. The best soil is a deep, rich, gravelly clay loam, or limestone soil. If the subsoil is porous, no drainage will be needed. If the water ever stands for forty-eight hours at a time in holes dug eighteen inches deep, or if there is a hard pan within three feet it should be drained. The roots of the apple and pear like to run deep. The pear especially need not be expected to do well unless the subsoil is dry and porous enough to admit of the percolation of water. Such a soil will stand both drought and wet. In all the prairie country it has been found advisable to set orchards pretty near the surface of the soil, and plow to the trees year by year, and both ways until a considerable ridge is raised, or rather until a pretty deep dead furrow is formed between each row, leaving the trees at last on elevated squares. Many persons have been deterred from this course from the supposition that the trees would suffer from drought. Gardeners, however, well know that a flat well raised, deeply plowed ridge will stand drought far better than land under level culture. Some of our best gardeners on prairie soil now lay up their land to correspond to the width of the rows to be planted, five feet for tomatoes, six feet for cucumbers, and so on up to twelve feet for melons and squashes For directions respecting the various orchard fruits, the reader is referred to the articles as they occur relating thereto. The following in relation to orchard trees when received from the nursery, or when propagated on the farm will be useful, and to assist this we give illustrations of various forms of pruning for training in the nursery. Fig. 1 shows a standard tree with stem of trunk three or four feet clear of branches. Fig. 2, Low branched standard, with stems eighteen inches to two feet. Apples on Doucin stock, have usually this form. Fig. 3, Dwarf bush, with stems a foot or more high. The dwarf apple on Paradise stock has usually this form. Fig. 4 shows the usual appearance of a well developed nursery tree, well trained and grown. For fruit trees the soil should be dry, either naturally or made so by thorough drainage, as they will not live or thrive on a soil constantly saturated with stagnant moisture. It should also be well prepared by twice plowing, at least, beforehand, using the subsoil plow after the common one, at the second plowing. On new, fresh lands, manuring will be unnecessary; but on lands exhausted by cropping, fertilizers must be applied, either by turning in heavy crops of clover, or well decomposed manure or compost, To ensure a good growth of fruit trees, land should be in as good condition as for a crop of wheat, corn, or potatoes. In regard to the preparation of the trees. As a general thing, trees are placed in the ground precisely as they are sent from the nursery. In removing a tree, no matter how carefully it may be done, a portion of the roots are broken and destroyed, and consequently the balance that existed in the structure of the tree is deranged. This must be restored by a proper pruning, adapted to the size, form and condition of a tree, as follows: Standard orchard trees. These, as sent from the nursery, vary from five to seven feet in height, with naked stems or trunks, and a number of branches at the top forming a head. These branches should be all cut back to within three or four buds of their base. This lessens the demand upon the roots, and enables the remaining buds to push with vigor. In case of older trees of extra size, the pruning must be in proportion; as a general thing, it will be safe to shorten all the previous years' shoots to three or four buds at their base, and where the branches are very numerous some may be cut out entirely. Pyramidal trees, if of two or three years' growth, with a number of side branches, will require to be pruned with a two-fold object in view, viz.: The growth of the tree, and the desired form. The branches must be cut into the form of a pyramid by shortening the lower ones, say one-half, those above them shorter, and the upper ones around the leading shoot to within two or three buds of their base. The leader itself must be shortened back one-half or more. When trees have been dried or injured much by exposure, the pruning must be closer than if in good order. Low-headed standard trees and dwarf bushes must be pruned as recommended for standards, aiming at producing a round, well-proportioned head, with the main branches regularly distributed and far enough apart to admit air freely to all parts. Yearling trees intended for pyramids may have a few side branches, the smallest of which should be cut clean away, reserving only the strongest and the best placed. In other respects they will be pruned as directed for trees of two years' growth. Those having no side branches should be cut back so far as to insure the production of a tier of branches within twelve inches of the ground. A strong yearling, four to six feet, may be cut back about half, and the weaker ones more than that. It is better to cut too low than not low enough, for if the first tier of branches be not low enough, the pyramidal form can not afterward be perfected. Planting. Dig holes in the first place, large enough to admit the roots of the tree to spread out in their natural position; then, having the tree pruned as above directed, let one person hold it in an upright position, and the other shovel in the earth, carefully putting the finest and the best from the surface in among the roots, filling every interstice, and bring every root in contact with the soil. When the earth is nearly filled in, a pail of water may be thrown on to settle and wash in the earth around the roots; then fill in the remainder, and tread gently with the foot. The use of water is seldom necessary, except in dry weather, early in fall or late in spring. Guard against planting too deep; the trees, after the ground settles, should stand in this respect as they did in the nursery. Trees on dwarf stocks should stand so that all the stock be under the ground, and no more. In very dry, gravelly ground, the holes should be dug twice the usual size and depth, and filled in with good loamy soil. If trees are tall and much exposed to winds, a stake should be planted with the tree, to which it should be tied in such a manner as to avoid chafing. A piece of matting or cloth may be put between the tree and the stake. When the tree is planted, throw around it as far as the roots extend, and a foot beyond, five or six inches deep of rough manure or litter. This is particularly necessary in dry ground, and is highly advantageous everywhere, both in spring and fall planting. It prevents the ground from baking or cracking, and maintains an equal temperature about the roots. The grass should not be allowed to grow around young trees after being planted, as it stunts their growth and utterly ruins them. The ground should be kept clean and loose around them, until, at least, they are of bearing size. The best treatment for trees that have been frozen in the packages, or received during frosty weather, is to place the packages, unopened, in a cellar or some such place, cool, but free from frost, until perfectly thawed, when they can be unpacked, and either planted or placed in a trench, until convenient to plant. Treated thus, they will not be injured by the freezing. Trees procured in the fall for spring planting, should be laid in trenches in a slanting positions, to avoid the winds; the situation should also be sheltered and the soil dry. A mulching on the roots and a few evergreen boughs over the tops will afford good protection.

ORCHIDACEÆ. Herbaceous endogens with remarkably irregular and beautiful flowers; they are propagated by seeds, and bear bulbs containing an agreeable farina (*salep*) for which the *Orchis mascula* is partially noted. They are natives of calcareous soils. In the tropics the species and genera often become splendid parasites.

ORCHIL, or ARCHIL. *Rocella tinctoria.* A lichen yielding a purple dye.

ORCINE. The coloring matter of the *Violaria orcina*, or *Lichen dealbatus.*

ORDER. A style of architecture, or column.

OREGON ALDER. *Alnus Oregona.* An alder of from twenty-five to thirty feet.

ORES. Minerals containing a large amount of some metal.

ORGAN. In anatomy, a viscus, or structure of the body.

ORGANIC DISEASE. Disease attended with an alteration of the structure of a viscus or organ.

ORGANIC REMAINS. Fossils.

ORGANIZATION. The processes by which an organized body is formed; also the totality of the parts which constitute, and of the laws which regulate an organized body.

ORGANOGRAPHY. A description of the structure of plants.

ORIOLE. *Icterus.* There are two species, the garden oriole, *I. spurius*, and the Baltimore oriole, *I. Baltimore.* The first named is of a bright chestnut color, the head, neck, back, wings and tail black, bill and legs bluish-black. Mature birds, or after the third year, mottled on the upper parts of back with black and olive; on belly, sides, and breast reddish-gray begins to appear, blended with yellow; generally the two middle tail feathers are black, the others centered with black. The female and young of one year are olive yellow, inclining to brown, yellow beneath; wings and tail, dusky brown. The orchard oriole eats berries and small fruits to some extent during their season, but they are so largely insectivorous that they should be harbored rather than destroyed. It also eats largely of seeds. In confinement individuals often retain their summer plumage during the winter. They are alert and industrious in the pursuit of insects. The eggs are from four to six in number, bluish-white, sprinkled with brown. The nest is curiously interwoven of grass, and is supported by the sides only. The Baltimore oriole, also called golden robin or hanging bird, is one of the most beautiful of our summer visitors. Brilliant in its color, black and orange, cheerful in its song, an indefatigable hunter after insects, flitting here and there it should be carefully preserved wherever found. It is much rarer in the North than its relative the orchard oriole, and hence more highly prized. It has the name of hangbird from the peculiar pendant nest which it forms, in the South of the long hanging moss, and in the North of cotton threads or any long, soft filament which it may find. It loves the habitation of man, and is generally found near dwellings, and from the fact that it is seldom disturbed, often becomes tame and fearless of man. Another, Bullock's oriole, is found on the Pacific coast ranging from California to the Columbia river in Oregon; it is quite similar in appearance and habits to the Baltimore oriole.

ORLO. The plinth to the base of a column or pedestal.

ORNITHICHNITES. Certain marks in the new red sandstone, supposed, incorrectly, to be bird tracks.

ORNITHOLOGY. The department of science which treats of birds, their characteristics, their form, structure, habits and uses is called ornithology; from two Greek words signifying, a bird, and discourse. To the farmer, the study is of great importance as enabling him to distinguish between birds useful, those whose benefit is not counterbalanced by the injury they accomplish, and those decidedly injurious. Thus the horticulturist would narrow down his list of beneficial birds to a far greater extent than the grain farmer. The florist would find very few birds doing him injury, and the grass farmer or grazier almost none, if any. Agricultural ornithology may therefore very properly be considered outside of ornithology proper, since the rural population are especially interested in birds useful and injurious. These will be treated of under their proper names—which see—at least those of more special importance. In this connection we present a list of the more common birds of the country ranging from the lakes to Kentucky as the north and south lines. Further south our summer birds are, many of them, there, winter birds. The list was most carefully prepared by E. Michener, M.D., Pennsylvania, for the Department of Agriculture at Washington, and we believe has never appeared in print outside the Government report. It is the most condensed and complete catalogue of these classes we have found. A system of classification has been adopted with the names of the families, genera, and species. Immediately after will be found the common or familiar names. It is convenient to designate the species as, Constant residents; some portion, at least, of which remain nearly or throughout the year. Summer residents; greater or less numbers of which spend the summer, nest and breed. Winter residents; mostly northern species, which spend the whole or part of the winter. Migratory; those birds which pass and repass in spring and autumn. Wandering; birds which migrate irregularly, wherever their food may be most abundant. The reader will no doubt find many seeming exceptions to these divisions; for instance, the turkey vulture mostly migrates further south in winter, yet it has been seen in midwinter, when the mercury was below zero, striving with a crow for the possession of a dead mouse. Birds are also either Carnivorous: flesh-eaters—vultures, hawks, etc.

Piscivorous: fish-eaters—kingfishers, herons, etc. Insectivorous: insect-eaters—woodpeckers, fly-catchers, etc. Granivorous: grain-eaters—pigeons, sparrows, etc. Omnivorous: all-eaters—crows, blackbirds, etc. These terms are even more exceptional than the preceding ones. In a variable climate, or where the species migrates from warm summer to cold winter regions, or the contrary, its food must often vary with the season, etc. Hence, both as regards residence and food, the terms are only the expression of a general fact, and have, of course, only a relative application. Of land birds we have:

I. FAMILY VULTURIDÆ, (THE VULTURES).

Genus *Cathartes*, turkey vulture. Resident, common in summer; rare in winter; carnivorous; with us its chief food is carrion; feeds on all sorts of food, and sucks the eggs, and devours the young of other birds. The turkey buzzard, rendered so repulsive by its habits, is nevertheless a most useful scavenger for the speedy removal of every form of putrescent animal matter, so offensive to our olfactories, so prejudicial to our health. It well deserves the protection with us that both it and its cousin the black vulture receive in southern climates where they are almost domesticated.

II. FAMILY FALCONIDÆ, (THE HAWK.)

Among hawks, genus *Falco*, we have: Duck Hawk. Winter resident, very rare; carnivorous; feeds on ducks, pigeons, blackbirds, etc.—Pigeon hawk. Wandering, very rare; carnivorous; feeds on pigeons and smaller birds, field mice, etc.—Sparrow hawk. Resident, common; less so in winter; carnivorous. As its name implies, it feeds on sparrows and other small birds, field mice, shrews, and small reptiles.

Genus *Astur*. Goshawk. Winter resident, not common; carnivorous; preys on partridges, birds, field mice, etc.

Genus *Accipiter*. Cooper's hawk. Winter resident, rare; carnivorous. Its principal food consists of birds and small quadrupeds; when hungry, will not refuse a chicken for its dessert.—Sharp-shinned hawk. Resident, or nearly so; never abundant; carnivorous; feeds on small birds, mice, etc. The smaller members of this family mostly resort to the woods, fields, and meadows in quest of food, and seldom visit the poultry yard, unless pressed by hunger. The farmer can well afford them this small pittance for their service in destroying mice, shrews, moles, etc, in his fields.

Genus *Buteo*. Red-tailed hawk. Resident, common; carnivorous. The predatory habits of this powerful bird have rendered him the terror of the poultry yard. Partridges, larks, and other birds, rabbits, squirrels, mice, and even reptiles, form his less dainty fare. I must leave the farmer to balance the account as he best can.—Red-shouldered hawk. Winter resident, frequent in season; carnivorous; habits somewhat similar to the preceding species with which it is often confounded; but is much less troublesome to the farmer.—Broad-winged hawk. Resident, and quite rare; carnivorous; feeds on birds, mice, reptiles; rarely on chickens.

Genus *Archibuteo*. Rough-legged hawk. Winter resident. It is not common; carnivorous; affects meadows and the marshy borders of streams, where it feeds on such birds, mice, and reptiles as are found in those places, The number of meadow mice which this species destroys, ought, one would think, to insure it the protection of every husbandman.—Black hawk. Winter resident, rare; carnivorous; habits similar to those of the last-named species Audubon considers this the same as the rough-legged hawk in more mature plumage.

Genus *Circus*. Marsh hawk. Wandering, mostly seen in winter; carnivorous; affects meadows and marshy grounds, hence its name; feeds on small birds, but more especially on mice and other small quadrupeds, and when in season, on frogs, snakes, etc.

Genus *Aquila*. Golden eagle. Wandering, but very seldom seen; carnivorous. With courage equal to his strength, he fearlessly pounces on a swan or a goose, a kid or a lamb, and, when instigated by extreme hunger, has been known to seize on little children and bear them off to his mountain aerie. Young fawns, raccoons, hares, wild turkeys, and other large birds constitute a portion of his bill of fare.

Genus *Haliœtus*. White-headed eagle. Wandering, not common: piscivorous The principal food of the bald eagle is fish, and this is mostly plundered from the fish-hawk; sometimes preys on ducks and other water birds; when these fail, he will even feed on carrion, and, like his older brother, attack lambs, fawns, pigs, etc. Instances are related of his seizing small children and carrying them away to his nest.

Genus *Pandion*. Fishhawk. Wandering, frequent along the larger streams; piscivorous; affects our rivers and bays, and passes from one to another as the occurrence of ice, etc, may require. Feeds almost wholly on fish, which it catches with wonderful dexterity; too often, as has been noticed, to be robbed of its prize by the white-headed eagle.

III. FAMILY STRIGIDÆ, (THE OWLS).

Genus *Strix*, *Owls*. Barn owl. Winter resident, rare; carnivorous. "I am satisfied that our bird feeds entirely on the smaller species of quadrupeds" (Aud.) This, of course, refers to mice and other nocturnal animals.

Genus *Bubo*. Great horned owl Resident, frequent: carnivorous. "Its food consists of half grown turkeys, pheasants, and domestic poultry of every kind; also hares, young opossums, and squirrels." (Aud.) This is our most noteworthy robber of the hen-roost.

Genus *Scops*. Red owl Resident, common; Carnivorous; preys on mice, small sparrows, etc., and very often catches nocturnal beetles and other insects. It thus destroys a large number of field mice, and the large cockchafer, so injurious to our fruit trees. In winter it familiarly enters our barns and outhouses, where it becomes an expert and industrious mouser. Mottled owl. Resident, common; carnivorous; habits similar to the last. Most ornithologists consider the red and gray screech-owls identical. This may be so. Bonaparte, Audubon, and others say the red is the young and the mottled the mature bird; others just reverse it. Audubon says the feathers change their colors as the pairing season advances, and in the first spring the bird is in its perfect dress; consequently the young or red bird could not be expected to breed, yet I have found red parents with a red brood, and also mottled parents with a mottled brood. Although presenting an anomaly perhaps unknown in any other species of bird, I have therefore reseparated them for the present.

Genus *Otus*. Long-eared owl. Resident, rare, or seldom seen; carnivorous. It preys chiefly on quadrupeds of the genus *Arvicola*, (meadow mice,) and in summer destroys many beetles.

Genus *Brachyotus*. Short-eared owl. Resident, frequent in winter, rare in summer; carnivorous; habits and food similar to those of the preceding species, which it somewhat resembles, except that it is more diurnal, and consequently feeds more on day food. When hungry, it will approach the farm-house in quest of garbage ejected from the kitchen.

Genus *Syrnium*. Barred owl. Resident, frequent; most so in winter; carnivorous A great destroyer of poultry, particularly of chickens when half grown; it also secures mice, rabbits, and small birds, and like other gourmands, is especially fond of a kind of frog common in the woods of Louisiana.

Genus *Nyctale*. Little owl. Resident, not common, or rarely seen; carnivorous; feeds on mice, beetles, moths, and grasshoppers, (Nutt.,) small quadrupeds and birds.—Snowy owl, *Nyctea*. Winter resident, very rare; carnivorous; rather diurnal or crepuscular than nocturnal. Its usual food while it remains with us consists of hares, squirrels, rats and fishes. It also catches the pheasant and other kindred birds.

IV. FAMILY CUCULIDÆ, (THE CUCKOOS).

Of the genus *Coccygus*, or cuckoos, we have the yellow-billed cuckoo. Summer resident, common; insectivorous They seem to prefer insect food, but suck the eggs of other birds, and also feed on berries, etc. It should, however, serve as a special plea on their behalf, that they not only devour but even feed their young on the hairy caterpillars of our orchards, which are rejected by most other insectivorous birds.—Black-billed cuckoo. Summer resident, frequent; insectivorous. This and the preceding species very closely resemble each other, both in appearance and habits.

V. FAMILY PICIDÆ, (THE WOODPECKER).

Genus *Picus*. Hairy woodpecker. Resident, common; insectivorous; feeds on the larvæ of insects and on the insects themselves; although in autumn it seeks berries, etc. Downy woodpecker. Resident, common; insectivorous; habits and food similar. Red-cockaded woodpecker. Accidental; very rare; insectivorous; habits similar. These are highly useful birds in destroying worms and insects which lodge under dead bark and in rotten wood. Some of these birds have a singular habit, the purpose of which is not well understood, of puncturing the smooth, thin bark of orchard trees in regular circles, so near to each other that eight or ten of them may be covered by a dollar. This has obtained for them the common name of sap-suckers. They even puncture resinous trees in the same manner.

Genus *Sphyropicus*. Yellow-bellied woodpecker. Resident, rarely seen during summer; insectivorous; secluded in the forest. Its food consists of wood-worms and beetles, to which it adds small grapes and berries.

Genus *Hylotomus*. Pileated woodpecker. Resident, but now almost extinct; insectivorous. This shy bird feeds, like its congeners, on the beetles, and their larvæ, which always abound among dead and decaying timber. If these fail, he resorts to acorns, nuts, and berries.

Genus *Centurus*. Red-bellied woodpecker. Resident, frequent; rare in summer; insectivorous; feeds on various kinds of insects and larvæ, and on berries, etc., in the manner of its yellow-bellied cousin.

Genus *Melanerpes*. Red-headed woodpecker. Resident, very common; insectivorous. This elegant and familiar species is extremely expert in finding and catching the insects which conceal themselves beneath the bark of trees. He also eats juicy fruits and berries, as well as the ripening corn. The farmer often thinks that he takes more in cherries and garden fruits than his services are worth.

Genus *Colaptes*. Golden-winged woodpecker. Resident, common; rare in winter; insectivorous; feeds on insects, wood-lice, ants, etc., with cherries, various berries, and even corn. The farmer, forgetting his past services, and only remembering his present faults, closes his career with the gun, and unthinkingly does to himself and the public an essential injury. (Nutt.)

VI. FAMILY TROCHILIDÆ, (THE HUMMING BIRDS).

Genus *Trochilus*, is represented by the Ruby-throated humming bird. Summer resident, common; insectivorous. This beautiful little bird has so long been considered *mellivorous* (honey-eater) that the reader will hardly admit its claim to be insectivorous; but it is essentially an insect hunter, and not a honey-sucker. Its long, delicate bill enters the cup of the flower, and the protruded, double-tubed tongue, delicately sensible, and imbedded with a glutinous saliva, touches each insect in succession, and draws it from its lurking place to be instantly swallowed. Their food consists principally of insects, generally of the coleopterous order, with some equally diminutive flies.

VII. FAMILY CYPSELIDÆ, (THE SWIFTS).

Genus *Chætura*. We have Chimney swift. Summer resident, abundant; insectivorous. If the reader will reflect on the myriads of insects which fill the air on the approach of eventide, and watch these birds, as they wing their rapid flight in ceaseless circles, gathering their evening repast, he will not grudgingly endure the little annoyance which they may occasion in his chimney. The chimney swallows incline to be gregarious, especially in their roosting places. Audubon tells of a hollow tree in which he estimated that over nine thousand had collected, and were in the habit of collecting nightly to roost.

VIII. FAMILY CAPRIMULGIDÆ, (THE GOAT-SUCKERS).

Genus *anthrostomus*. Whip-poor-will. Summer resident, common; insectivorous; habits nocturnal; feeds on moths and other night-flying insects.

Genus *Chordeiles*. Night hawk. Summer resident, very common; insectivorous; habits much like the preceding, but more crepuscular or diurnal; often seen out in cloudy weather. Its food consists entirely of insects, especially coleoptera; it also seizes on moths and caterpillars, and is very expert at catching crickets and grasshoppers, with which it sometimes gorges itself.

IX. FAMILY ALCEDINIDÆ, (THE KINGFISHERS).

Genus *Ceryle*. Belted kingfisher. Resident, frequent along streams; piscivorous; feeds on fish and a few water insects.

X. FAMILY COLOPLERIDÆ, (THE FLY-CATCHERS).

Genus *Tyrannus*. Kingbird fly-catcher. Summer resident, common; insectivorous. Beetles, grasshoppers, crickets, and winged insects of all descriptions form his principal summer food; in autumn berries constitute a favorite repast. Reader, see him perched on an old mullen stalk, watching all around, and capturing every insect that comes in his sight, and say whether he does not pay for the few bees he may destroy.

Genus *Myiarchus*. Great-crested fly catcher. Summer resident, frequent; insectivorous; dwells mostly in forests and feeds on such insects as are found there

Genus *Sayornis*. Pewee fly-catcher. Summer resident, common; insectivorous. This familiar and industrious destroyer of insects needs no introduction, and is capable of telling its own story.

Genus *Contopus*. Olive-sided fly-catcher. Summer resident, not frequent; insectivorous; feeds on others of the genus.—Wood pewee fly-catcher. Summer resident, common; insectivorous. These two species are very similar and among the most active and industrious fly-catchers.

Genus *Empidonax*. Trail's fly-catcher. Summer resident, frequent; insectivorous.—Least fly-catcher. Summer resident, frequent; insectivorous.—Small green-crested fly-catcher. Summer resident, common; insectivorous.—Yellow-bellied fly-catcher. Summer resident, frequent; insectivorous. All the species of this genus, indeed all the family, possess similar habits. We can hardly walk out on a summer day without seeing some of them perched on a fence stake or dead bough intently watching for their prey, and woe betide the insect, whether beetle, moth, or fly, which may dare to show itself either on the ground or wing. The feat accomplished, they return to the same perch to await the appearance of other prey. Surely no observer can be so obtuse as not to appreciate the service thus rendered.

XI. FAMILY TURDINÆ, (THE THRUSHES).

Genus *Turdus*. Wood thrush. Summer resident, common; omnivorous. Beetles, caterpillars, various insects, and, in autumn, berries, constitute its principal food.—Hermit thrush. Summer resident, frequent; omnivorous; feeds on various insects, and small berries. Wilson's thrush. Summer resident, frequent; omnivorous. Like the preceding, its food is principally coleopterous insects and autumnal berries.—Olive-backed thrush. Summer resident, frequent; omnivorous; food and habits similar.—Gray-cheeked thrush. Summer resident, very rare; doubtful; omnivorous; unknown, except from analogy.—Robin. Resident, frequent; rare in winter; omnivorous. In early summer they feed much on the ground, picking up the various worms and insects of the season. In autumn they often resort to small fruits and berries. When winter arrives many of them East retire to the tide marshes of rivers, where seed and insect food are still found. When these have been long covered with snow the robins are said to return to orchards and find subsistence in the rotten apples still hanging on the trees.

Genus *Sialia*. Bluebird. Resident, very common; rare in winter; insectivorous. This favorite of every household, the lovely and confiding bluebird, seeks its food on the ground among grass. It seems to prefer coleopterous beetles, but also devours other insects, caterpillars, spiders, etc., and sometimes ripe berries. It well repays the use of the box, so often provided for its habitation.

Genus *Regulus*. Ruby-crowned wren. Migratory, frequent in season; insectivorous.—Golden-crested wren. Migratory, frequent in season; insectivorous. These species, very nearly identified by appearance and habits, are wholly insect feeders. Ever vigilant, they may be seen closely scanning the bark and leaves of trees and shrubs, in the orchard or garden, in quest of small insects or larvæ, spiders, etc. Sometimes they pursue and capture them on the wing. Their scrutinizing habits have obtained for them the name of wrens.

XII. FAMILY SYLVICOLIDÆ, (THE WOOD WARBLERS).

Genus *Anthus*. Titlark. Winter resident, frequent; gregarious; insectivorous; mostly affects plowed and bare fields on the margin of waters where it seeks various insects, seeds, etc.

Genus *Mniotilta*. Black and white creeper. Migratory, frequent; insectivorous. It lives principally on small ants and their larvæ, which it mostly gleans from the rough bark of orchard and forest trees.

Genus *Parula*. Blue yellow-backed warbler. Migratory, frequent; insectivorous; somewhat of a creeper; very active and useful in destroying small insects during the opening bloom of spring.

Genus *Protonotaria*. Prothonotary warbler. Summer resident, extremely rare; insectivorous; feeds on small insects, worms, caterpillars, etc.

Genus *Geothlypis*. Maryland yellow throat. Summer resident, frequent; insectivorous. Lives secluded in thickets and course tangled grass near streams where it feeds on small insects. Caterpillars and spiders form its principal food.—Mourning warbler. Summer resident, extremely rare; insectivorous; habits resemble the former.

Genus *Oporornis*. Connecticut warbler. Migratory, very rare; insectivorous. Audubon saw them chasing a species of spider which runs nimbly over the water, and which they caught by gliding over it.—Michener's warbler. Migratory, very rare; insectivorous; affects margins of woods, thickets, and old fences; keeps near the ground when seeking insects.—Kentucky warbler. Migratory, very rare north of Maryland; insectivorous. This species destroy great numbers of spiders. All the species are active insect hunters, and affect the woods and neighboring fields, orchards, and gardens.

Genus *Icteria*. Yellow-breasted chat. Summer resident, frequent; insectivorous; affects thickets, near water, and feeds on shelly-winged beetles, sometimes on berries and seeds.

Genus *Helmitherus.* Worm-eating warbler. Migratory, or very rare in summer; insectivorous. They are very active and indefatigable insect hunters.

Genus *Helminthophaga.* Blue-winged yellow warbler. Summer resident, rare, and very secluded; insectivorous. They feed on the eggs and larvæ of various insects, as well as flies, caterpillars, ants, and coleoptera.—Golden-winged warbler. Migratory, quite rare; insectivorous. This scarce bird is only seen in spring, when it frequents the tops of forest trees, and collects its food among the leaves and branches.—Nashville warbler. Summer resident, very rare; insectivorous. Its food consists of insects and larvæ, which it procures by searching actively and diligently among the leaves and buds of low trees.—Tennessee warbler. Migratory, very rare; insectivorous; an expert catcher of flies.

Genus *Seiurus.* Golden-crowned thrush. Summer resident, common in woods; insectivorous. Feeds wholly on insects and their larvæ, particularly small coleopterous kinds, and ants collected on the ground.—Water thrush. Migratory, frequent in marshy thickets; insectivorous. Feeds on such insects and their larvæ as inhabit marshy localities.—Large-billed water thrush. Migratory, more rare than the last; insectivorous. Very closely resembles the preceding species in appearance and habits.

Genus *Dendroica.* Black-throated green warbler. Migratory, rather rare; insectivorous. May be occasionally seen for an hour at a time carefully and actively searching for small caterpillars and winged insects amidst the white blossoms of the shady apple tree.—Black-throated blue warbler. Migratory, rare; insectivorous. An expert catcher of flies.—Yellow-rumped warbler. Migratory, abundant; insectivorous. Feeds on insects, etc.; is expert in catching flies, and is a great devourer of caterpillars.—Blackburnian warbler. Migratory, rather rare; insectivorous. An exceedingly nimble insect-hunter, keeping toward the tops of trees.—Bay-breasted warbler. Migratory, quite rare; insectivorous. Sometimes seen searching for insects along fences, etc.—Chestnut-sided warbler. Migratory, frequent; insectivorous. In the spring they are generally restless, and intently engaged in the chase of insects amidst the blossoms and tender leaves.—Blue warbler. Migratory, quite rare; insectivorous. Feeds principally on insects and their larvæ.—Black-poll warbler. Migratory, frequent; insectivorous. An active fly-catcher.—Yellow warbler. Summer resident, frequent; insectivorous. Feeds on the smaller insects, and a variety of small larvæ and caterpillars.—Nuttall remarks: It is amusing to observe the sagacity of this little bird in disposing of the egg of the vagrant cow troopial (genus *cassicus*). The egg being deposited before the laying of the rightful tenant, and too large for ejectment, it is ingeniously incarcerated in the bottom of the nest, and a new lining placed above it, so that it is never hatched, to prove the dragon of the brood.—Black and yellow warbler. Migratory, common; insectivorous. Very active in searching for their insect and larvæ food.—Cape May warbler. Migratory, extremely rare; insectivorous. Feeds on insect food, but its habits are little known.—Yellow red-poll warbler. Migratory, rare in swampy thickets; insectivorous. Industrious insect-eater.—Prairie warbler. Migratory, rare; found in open woods; insectivorous. Feeds on caterpillars and flies.

Genus *Myiodioctes.* Hooded warbler. Summer resident; very rare so far north, insectivorous. It flies swiftly after its insect prey, securing the greater part of it on the wing.—Green Black-capped warbler. Summer resident, very rare; insectivorous. It has all the habits of a true fly-catcher, feeding on small insects, which it catches entirely on the wing.—Canada warbler. Migratory, or summer resident, frequent; insectivorous. A truly insect-catching species. Audubon says: I found it breeding in the pine forest.

Genus *Setophaga.* American redstart. Migratory, common in dense woods; insectivorous. He is no pensioner on the bounty of man. He does not wait the accidental approach of his insect prey, but, carrying the war among them, he is seen flitting from bough to bough, or at times pursuing the flying troop of insects from the top of the tallest tree, in a zig-zag, hawk-like manner to the ground.

Genus *Pyranga.* Scarlet tanager. Summer resident, frequent in woods; omnivorous. Its food consists chiefly of winged insects, wasps, hornets, and wild bees, as well as smaller kinds of beetles, and other shelly tribes. He rarely visits the orchard and tastes the early and inviting, though forbidden cherries.—Summer redbird. Summer resident, rare; omnivorous. Habits very similar. Both species become more fructivorous in autumn.

XIII. FAMILY HIRUNDINIDÆ, (THE SWALLOWS).

Genus *Hirundo.* Barn swallow. Summer resident, very abundant; insectivorous. Its food consists entirely of insects, some being small coleoptera. The swallows, like the swifts, feed entirely on the wing, and thus devour vast numbers of flying insects, which otherwise might annoy us.—Cliff swallows. Summer resident, now become frequent; gregarious; insectivorous. Its feeding proclivities are, as a general rule, similar to the barn swallow. Its curious, bottle-shaped mud tenements may now be seen beneath the eaves of buildings in several localities.—White-bellied swallow. Summer resident, frequent; insectivorous. Like all other swallows, it feeds on the wing, unceasingly pursuing insects of various kinds. Once the tenant of the forest, it is fast changing its habits, and in some parts has taken possession of martin-boxes in preference to hollow trees.

Genus *Cotyle.* Bank swallow. Summer resident, abundant. gregarious, insectivorous. The bank swallow builds in holes excavated in the sandy, steep banks of creeks, etc.; hence is more frequent near watercourses, and, consequently, feeds on such insects as inhabit them. Its food which consists of small insects, principally of the hymenopterous kind, is taken on the wing.—Rough-winged swallow. Summer resident, frequent; insectivorous. Closely resembling the preceding species, and often associated with it in the same community, until recently the two appear to have been confounded.

Genus *Progne.* Purple martin. Summer resident, abundant, gregarious and insectivorous. Familiarly domiciled in the martin-box, our bird seems specially commissioned to rid the neighboring premises of noxious insects. The food of the martin is usually the larger winged insects, as wasps, bees, large beetles, such as the common *Cetonias* or goldsmiths, which are swallowed whole. They seldom seize the honey bee.

XIV. FAMILY BOMBYCILLIDÆ, (THE WAX-WINGS).

Genus *Ampelis.* Cedar bird, cherry bird. Resident, common, rare in winter; granivorous; an eminently fructivorous species, as its common name implies. Too well known to fruit growers as the cherry bird, yet, as an amende honorable he feeds in spring on small caterpillars, beetles, and small insects. For hours together he may be seen feeding on the all-despoiling canker worm, which infests our apple and elm trees.

XV. FAMILY LANIIDÆ, (THE SHRIKES).

Genus *Collyrio.* Butcher bird. Winter resident, rare; insectivorous. Fond of crickets, grasshoppers, and various insects. In winter, when these become scarce, he grows more predacious, seizing small birds, mice, etc., with the vigor and dexterity of a hawk; to which its robust form and hooked bill give it some resemblance.

Genus *Vireo.* Red-eyed vireo. Summer resident, frequent; insectivorous. Its food consists of insects and their larvæ, especially caterpillars. He is an animated and melodious songster. Wantonly to destroy these delightful aids to sentimental happiness, ought to be viewed not only as an act of barbarity, but almost as a sacrilege.—Warbling vireo. Summer resident, frequent; insectivorous. The principal food of this species consists of small black caterpillars off the poplars. The most familiar of the vireos, it approaches the orchard and garden, where it carefully searches for insects among the leaves and branches of the trees.—White-eyed vireo. Summer resident, not common; insectivorous. Like its kindred, its food in spring consists of insects; in autumn, berries are added to its bill of fare.—Blue-headed vireo. Summer resident, rather scarce; insectivorous. Its food consists of insects and berries.—Yellow-throated vireo. Summer resident, not common; insectivorous. Habits similar to those of the preceding species.

XVI. FAMILY LIOTRICHIDÆ.

Genus *Mimus.* Mocking bird. Summer resident, rare; omnivorous. Insects, worms, grasshoppers, and larvæ are the food on which they principally subsist; in winter, on the berries of the red cedar, wax myrtle, holly, etc. They are eminently vocal.—Cat bird. Summer resident, abundant; omnivorous. This songster, which rivals even the mocking bird itself, and feeds during a large part of the season on the very insect races which are injuring the crops of the cultivator, is often greatly persecuted. The vulgar name which it bears has served to bring it into contempt with persons not the best judges of the benefits it confers on the husbandman in early spring, when with industrious care it cleanses his fruit trees of thousands of larvæ and insects, which in a single day would destroy, while yet in the bud, far more of his fruit than the cat bird would eat in a whole season. But alas! selfishness, the usual attendant of ignorance, not only heaps maledictions on the harmless bird, but dooms it to destruction. The boys pelt it with stones and destroy its nest whenever an opportunity presents; the farmer shoots it to save a pear, the gardener to save a raspberry; and some hate it not knowing why. In a word, excepting the poor crow, there is no bird more generally despised and tormented than this charming songster.

Genus *Harporhynchus.* Brown thrush. Summer resident, common; omnivorous. This is another mimic rival of the mocking bird. Its food consists of worms and insects generally; also caterpillars, beetles, and other coleopterous tribes, as well as various kinds of berries. He may scratch a few hills of corn or plunder a few cherries, but rest assured that his services have already paid for these; and his music, while it is sweeter, will cost less than that of the flute or the piano.

Genus *Thryothorus*. Carolina wren. Resident, frequent; insectivorous. This has much the habit of the common house wren, exploring dark nooks and corners, and piles of wood, brush, etc., where it finds spiders, moths, and other insects in abundance. Its powers of song and mimicry are excelled by few birds.—Bewick's wren. Resident; insectivorous; nearly related to the foregoing, its habits are very similar, feeding on spiders, moths, and other insects.

Genus *Cistothorus*. Long-billed marsh wren. Summer resident, frequent about marshes; insectivorous. Feeds on aquatic insects and others which frequent wet places. —Short-billed marsh wren. Summer resident, frequent; insectivorous. Habits similar to the preceding. Secluded among the brushwood and rank grass of their favorite swamps, they elude observation.

Genus *Troglodytes*. House wren. Summer resident, common: insectivorous. Our bird keeps up frequent squabbles with his neighbors, like other busybodies that are never happy but in mischief. He is still, upon the whole, a real friend to the farmer and horticulturist, by the number of injurious insects and their destructive larvæ, on which he and his numerous family subsist.—Wood wren. This is perhaps too near the preceding species to warrant a separate notice.—Winter wren. Winter resident, frequent; insectivorous. Its habits are much like those of the house wren; but is distinguished by season, the length of the tail, and the food which season may afford.

XVII. FAMILY CERTHIIDÆ, (THE CREEPERS).

Genus *Certhia*. American creeper. Resident, frequent, but eludes observation; insectivorous. Its food consists chiefly of ants, larvæ, and small insects, and small particles of lichens; and if one be placed near the nose, it is generally found to emit an odor like that of ants.

Genus *Sitta*. White-bellied nuthatch. Resident, frequent; insectivorous. It searches and shells off the bark, in quest of his lurking prey of spiders, ants, insects, and their larvæ in general.—Red-bellied nuthatch. Winter resident, rare in forests; insectivorous. The scarcity of insect food in winter often obliges our sojourner to resort to the seeds of the pine for subsistence.

XVIII. FAMILY PARIDÆ, (THE TITMICE, ETC.).

Genus *Polioptila* Blue-gray fly-catcher. Resident, frequent in summer; insectivorous. A very dextrous, lively insect-hunter; among other small insects, it preys on the troublesome mosquitoes

Genus *Lophophanes*. Tufted titmouse. Resident, frequent; insectivorous. This well known species seeks its food in summer in crevices and among rotten wood; in winter it has recourse to seeds and small berries, in addition to refuse from the kitchen and garbage from the butcher's stalls.

Genus *Parus*. Black-capped titmouse. Resident, frequent; insectivorous. Feeds on insects, their larvæ, and eggs of destructive moths; especially those of the canker worm, as well as every sort of small fruits, berries, and seeds.—Carolina titmouse. Summer resident, rare; insectivorous. Has the habits of the black-cap.

XIX. FAMILY ALAUDIDÆ, (THE LARKS).

Genus *Eremophila*. Shore lark. Winter resident, frequent; granivorous. Their food consists of various kinds of seeds which remain on the grass and weeds, and the eggs and dormant larvæ of insects when they fall in their way.

XX. FAMILY FRINGILLIDÆ (THE SPARROWS).

Genus *Pinicola*. Pine grosbeak. Winter resident very rare; granivorous. Its food consists of buds and seeds of almost every sort of trees, and occasionally a passing insect.

Genus *Carpodacus*. Purple finch. Winter resident, frequent; granivorous. Its food is chiefly seeds and berries of red cedar, etc., with a sprinkling of insects and larvæ.

Genus *Chrysomitris*. American goldfinch. Resident, common; rare in winter; granivorous. Its food consists of many kinds of small seeds, especially of the thistle, lettuce, and other composite plants. Many pernicious seeds are thus destroyed.—Pine finch. Winter resident, rare; granivorous. Consumes the seeds of the thistle and allied plants, and those of the pine tree.

Genus *Curvirostra*. Red crossbill. Winter resident, very rare out of the pines; granivorous. Affects pine forests, the peculiar structure of its bill having a peculiar adaptation for extracting seeds from the cones.—White-winged crossbill. Winter resident, rare away from pine woods; granivorous. Same habits with the preceding species.

Genus *Ægiothus*. Lesser red-poll. Winter resident, very rare; granivorous. Feeds on various small seeds, especially of the alder, buds of the maple, etc.

Genus *Plectrophanes*. Snow bunting. Winter resident, very rare; granivorous. Feeds on various seeds, grains, and small insects. Mingles with the snowbird in its familiar visits to the garden and house yard to glean the refuse from the kitchen. It is then noted as the white snowbird.—Lapland longspur. Winter resident, very rare; granivorous. Its food consists chiefly of seeds, and also of grass, leaves, buds, and insects.

Genus *Passerculus*. Savanna sparrow. Summer resident. common; granivorous. It subsists on various grass and other seeds, with such small insects and larvæ as may fall in its way.

Genus *Poocœtes*. Bay-winged bunting. Resident, common in summer, rare in winter; granivorous; feeds on the seeds of grasses and a spice of the more savory insects. In search of the latter it sometimes visits plowed fields.

Genus *Coturniculus*. Yellow-winged sparrow. Summer resident, frequent; granivorous; dwells among grass, where its food, the grass-seeds, is abundant. It delights to add a few insects to its common fare.—Henslow's sparrow. Summer resident, very rare; granivorous; habits similar to those of the preceding species.

Genus *Zonotrichia*. White-crowned sparrow. Winter resident, not common; granivorous; subsisting on grass-seeds, berries, coleopterous insects, etc.—White-throated sparrow. Winter resident, frequent; granivorous; habits similar to the last.

Genus *Junco*. Snowbird. Winter resident, very numerous; granivorous. Every one must be familiar with this little accompaniment of cold and storm, as it picks its scanty fare of grass and other seeds from the lawn, the garden, or the yard, wherever the winds or the housewife's broom have left the ground uncovered with snow.

Genus *Spizella*. Tree sparrow. Winter resident, frequent; granivorous. Sometimes seen during winter in company with the snowbird, and feeding in a similar way. Field sparrow. Resident, common in summer; granivorous. The food of this species consists of seeds and insects. They search the leaves and branches for moths, of which they seem to be fond.—Chipping sparrow. Summer resident, very common; granivorous. Its habits resemble those of other small sparrows; but being confiding and self-domesticated, it feeds and breeds among the trees and shrubbery in our orchards, gardens, and yards, and even boldly crosses the threshold to pick the crumbs which accident or design may have thrown in its way.

Genus *Melospiza*. Song sparrow. Resident, common; granivorous. This lovely songster dwells in the orchard and garden, where it subsists on small seeds and insects. In winter it often associates with the snowbird, and exhibits the same familiar habits. Its song is one of the earliest harbingers of spring.—Lincoln's sparrow. Migratory; extremely rare; granivorous; habits resemble those of the former species; feeds on seeds, berries, and insects. —Swamp sparrow. Migratory, frequent in proper localities; granivorous. Feeds principally on the seeds of grasses, with a few insects.

Genus *Passerella*. Fox-colored sparrow. Winter resident, frequent; granivorous. During their winter sojourn they frequent brier patches and thickets to search among the fallen leaves for seeds and the remains of insects, larvæ, etc.

Genus *Euspiza*. Black-throated sparrow. Summer resident, common; granivorous. Their food consists of seeds, eggs of insects, and in the early part of summer of caterpillars and small coleopterous insects.—Townsend's sparrow. Summer resident, unique; granivorous. Its food inferred from analogy to be, as in other sparrows, seeds and insects.

Genus *Guiraca*. Rose-breasted grosbeak. Summer resident, very rare and recluse; granivorous. The food of this beautiful bird consists of the seeds of cereal plants, of grasses, and those of different kinds of berries, along with insects, etc.—Blue grosbeak. Summer resident, very rare; granivorous. They feed on grains, hemp-seed, millet, and the kernels of different sorts of berries.

Genus *Cyanospiza*. Indigo bird. Summer resident, frequent; granivorous. The usual food of this species is insects, and various kinds of seeds.

Genus *Cardinalis*. Cardinal grosbeak Resident, frequent; granivorous. Indian corn constitutes their chief and favorite food, when attainable. The seeds of apples, cherries, and of many other sorts of fruit, are also eaten by them.

Genus *Pipilo*. Towhee bunting. Summer resident, common; granivorous. He scratches continually among fallen leaves along the fences, in thickets, and brier patches, in quest of the seeds, and worms, etc., which are concealed there.

XXI. FAMILY ICTERIDÆ.

Genus *Dolichonyx.* Reedbird, bobolink. Migratory, frequent in season; granivorous. The reed or wild rice of all our tide water marshes is, in autumn, the essential food of this bird. To this may be added grain and grass-seeds generally, with insects of various kinds, grubs, mayflies and caterpillars. They sometimes collect in very numerous flocks, and if they happen to alight on a grain field, either ripe for harvest or newly sown, the farmer, to use the language of Wilson, may look upon them as a devouring scourge, and worse than a plague of locusts.

Genus *Molothrus.* Cow blackbird. Summer resident, abundant; omnivorous. To the ordinary habits of the common blackbird it adds that of following cattle in the pasture, to feed on the insects which are attracted by their ordure. Some say it is to feast on the intestinal worms dropped by the cattle at certain seasons of the year. The cow buntings have ever been a race of foundlings. They are remarkable for a total want of the natural instincts of maternity. They do not provide themselves a nest; they never incubate their own eggs; they feel no parental care for their young, which they never nurse. Like the European cuckoos, they possess a wonderful degree of instinctive cunning in employing the maternal instincts of other birds for the performance of their own parental duties, which they ignobly refuse to render. The offspring of the foster-mother is generally sacrificed in her attempt to raise the foundling of another

Genus *Sturnella.* Meadow lark. Resident, common; omnivorous. Their food consists of caterpillars, grub-worms, beetle, and grass-seeds.

Genus *Icterus.* Orchard oriole Summer resident, frequent; insectivorous. I have good reason for believing that the species of insects on which he feeds are almost altogether such as commit the greatest depredations on the fruits of the orchard.—Baltimore oriole. Summer resident, frequent; insectivorous. Their food consists of worms, caterpillars, beetles, and bugs, particularly one of a brilliant glossy green, (the goldsmith). In autumn both species partake of seeds and small berries.

Genus *Scolecophagus.* Rusty blackbird. Migratory, frequent; omnivorous. They feed on grasshoppers and other insects, berries, etc., and in autumn, on corn.

Genus *Quiscalus.* Crow blackbird. Summer resident, very abundant; omnivorous. Every industrious farmer complains of the mischief committed on his corn by the crow blackbird. But were I placed in his situation, I should hesitate whether to consider these birds most as friends or enemies, as they are particularly destructive to almost all the noxious worms, grubs, and caterpillars that infest his fields; which, were they allowed to multiply unmolested, would soon consume nine-tenths of all the production of his labor, and desolate the country with the miseries of famine.

XXII. FAMILY CORVIDÆ, (THE CROWS).

Genus *Corvus.* Raven. Resident, now very rare or extinct; omnivorous. Audubon writes: The more intelligent of our farmers are well aware that the raven destroys numberless insects, grubs, and worms; that he kills mice, moles, and rats whenever he can find them; that he will seize the weasel, the young opossum, and the skunk; that, with the perseverance of a cat, he will watch the burrows of the fox, and pounce on the cubs. Yes, good reader, the farmer knows all this well, but he also knows his power, and, interfere as you may, with tale of pity or of truth, the bird is still a raven.—American crow. Resident, very abundant; omnivorous. This more familiar epitome of the raven is known to every one. Our crow feeds on fruits, seeds, and vegetables of almost every kind; it is equally fond of snakes, lizards, frogs, and other small reptiles. It looks upon various species of worms, grubs, and insects as dainties; and, if hard pushed by hunger, will devour even putrid carrion. It is fond of the eggs of other birds, and it plunders the fields of their superabundance. It is blamed for so doing, but seldom praised when it chases the thieving hawk from the poultry yard. With such a ledger it is often difficult for the farmer to settle the accounts with his tenant to mutual satisfaction —Fish crow. Resident, rare; omnivorous. The fishing habits of this crow lead it more about the water, where it finds many aquatic insects, reptiles, etc.; otherwise it is a mere epitome of its older brother.

Genus *Cyanura.* Blue jay. Resident, common; omnivorous. This gay and gaudy bird has very much the same habits as its more sombre relatives, the crows. Like them his organs of destructiveness and acquisitiveness are very large, without a sufficient balancing power. He is both cruel and dishonest. He feeds indiscriminately on flesh, reptiles, insects, seeds and fruits.

XXIII. FAMILY COLUMBIDÆ, (THE PIGEONS).

Genus *Ectopistes.* Wild pigeon. Wandering; at times very abundant and gregarious; granivorous; feeds on beech mast, acorns, grains and seeds of various kinds. It sometimes attacks the newly sown grain of the farmer, and when the flock is large does much injury.

Genus *Zenaidura.* Turtle dove. Resident, frequent; granivorous. It feeds on small acorns, various kinds of grains and seeds; also on the fruits of the dogwood, holly, poke, etc.

XXIV. FAMILY PHASIANIDÆ, (THE TURKEYS).

Genus *Meleagris.* Wild turkey. The turkey in a wild state feeds on nuts, acorns, grains, and berries, together with various insects, tadpoles, lizards, etc. The domestic bird has the same habits, but feeds especially on grasshoppers and the seventeen-year locust when abundant on which they become fat. The great destruction of insect pests by turkeys, added to their market value, makes them a profitable crop for the farmer.

XXV. FAMILY TETRAONIDÆ, (THE GROUSE).

Genus *Cupidonia.* Pinnated grouse. Their food consists of acorns, of the dwarf-oaks, fruits and berries, and the buds of trees, especially the apple tree, and sometimes insects, such as grasshoppers, etc. Audubon says: I have counted more than fifty on a single apple tree, the buds of which they entirely destroyed in a few hours.

Genus *Bonasa.* Ruffed grouse, pheasant. Resident, frequent; granivorous. The habits and food are very similar to those of the pinnated grouse. During the snows of winter, when their favorite berries have been exhausted, or are concealed, they feed on various buds, etc., and may then be found in the trees of the apple orchard.

Genus *Ortyx.* Partridge, quail. Resident, common; granivorous. The food of the partridge consists of grain, seeds, insects, and berries of various kinds. Buckwheat and Indian corn are particular favorites. In winter it becomes more familiar, and sometimes enters the farm-yard to feed with poultry.

XXVI. FAMILY ARDEIDÆ, (THE HERONS).

Genus *Botaurus.* American bittern. Resident, not common; piscivorous. The habits and food of this bird do not appear to differ essentially from the last.

Genus *Butorides.* Green heron. Summer resident, frequent; piscivorous. Small fish and frogs are his principal food, with small reptiles and aquatic insects.

XXVII. FAMILY CHARADRIIDÆ, (THE PLOVERS).

Genus *Charadrius.* Golden plover. Migratory, frequent; insectivorous; feeds on insects, worms, grasshoppers, small shell fish, and sometimes a few seeds and berries according to season.

Genus *Aegialitis.* Killdeer plover. Resident, or nearly so, frequent; insectivorous; feeds on various insects, grasshoppers, snails, and worms.

Genus *Squatarola.* Black-bellied plover. Summer resident, rare; insectivorous; feeds on insects, water snails, worms, and in season on small berries.

XXVIII. FAMILY SCOLOPACIDÆ, (THE SNIPES).

Genus *Philohela.* Woodcock. Resident, frequent; insectivorous. The food of the woodcock consists principally of earth worms and such other insects and worms as occur under fallen leaves and in soft bogs, which it probes with its long slender bill, and which is so sensitive at the tip as to enable the bird to discover and drag out its prey.

Genus *Gallinago* Wilson's snipe. Summer resident, or very rare in winter; insectivorous. They continually bore in marshes, like the woodcock, for food, which appears to consist of worms, leaches, and water spiders.

Genus *Gambetta.* Tell-tale tattler. Summer resident, not frequent; insectivorous; affects marshy meadows and margins of streams. Feeds on small fish, insects, worms, water snails, etc.—Yellowshanks tattler. Summer resident, frequent; insectivorous; nearly related to the last. Feeds on fishes, shrimps, worms, and aquatic insects.

Genus *Rhyacophilus.* Solitary sandpiper. Summer resident; insectivorous. Feeds on caterpillars, water insects, spiders, etc., etc.; mostly found about muddy ponds and ditches.

Genus *Tringoides.* Gray-spotted sandpiper. Summer resident, common; insectivorous. Feeds on insects and worms, which it often seeks by probing the marsh mud.

Genus *Actiturus.* Bartram's sandpiper. Summer resident, frequent; insectivorous. Feeds on coleopterous insects, crickets, grasshoppers, and sometimes on the seeds of grasses.

ORRIS. *Iris florentina.* The root of this flag is remarkably fragrant, and used in powder as a dentifrice. It is readily cultivated in moist, light soils, and grows rapidly from offsets.

ORTHOPNŒA. Difficulty of breathing, especially when lying down.

ORTHOPTERA. The name orthoptera signifies straight wing, as the generality of insects of this order are distinguished by having their under wings folded in straight plaits, and not doubled up under the wing-cases, as in the coleoptera or beetles. When the insect is at rest the under wings are folded longitudinally, or lengthwise, in long, narrow plaits, diverging from a common center at the root of the wing near the body, like a fan; these plaits gradually grow wide as they approach the circumference. When closed, the under wings are concealed under the upper wings, but when in flight they are expanded to the utmost, also in the manner of a fan. The insects of this order are furnished with strong and powerful jaws for biting their food, which consists principally of vegetable substances, leaves, blossoms, and sometimes fruits, and as their digestive organs are also well developed, and as they feed voraciously in larva, pupa, and perfect stages, the injuries they are able to inflict upon the farmers are sometimes almost incredible. Take, for example, the Western grasshoppers, which migrate in innumerable numbers, and sometimes in a single day will destroy the produce of a whole region. As soon as the eggs are hatched the young insects of this order begin to eat, and are in form almost exactly like the perfect insects, with the exception of having no wings. They shed their skins several times before arriving at maturity; as pupæ they acquire rudimentary wings, or wing-sheaths, and it is only as the perfect insect that they acquire perfect wings and are able to fly. There are, however, several species of the orthoptera which never acquire any wings whatever, but during their whole existence are obliged to leap, walk, or crawl, either wholly wingless, or with rudimentary wings only, which are of no use for purposes of flight. Cockroaches, crickets, grasshoppers, etc., belong to this order of insects.

ORTHOTROPORES. Seeds in which the hilum and foramen are opposite.

ORTOLAN. A bird of passage of the family *Fringillidæ.* They migrate from Africa to Southern Europe, and are fattened for the tables of the wealthy.

ORYZA. The genus to which rice belongs.

OSCILLATION. Movement similar to that of the pendulum.

OSCILLATORIA. Plants of the lowest organization, living in wet or damp places, and consisting of threads, which have sometimes an apparent movement.

OSMAZOME. The brown, fragrant extrac tive matter of roasted meats.

OSMIUM. A rare metal, associated with platina in ores.

OSSEOUS BRECCIA. Fragments of bones and mineral matters found cemented together in some caverns and fissures of rocks.

OSSIFICATION. The process of the deposition of bone.

OSTEOLOGY. A dissertation on bones.

OSTITIS. (See Spavin).

OTITIS. Inflammation of the internal parts of the ear.

OTTO, or ATTAR OF ROSES. A perfume, the essential oil of roses. The fresh flowers are distilled with water by a gentle heat, as in the case of other essences.

OUNCE. In troy weight, 480 grains, one-twelfth of a pound; in avoirdupois, one-sixteenth of a pound; it contains only 437½ troy grains.

OURARI. A virulent poison from the *Strychnos toxifera,* of Guiana. It produces convulsions and suspended animation.

OUTCROP. In geology, the exposure of rocks or strata above the earth.

OUTFALL. The lower end of a water-course.

OUTFIELD. Unenclosed lands, distant from the homestead.

OUTLIER. The detached portion of rock, distant from the mass.

OUZE. The muddy deposits of the sea, or waters.

OVARIA. The oval bodies which contain the eggs, or germs, in female animals.

OVARIUM. In plants, a hollow case, enclosing ovules or young seeds, containing one or more cells, and ultimately becoming the fruit; it is always situated in the center of the flower, and, together with the style and stigma, constitute the female system of the vegetable kingdom. When it is united to the calyx, it is called inferior; when separate from it, it is termed superior.

OVERLAND FARM. Without buildings.

OVERREACH. This is an injury to the coronet of a fore foot, by striking with the hind shoe, in traveling. Interfering is an injury of one fetlock by a blow of an opposite shoe, caused by setting the foot to which the injury is done out of line. Overreach, when it is a natural disability, may be prevented by making the forward shoes heavier than the hinder ones.

OVERSHOT WHEEL. That form in which the water falls from above the wheel upon the upper parts.

OVIDUCT. Fallopian tube, a membranous tube which conveys the germs, or eggs, from the ovarium into the womb, or out of the body.

OVINATION. Vaccination of sheep. It is sometimes practiced when the small pox of sheep, *variola ovina,* is ripe; but thorough isolation is the better course.

OVIPAROUS. Producing eggs. Birds, serpents, insects, and fishes are usually oviparous.

OVIPOSITOR. A pointed tube whereby many insects deposit their eggs in holes or chinks.

OVIS. The generic name of the sheep. The Mouflons are supposed to be the original of our domestic animal, but this is questionable.

OVIVIPAROUS. Producing living young, enclosed within an egg-like membrane; the marsupials, the viper, flesh fly, and several mollusks, are instances.

OVULUM. In botany, the rudimentary seed before impregnation.

OWL. (See Ornithology.)

OX. The gelded males of neat cattle are called oxen. These, until they have attained their growth and full development, are called steers. For all purposes of human food the steers are preferable. For draft the mature animals—oxen—are preferred. The proper age at which to geld the males depends upon whether they are intended for their flesh or labor, if for the former, the earlier the better. It is generally performed at the age of four to six weeks, and seldom delayed later than the age of two months. If the animals are intended for labor, it would undoubtedly be better that the operation be performed at one year old, but since the animal is to serve as food when no longer serviceable for labor, and since the animal gelded at one year old is more or less staggy, gelding is usually performed at the age first mentioned. By butchers, drovers, and feeders, any male of the cow kind, gelded at one year old or older, is termed a stag.

OXALIS. The genus of wood sorrels. The *O. crenata* is a perennial, ornamental plant, native of Chili. The flowers are yellow, and in umbels; the stalks and leaves are succulent and acid.

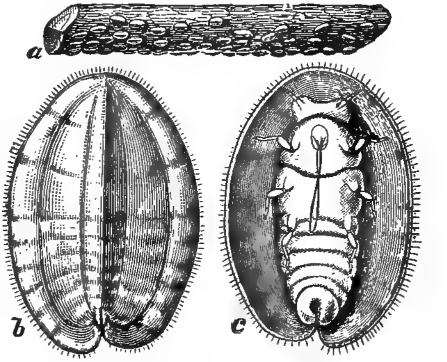
OX EYE. The genus *chrysanthemum.* Weeds growing among wheat and small grain, with large white and yellow composite flowers.

OXYCHLORIDES. Compounds of chlorine with metallic oxides, as bleaching salt.

OXYGEN. This important element was discovered in 1774 by Dr. Priestley. There are several compounds of oxygen which, when exposed to heat, are decomposed, and yield the gas in a state of purity. Of these, the best is chlorate of potash; but as that salt is expensive, we generally resort to black oxide of manganese, which at a dull-red heat, gives out a considerable quantity of tolerably pure oxygen gas. Oxygen gas is colorless, tasteless, and inodorous, it is electro-negative, and therefore, when compounds containing it are electrically decomposed, it always appears at the positive surface. It is a little heavier than atmospheric air, in the proportion of eleven to ten; 100 cubic inches weighing 34.18 grains. It is absorbed by water to the extent of less than one per cent., and is neither acid nor alkaline. It has a powerful attraction for most of the simple substances, especially for the electro-positive bodies. The act of combining with it is called oxidation. The compounds thus formed are divided into acids and oxides; among the latter are the alkalies, and almost all salifiable bases. Oxidation is often attended with the evolution of heat and light, as in all processes of combustion in atmospheric air; sometimes it is slow, and unattended with such phenomena, as in the gradual rusting of metals. Oxygen is a most powerful supporter of combustion; it constitutes one-fifth of the bulk of the atmosphere, and is the principle which enables combustible bodies to burn in it. The product of combustion, that is, the oxide, or acid, is sometimes itself gaseous, as when charcoal, by burning is converted into carbonic acid; or it is liquid, as hydrogen, by combustion, produces water; or it is solid, as when iron, by burning, produces oxide of iron. Oxygen gas is also essential to respiration; that is, to the evolution of carbonic acid from the blood; but requires to be diluted with nitrogen, as in the air, otherwise it destroys life by producing over-activity. Seeds can not germinate without oxygen, and are, therefore not to be buried too deep in a compact soil. The leaves of trees, also, can not perform their functions without its presence, although they are always exhaling a large quantity of this gas. Oxygen is very extensively diffused in nature; in the compound state it forms eight-ninths of all waters, and at least one-half of all structures, whether mineral or organic, except a few oils and resins.

OXYURES. A family of hymenopterous insects with an external ovipositor resembling a tail. They are pupivorous, and prey on other insects. A genus of intestinal worms, also.

OYSTER SHELL BARK LOUSE. The Oyster shell bark louse, (*Aspidiotus conchiformis,*) is often destructive to young orchards if neglected, fastening themselves in countless numbers on the young bark of the twigs and smaller limbs, and thus sapping the life of the tree by sucking its juices. This is an imported species, not originally a native of America. The native bark louse (*A. Harisii*) does comparatively little damage. The cut shows the manner in which the insect attaches itself to a limb at *a*, natural size; *b*, and *c*, show the insect highly magnified, the former a dorsal, and the latter a ventral view. Dr. Riley renamed this insect in 1873 *Mytilaspis pomicortis*, retaining the popular name, although the case under which the insect lives is usually more of the form of the mussel than the oyster. Once the insects are firmly fixed to the bark under their covering, remedies, except slowly scraping them away are of but little value. The proper time to attack them is in June, or at the time when the young hatch, and crawl forward to seek new quarters. Then any alkaline wash or strong soap suds readily kills them. They are active, however, but a few days, and should be closely watched. Fortunately they have many parasitic enemies, so that with a little attention at the right season they are easily kept down, and once an orchard is cleared, it is generally for good, unless infested trees are planted in, for as is well known they are incapable of moving far, unless carried. Harris says the body of the female insect, which is covered and concealed by the outer case, as shown above, is minute, of an oval form, wrinkled at the sides, flattened above, and of a reddish color. By means of her beak, which is constantly thrust into the bark, she imbibes the sap, by which she is nourished; she undergoes no change, and never emerges from her habitation. The male becomes a chrysalis or pupa, and about the middle of July completes its transformations, makes its escape from its case, which it leaves at the hinder extremity, and the wings with which it is provided are reversed over its head during the operation, and are the last to be extricated. The perfect male is nearly as minute as a point, but



OYSTER SHELL BARK LOUSE.

a powerful magnifier shows its body to be divided into segments, and endued with all the important parts and functions of a living animal. To the unassisted eye, says Dalman, it appears only as a red atom, but it is furnished with a pair of long whitish wings, long antennæ or horns, six legs with their respective joints, and two bristles terminating the tail. This minute insect perforates the middle of the case covering the female, and thus celebrates its nuptials with its invisible partner. The latter subsequently deposits her eggs and dies. In due time the young are hatched and leave the case, under which they were fostered, by a little crevice at its hinder part. These young lice, to the naked eye, are very small, of a pale yellowish brown color, and of an oval shape, very flat, and appearing like minute scales. They move about for a while, at length becoming stationary, increase in size, and in due time the whitish shells are produced, and the included insects pass from the larva to the pupa state. The means for destroying these insects are the same as those recommended for the extermination of the previous species.

OZŒNA. A putrid discharge from a fetid ulcer of the nostril or nostrils.

OZONE. (See nitrogen.)

P

PACHYDERMATA. The order of quadrupeds with thick hides, as the horse, elephant, ox, pig, etc.

PACING, AMBLING. A natural pace of the horse, in which both legs of one side are raised at a time.

PADDLE-STAFF. An instrument used by plowmen to free the share from clinging earth,

PADDOCK. A small field or enclosure.

PAGINA. The flat surface of the leaf.

PALATE. The roof of the mouth. It is divided into hard or bony palate, and soft palate, the latter being the membrane at the innermost portion. The shape and markings of the palate are adduced by zoologists in their descriptions. The elevated portion of the lower lip of a personate flower.

PALEÆ CHAFF. A name given to the bracts that are stationed upon the receptacle of compositæ between the florets, and having generally a membranous texture and no color; also the interior bracts of the flowers of grasses.

PALMA CHRISTI. The castor-oil plant.

PALMATE. Resembling the hand, five-lobed or toothed.

PALMETTO. Exotic trees containing many species, valuable for their fruit, fiber, oil, etc., as the cocoa-nut, date, cabbage, sago, etc. The palmetto of the Southern States is valuable for many purposes, as making paper, etc. Its leaves and roots are also applied to useful purposes.

PALMIPEDES. The anseres, or swimming birds of Linnæus.

PALM OIL. Oil of several of the palm trees, especially that of *Elais Guinensis.* Palm tree,

PALMS, PALMACEÆ. A natural order of arborescent endogens, like the palmetto, chiefly inhabiting the tropics, distinguished by their fleshy, colorless, six-parted flowers, enclosed within spaths, and rigid plaited or pinnate inarticulated leaves, sometimes called fronds. They yield bread, oil, wine, cordage, fuel, and all necessaries to the savages of the tropics.

PALP, PALPUS. The jointed organs attached to the labium and maxilla of insects; the feelers.

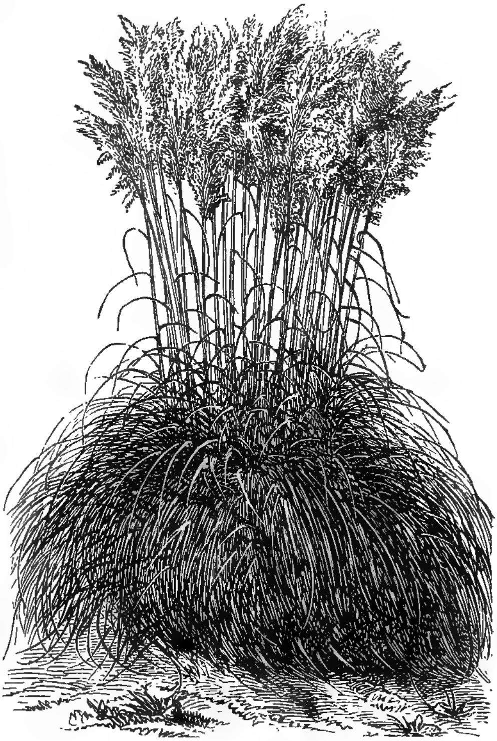
PALPATORS. Clavicorn beetles with long palpi, or feelers.

PALUSTRINE, PALUSTRIS. Marshy, belonging to a marsh.

PAMBINA. A species of high cranberry, found near the Columbia river.

PAMPAS. South American prairies.

PAMPAS GRASS. *Gynerium argenteum.* This is one of the very finest ornamental grasses in cultivation. Its immense size, superb, feathery spikes and thick bottom of foliage making it as conspicuous as it is beautiful, as a single specimen on a lawn. It is a native of the Pampas of South America, whence it has been introduced to various parts of the world. Wherever known it has been universally admired. Unfortunately it is not hardy north of about 38°, and not at all in the West. When it is planted it should be protected by a covering sufficient to preserve the ground from freezing. A good way is to place a frame about the plant, cover it inside with evergreen boughs, and then strew thickly with litter and horse manure over the whole, banking the frame well up. (See Ornamental Grasses.)



PAMPAS GRASS.

PAN. A term applied to the bed or flooring upon which the cultivated soil lies or is placed;

used only in a limited sense by some greenhouse men, or to designate a very compact subsoil.

PANACEA. A universal and fabulous remedy.

PANCREAS. The sweet bread. It is composed of innumerable small glands, the excretory ducts of which unite and form one duct, called the pancreatic duct, that conveys a fluid very similar to saliva into the intestines, called the pancreatic juice, which mixes with the chyle in the duodenum.

PANE OF GROUND. An old term for a small, four-sided piece of ground capable of irrigation.

PANDURIFORM. Fiddle-shaped or like a guitar.

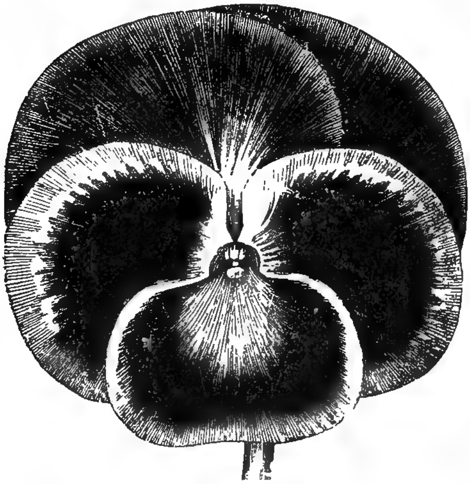
PAN-FEEDERS. In horticulture, the shallow vessels in which pots are set.

PANIC GRASS. The genus *Panicum.* Coarse annuals, of little value for grass. *P. miliaceum* is one variety of millet.

PANICLE. A kind of inflorescence, in which the central stalk throws out lateral stems, and these bear the petioled flowers, as in oats.

PANNAGE. The food consumed by hogs in woods.

PANSY. Heart's-ease. *Viola tricolor.* The pansy is a biennial plant, but blooming in autumn of the first year if sown early. In the North the plants should be protected in winter with litter and brush, but the litter should not press directly on the plants, else they are liable to smother. The colors of pansies are various and beautiful from almost pure white to a maroon purple which looks black. The perfection of form in the pansy is that the blooms shall be round, flat, and distinctly marked as shown in the cut. When extra fine pansies are desired, great care is taken in fertilizing the flowers and saving the seed. Hence the high price not only of such seeds, but of all other especially high grades of choice flower seeds. Pansies require a rich but thoroughly drained soil, (sandy loam is best). Sow the seeds early in the spring, or better in March, in a hot bed and prick out, two inches apart when large enough. The middle of May, transplant in the border or bed six inches apart, and you will have abundance of bloom, some varieties come measurably true to name if care is taken in saving the seed.



PERFECT PANSY.

PAPAVERACEÆ. Plants allied to the poppies; they are for the most part narcotics.

PAPAW. *Asimina triloba.* A tree, or rather large shrub, bearing edible, oblong, pulpy fruit, something resembling the banana. The tree grows sometimes to the height of thirty feet, with a stem six inches in diameter. From western New York to Northern Illinois it is rare, except in particular locations, but farther south is quite common. The flowers and foliage of the tree are very handsome, but the fruit is not generally liked.

PAPILIONACEOUS PLANTS. The *Leguminosæ*, as peas, beans, clover, etc.

PAPILIONACEOUS FLOWERS. A name given to the corolla of leguminous plants, as that of the garden pea and bean; it consists of a large upper petal, standard, or *vexillum;* two lateral petals, called *alæ*, wings; and two intermediate petals, forming the keel, or *carina.*

PAPILIONIDÆ. Lepidopterous insects, properly called butterflies, they feed by day.

PAPILLA, PAPILLÆ. Small delicate eminences, as on the tongue.

PAPPUS. The hairy down of thistles and other compositæ. Pappose is a derivative.

PAPS, or BARBS. (See Lampas.)

PAPYRUS. A large sedge (*Cyperus papyrus*). A native of the Nile and southern Asia, from which the ancients made their paper, or papyrus.

PARACENTESIS. Tapping, opening the covering of the abdomen, etc., to let out water.

PARACYANOGEN. A brown solid, with the composition of cyanogen.

PARADOX. An apparent absurdity, but really a fact.

PARAFFINE. A tasteless, inodorous, fatty matter, obtained, among the products of distillation, from wood tar.

PARAGUAY TEA. *Ilex Paraguayensis.* An evergreen holly, the leaves of which contain theine, and are used as tea in South America. (See Tea.)

PARALYSIS. Palsy. Paralytic is a derivative

PARAPLEGIA. Paralysis of the upper or lower part of the body only.

PARASITE. Small insects or fungus growths on animals and plants, which live on the blood of the body, or the juices of plants. Their numbers are many, and species various. Among parasitic insects the flea, louse, mange insect, and itch insect are most annoying to animals. The principal species will be noticed under their appropriate names.

PARASITIC PLANTS. Plants which strike their roots into the textures of others, as the mistletoe; mildew, smut, rust, etc., are also parasites. Many insects are parasitical on animals.

PARASTATE. Square pillars standing from the wall.

PAREGORIC. Tincture of opium and camphor with oil of anise seed; an anodyne to allay pain.

PARELLA. *Lecanora parella.* A lichen of Europe, used as a dye, and similar to archil.

PARENCHYMA. The cellular substance of vegetables or animals.

PARGASITE. A kind of hornblende; sometimes crystallized, and of high value.

PARGET. A plaster of lime, hair, cow dung, and water sometimes used in coating the flue of a chimney.

PARHELION. The appearance of two or more suns from the misty state of the air. *Paraselenæ* are several moons seen from the same cause.

PARIETAL. In botany, any organ which grows from the sides of another is said to be parietal. The parietal bones, in zoology, are those at the sides of the skull, which together form the arch.

PARIS GREEN. Arsenite of copper, a deadly poison, used in the arts as color, and of late years extensively mixed with water, flour, gypsum, etc., as an insecticide for destroying the Colorado beetle and other noxious insects infesting vines and plants. The proportions are from one to two parts of Paris green to forty to fifty parts of the medium with which it is mixed.

PARK. An enclosed woodland pasture, or ornamental, wooded landscape.

PAROTID GLAND. A large salivary gland, situated at the angle of the jaws.

PAROXYSM. A sharp attack, an increase of sickness.

PARSLEY. *Petroselinum sativum.* A biennial plant, that will endure the winter in the West, if thickly covered with brush and litter just before freezing weather, but which is universally grown as an annual plant. It requires extra rich, mellow soil for the best results, and the curled varieties should be transplanted several times to get extra fine leaves for garnishing. Sow the seeds in a hot bed about the first of March. Transplant as soon as large enough, three inches apart. When nice plants are thus obtained, select the handsomest curled ones and transplant six inches apart, and again at a distance of twelve to sixteen inches apart each way. The other plants, to be used in soups, stews, etc., may be planted six inches apart by sixteen inches between rows, or the seed may be sown in drills half an inch deep, and sixteen inches apart, and the plants thinned to six inches in the row. In the autumn the roots may be taken up and kept in dry sand in the cellar, to be planted out the succeeding spring, or to be used for forcing in the hot bed. Dwarf curled parsley is one of the best for family use. The Hamburg parsley, is a variety with fusiform roots, and are eaten boiled. The cultivation is precisely like that of parsnips, carrots, etc., which see.

PARSNIP. *Pastinaca sativa.* A hardy biennial plant standing out during our coldest winters, and with advantage in flavor to the fusiform root, the edible portion of the plant. If allowed to stand, the second year the flower stalk is thrown up to the height of five or six feet, the seed ripening in July and August. The preparation of the soil and cultivation of all esculent fusiform roots is alike. The land requires deep plowing, heavy manuring, with compost, or if not with manure the year previous to planting, since recent green manure causes the roots to fork and become uncouth in shape. The rows should be two feet apart for ease in horse cultivation. About three pounds of seed is required per acre, and the plants are to be thinned to about three or four inches in the row, when of sufficient size to admit of it. The cultivation should be thorough enough to keep the rows friable and mellow, and the rows must be kept entirely free of weeds. In the autumn just before the ground freezes a sufficient quantity should be dug out for winter consumption, and packed in a bin with air-dry sand or road dust about them, the remainder of the crop may be left until spring and taken out as soon as the frost leaves the ground. For garden cultivation the rows may be eighteen inches apart, and the plants thinned to six inches. The best varieties of parsnips for garden cultivation, is the Guernsey and the Student. For field cultivation the hollow crowned is generally sown. Upon rich, deep, mellow soil, crops as high as fifty tons per acre have been taken. They are a most valuable winter food for cows and swine, and in some countries they are largely raised for this purpose. The only drawback is the expense of digging. This, however, may be much simplified by the use of two heavy curved coulters, of a peculiar shape, attached to a gang plow, and which is capable of loosening two rows at once, going over five acres a day so they may be easily drawn by hand.

PARTERRE. In gardening, a system of beds of different shapes and sizes, in which flowers are cultivated, with intervening spaces, paved, of gravel, or turf, for walking on.

PARTRIDGE. *Perdicidæ.* The partridge differs from the grouse in having the legs unfeathered below the knee, and in having the nostrils uncovered. In the New England States, most of the Middle States and generally in the West, this bird is known as Quail. In the South, it is known by its true name of partridge. In the New England States the Ruffed Grouse is called partridge, and in the Middle States, this bird is called pheasant. The true quail is not found in the United States. It is of the genus *coturnix*, the partridge subfamily, while the American family of so called quails belong to the subfamily *odontopharinæ*, and *ortyginæ*, and of the genus, *ortyx*, *oreortyx*, *lophortyx*, *callipepla*, and *lyrtonyx*. The partridge of the North and most of the South, is well known by its familiar cry, resembling Bob White, and hence often so called. The female makes her nest of grass, circular in form, and places it at the foot of some tuft of grass, or amid the cornstalks, laying from ten to twenty pure white eggs, sharp at the smaller end. These are so nicely arranged within the nest, that should they be taken out it would be found impossible to return them as they previously were. The male often assists in hatching these, and always remains in the vicinity, cheering his mate by uttering his love-note from some favorite perch. When the young are ready to leave the shell, a circular opening is made by the mother through which they are issued into the world. The shell that covers this spot remains unbroken, and is attached to the remaining portion by a small fragment which allows it to open and shut like a door upon its hinges; and a deserted partridge's nest, if it has escaped injury, is a curiosity well worth preserving, containing, as it would, a number of these shells, with their movable lids. The young run as soon as they are hatched, and remain with their parents until the following spring, when they separate for the purpose of reproduction. They always roost at night upon the ground, arranged in the form of a circle, with their bodies nearly touching, and if alarmed, each individual takes a direct and separate course. The food of all the species is the seeds of weeds and grain, but during the season of their activity their principal food is insects, of which they destroy vast numbers of many noxious species, with the greatest pertinacity. They are one of the most valuable of insectivorous birds. Yet notwithstanding their usefulness, they have been so ruthlessly destroyed, as to have become almost extinct in the older States. As a rule the birds remain in a given locality winter and summer, yet sometimes they become partially migratory, suddenly leaving one neighborhood and as suddenly appearing in another. Nevertheless, the bird is not capable of long flights, as is its European relative. Although a hardy bird, yet it frequently succumbs to our severe winters, and multitudes of them are found frozen to death. When disturbed the whole flock rise at once, with a loud whirring of the wings, very trying to the nerves of the young sportsman, and fly with much rapidity, generally in a direct course, and after alighting scatter and lie very close, enabling their pursuer to flush them one at a time, and frequently in this way the entire covey is destroyed. As an article of food this bird is in much demand, being generally very plump, and its flesh white, tender, and juicy. The male has the forehead, line over the eye, and throat white, sides of head and band below the throat black; the rest of the head and neck reddish brown; back and wings chestnut, lower portion of the former tinged with yellow; tail grayish blue, the middle feathers grayish yellow, mottled with black; sides of the neck spotted with white; under parts white, streaked on the sides with red, and transversely barred with black; under tail coverts red; bill black; feet grayish. The female resembles the male, excepting the head, which has more reddish yellow, and also the throat is yellow instead of white. An allied species, characterized as the Texan partridge, (*Ortyx Texensis,*) is found in Texas. It is a smaller bird than our common species, but closely resembles it in plumage; a casual observer, indeed, would not detect much difference between them. I am not aware that they are very unlike in their habits, and the foregoing account will very likely answer for both. The next, a very handsome species, and equally valuable as an article of food, is the Plumed partridge, (*Oreortyx pictus,*) a native of the mountain ranges of California and Oregon. It goes in rather small coveys, sometimes of not more than eight or ten, excepting from October to March, when, according to Douglas, it congregates in vast flocks, and seems to live in a state of almost perpetual warfare, and is found principally among the dense woods that border the Columbia river and its tributaries. The male has the forepart of the body plumbeous, the upper parts yellowish brown, sometimes slightly shaded with red; the forehead is ash color, rest of head lead color; a crest of two long straight feathers spring from the center of the head of a black color; the throat is bright chestnut, with a black margin, followed by a white band passing downwards from the eye; the middle of the breast is bright chestnut, the feathers on the flanks possessing margins of black and white bands succeeding each other; tail brown, the under coverts black, streaked with orange chestnut; bill black; feet yellow. The female is similar, but less brightly colored. The feathers of the crest are much shorter, while the center of the back, the wings, and tail are faintly crossed with dusky lines. The next genus contains two very handsome species, the first of which is the California partridge, (*Lophortyx Californicus,*) an inhabitant, as its name implies, of California, where it is found upon the plains and lowlands, sometimes assembling in flocks to the number of two or three hundred, and are generally fat and well flavored. It takes the place there of our brave little bird of the eastern coast which is never found so far to the westward. It appears to be confined to the plains, rarely or never, I believe, found in the mountainous districts, where it is replaced by the preceding species. I have had them in captivity, but like all of this family they were very restless, seeking all the time for some avenue of escape. The male has the forehead straw color, behind which is a white band, which passes back along the sides of the crown, in the center of which anteriorly is a narrow line of the same color; back of head light brown; crest velvet black, commencing in a fine point, increases in width toward the end, and curls forward sometimes over the bill; chin and throat black, with a white line coming from the eye; back and sides of neck blue gray, bordered with black, and a small spot of white at the end of each feather; rest of upper parts olive brown; tail gray; forepart of breast blue; abdomen buff, with a large chestnut spot in the center, each feather margined with black in the form of a crescent; flanks brown, with a whitish line in the center, and a broad one of buff on the outer webs; under tail coverts buff, with a central stripe of whitish. Female wants the black and white marking of the head; has the throat brownish yellow, streaked with brown, and without the orange spot on the abdomen; the crest is short; bill black; feet gray. The second species, equally distinguished for its beauty of plumage, is the Gambel's partridge, (*Lophortyx Gambelii,*) named in honor of its discoverer. It is an inhabitant of the upper Rio Grande and Gila rivers to the Colorado of California. In the male the forehead is white, each feather having a narrow line of black, with a transverse white band succeeding; top of head reddish chestnut, crest brownish black, throat black, margined with white. The upper part of the body is bluish ash, flanks chestnut, each feather having a longitudinal stripe of white; middle of the breast and abdomen white, with a large black spot on the latter; bill black; feet brown. The female has the throat whitish, with the head plain ash color, without the conspicuous markings of the male, and also destitute of the black on the belly. The crest is short and of fewer feathers. The next genus has but one species, not as handsome as the preceding, and is known as the Scaly Partridge, (*Callipepla squamata*). This bird is also an inhabitant of the Rio Grande of Texas, and although not so beautiful in plumage as either of the two last species, yet is a very pretty bird. It is noted for its extreme swiftness in running, and depends as much upon this power for eluding pursuit as upon its wings, rarely using the latter even in open ground. It prefers the vicinity of water courses, and is wild and exceedingly watchful, rarely approaching the settlements. This species is generally very plump, its flesh white and of a delicate flavor, and is much esteemed for food. It has a beautiful crest, which can be laid flat upon the head, although it is frequently spread out like a fan. The head is light ash color, the crest broadly margined with white. General color bluish-ash, growing paler on the under parts, and nearly white on the abdomen, with the feathers of the under parts edged with black; flanks have a central stripe of white on each feather, and frequently there is a large chestnut spot of a pale hue on the abdomen; under tail coverts almost white, striped with brown; bill black; feet brownish. The sexes are nearly alike, the female, perhaps, not being quite so deeply colored, and the crest not so full. The last member of this family, to be included in this article, is a very singular looking, yet beautiful bird, and is known as the Massena partridge, (*Cyrtonyx Massena*). The fantastic arrangement of opposing colors upon the head of the male creates a very curious and striking effect, so much so as to cause Mr. Gould, the eminent English ornithologist, to exclaim that it forcibly reminds one of the painted face of the clown in a pantomime. It is a native of Texas and Mexico, met with chiefly in the former region, on the upper Rio Grande and the high plains of the Pecon. This species, I believe, generally goes in small covies, and is gentle and affectionate in its disposition, evincing but little fear of man's presence when he invades their domains, thus showing exactly the opposite trait of character from the scaly partridge, which is at all times wild and suspicious. The male had the forepart and sides of the head white, with a black stripe beginning at the base of the bill, and running above and below the eye, the lower portion widening into a gular patch, which joins a broad black mark on the throat. A black line in the center of the head, commencing at the bill, and changing to brownish on the upper part of the head. Crest buff yellow, upper parts light chestnut, every feather transversely barred with black, and having a central streak of yellowish-white. The black bars are broader on the wings, sometimes forming nearly circular spots. A wide stripe of deep chestnut runs down the center of the breast and abdomen; the flanks deep black, each feather with several circular spots of pure white; thighs and under tail coverts deep black. Tail and upper coverts same color as the wings. Bill dark brown, feet paler brown. The female is very different. Head and upper parts of the body are reddish-brown, each feather barred with black and streaked with yellowish-white. Under parts cinnamon, with central stripes, and also one on each side the shaft, of black. The head is entirely without the conspicuous markings of the male. The throat is pale white, and the flanks have regular lines and small spots of black.

PARTURITION. On the farm, among animals which have good shelter and plenty of food, but little difficulty is experienced in bringing forth the young. The exceptions are generally when mechanical difficulty is present, as in rigidity of the womb, or else contracted pelvis bones. Other difficulties are the unnatural presentation or position of the young. These are, a reverse presentation, or the tail first; the fore feet protruding without the head; the head protruding without the fore feet, or with only one; the fore feet appearing, with the head turned under the brisket; with the belly upward, the head turned over the shoulder, the fore legs first; or, with the fore legs folded against the back of the dam, the head, side, or hind leg presenting first. All violence should be carefully avoided until it becomes absolutely necessary, a case that seldom happens. The first thing to be done is to put the fœtus in proper position, with the fore feet first, the head between the feet, and the back upwards. This may generally be accomplished by having the cow standing with her hind feet considerably higher than the fore feet. Then a small hand and arm, well oiled to the elbow, introduced into the womb, the difficulty may generally be obviated. The calf being in position, and delivery difficult, introduce both hands, the palms together, to grasp with the tips of the fingers the head behind the ears. When the labor pain comes on, press strongly, at the same time pulling forward, and the fœtus generally follows one or more attempts. If there is rigidity of the mouth of the womb, a knife should be introduced (narrow and blunt at the point), held in the hollow of the hand. Fix the mouth of the womb with the fore finger, slip the blade of the knife along the fingers, until the mouth of the womb is reached, and inside, about a quarter of an inch, make a slight cut or nick on four sides of the neck thereof. This will allow expansion, and generally allow delivery. Except in very urgent cases, a little extract of belladonna, rubbed about and inside the neck of the womb will sufficiently relax. In very rare instances with the cow, the neck of the womb may have become twisted. This being the case, to be suspected in long continued labor without presentation of the bag enclosing the water, the hand should be carried well into the orifice, so as to push the bag in the opposite direction to the twist, while assistants roll the cow quickly over on the other side. Repeat this until the presentation of the womb is natural. In rare cases, the orifice is so small, or the calf so large that considerable violence must be used even with a natural presentation. In this case a hook is to be inserted in the socket of the eye of the calf and a steady pull maintained, in connection with the labor pains, and finally in still more extreme cases, the calf may have to be dissected piecemeal within the walls of the womb; this any careful person with a firm hand may accomplish, if he has previously studied the anatomy of the animal. Generally all that will be necessary will be to dislocate the shoulders and perhaps the head. In all such cases, however, the dam should be fattened, or if a mare prevented from further breeding. In case of flooding, bleeding from the womb, if the flow is free a sponge dipped in hot vinegar and water, or hot water alone, or very cold water, should be introduced and wrung out in the womb. Give also one or two ounces, as the case may be, of ergot of rye at once. If the bleeding is internal, shown by paleness of the nose, weak pulse, great debility and general coldness of the skin, introduce the hand, clean away the clots of blood from the womb and especially any adherent portions of the afterbirth, and proceed as before directed. If these do not act promptly introduce a piece of ice the size of a small hen's egg into the womb, or dissolve a teaspoonful of powdered alum in a teaspoonful of milk, and squeeze a tablespoonful into the womb. To the mare or cow may also be given two tablespoonfuls every two hours in a quart of water, of the following: three ounces compound tincture of cinnamon, and five ounces of dilute sulphuric acid.

PASSERINES, PASSERES. Birds similar to the sparrow, including those which neither manifest the violence of birds of prey, nor have the fixed regimen of the terrestrial birds, but which feed on insects, fruit, or grain, according to the slenderness or strength of their beak; some with sharp and toothed mandibles, pursue and feed on small birds. All the passerines have short and slender legs, with three toes before and one behind, the two external toes being united by a very short membrane. They form the most extensive and varied order of birds, and are the least readily recognizable by distinctive characters common to the whole group. The passerines, in general, have the females smaller and less brilliant in their plumage than the males; they always live in pairs, build in trees, and display the greatest art in the construction of their nests. The young are excluded in a blind and naked state, and wholly depend for subsistence, during a certain period, on parental care. The brain arrives in this order at its greatest proportional size; the organ of voice here attains its utmost complexity; and all the characteristics of the bird, as power of flight, melody of voice, and beauty of plumage, are enjoyed in the highest perfection by one or other of the groups of this extensive and varied order.

PASSION FLOWER. The genus *Passiflora*, bearing beautiful flowers, and, in some species, tolerable fruit, and a good wood resembling ebony.

PASTEL. A dye stuff, resembling indigo, from the plant *Isatis tinctoria.*

PASTERN OF A HORSE. The distance that intervenes between the joint of that name and the coronet of the hoof.

PASTURAGE. The value of pasturage is second to no other product of the country. Yet it is the fact that comparatively few permanent pastures are to be found in the country. This is undoubtedly owing to the fact, that but comparatively a small portion of the United States is so broken and hilly as not to be susceptible of easy cultivation. Hence our pasture grasses are such as are used for hay. Timothy and clover are the two principal plants used for hay. Clover is a biennial, or, at most a triennial, and hence except when it constantly re-seeds itself, it is soon lost. Timothy, on account of its bulbous root at the surface of the ground, is not adapted to close pasturage. Hence for permanent pasture, we must seek for those grasses forming a close, compact sod, and which, at the same time, are perennial and not easily killed by the tramping of stock. In the article clover, in that of grass, and in writing of individual species, we have noticed many varieties not in general cultivation here. In the question of grasses for pasturage, therefore, experiment must be made as to the adaptability of certain species. This will be treated of further on. Those grasses that do well generally, and which are well known in all the grass growing sections are red and white clover, timothy, red top, blue grass, and orchard grass. If our agricultural colleges in each State would make careful and long-continued experiment with various grasses, both for hay and pasturage, with a view of ascertaining their adaptability to various soils and climates, their power of withstanding summer droughts and tramping, then it would be of incalculable benefit to the agriculture of the several States in a direct money point of view, and greatly assist farmers in determining their respective values. Until this is done systematically and in concert by the management of the several State schools, the farmer must depend upon his own experiments. (See article Grasses, for specific distinction of grasses.) It is evident that the main dependence for pastures must be those plants that do well generally. Among the clovers will be found red clover, white or Dutch clover, and Alsike clover; the two last given will do well on rather moist land. Alsike clover (*Trifolium hybridum*) is a pale-red perennial species, and on moist lands may undoubtedly be cultivated with advantage, either for pasture or mowing. It makes fine pasturage, better, we think, than white clover; and fair hay, but not so valuable as that from red clover. As a pasturage for bees, it is also most valuable. It loves a clayey soil, especially a marly clay, and thrives on marshy lands, even when sometimes overflowed. It has the disadvantage of not springing into growth after being mown for hay, and also that it requires two or three years to become well established in the soil. In general appearance and habit of growth is intermediate between the common red and white clover. It is highly valuable for pasturage, growing rapidly after being eaten down, and furnishing a large amount of food during the season. The stems remain soft and succulent even when old, never becoming so woody and hard as that of red clover; it also partakes of the creeping, spreading habit of white clover. It yields well when cut for hay, being thick and close, although not so tall in growth as the red clover. Red clover succeeds well in all soils not strongly inclined to heave. In fact, in all well drained soils. White clover succeeds well in dry soils, and also in moist ones, if not wet. Alsike grows in soils moister. From their general adaptation to the West, they should be given a trial everywhere. These three varieties of clover are all that may be considered, except on the dry soils far west, where alfalfa is found valuable. Our advice in seeding either for pasture or meadow is to seed freely for pasture of all three varieties, and for meadow with red clover on dry soils, and with Alsike on moist soils. Of the three grasses for pasturage, where it will stand, the chief reliance may be upon blue grass, red top, orchard grass, fowl meadow, sheep fescue. Late experiments in Wisconsin with fowl meadow grass (*Poa Serotina*) sometimes called false red top, have shown this to be a most valuable grass both for the meadow and pasture. It will undoubtedly be found so in many localities. Hence the necessity of experiment with other varieties. In relation to the nature of the pasturage and the grasses to be sown for special grazing, all farmers know that horses and sheep bite close to the ground and that cattle do not. Hence for cattle long pasturage is necessary; also that cattle, horses, and sheep leave particular varieties to grow up to seed, unless starved, while others they pasture close. In our dry, summer climate, pasture often becomes brown in summer, sometimes for long periods. At such time soiling crops, or grain, or both, should be provided, if in one's power. To accomplish this the soil should be rather compact as to its lower portion, but smooth and with a firm mellow tilth as to its surface or seed-bed. In seeding for a permanent pasture anywhere, whatever the mixture of grasses may be, not less than thirty pounds per acre of grass seed should be sown, and many of our best graziers advise forty pounds of seed per acre. The basis of our pastures must consist of red clover, white clover and Alsike clover, and the fine grasses named. Blue grass, however, is so persistent that it will soon root out the other grasses on soils congenial to it, and also the clovers, except white clover. As the basis for experiment, we give a list that has been found valuable in England, and regret that there has been no accurate test experiments carried out as yet in the United States to show the value of many of the varieties, that will be named from first to last, to test their capabilities in their power of withstanding drought and our more severe northern winters. It must be recollected that the climate of Great Britain is cool and moist, and mild in winter, while ours is hot. The varieties are as in the following lots:

FOR SPRING, ELEVEN SPECIES.

1. Alopecurus pratensis.
2. Dactylis glomerata.
3. Festuca pratensis.
4. Phleum pratense.
5. Anthoxanthum odoratum.
6. Arrhenatherum avenaceum.
7. Lolium perenne.
8. Bromus arvensis.
9. Poa annua.
10. Avena pratensis.
11. Vicia sepium.

FOR SUMMER AND EARLY AUTUMN, ELEVEN GRASSES OR CLOVERS.

1. Avena flavescens.
2. Hordeum pratense.
3. Cynosurus cristatus.
4. Festuca duriuscula.
5. Poa trivialis.
6. Poa pratensis.
7. Holcus lanatus.
8. Trifolium pratense.
9. Trifolium repens.
10. Lathyrus pratensis.
11. Festuca glabra.

FOR AUTUMN, FOUR SPECIES.

1. Agrostis stolonifera.
2. Achillea millefolium.
3. Agrostis palustris.
4. Triticum repens.

In lot one we should throw out numbers 9 and 11. It is hardly probable that the annual poa, or that the vetches will be valuable. The same may be said of lot two, number 10. The Latherus or pea tribe are valuable for fattening, but would hardly stand in a pasture. The same may be said of number 2, in lot three, the Yarrow, or Milfoil. The probability is the list may have to be narrowed still more. Permanent pastures are not made in a single year. They take time, and once they have become permanent, they should be kept so by every means in one's power. Do not pasture too young, and never when so soft that it will poach. Give the sod time to form hard and solid, and you will have a permanent mine of wealth. The object of thick seeding is not only that one plant may support and nurse another, and thus quickly shade the soil, but also that every square inch of soil will surely contain seed. Sixty-four varieties of plants have been found in a single square foot of old English pasture, and from twenty to thirty is not unusual. The improvement of stock commenced in England, and has kept even pace there with the introduction of cultivated grasses and other forage plants. The four quarters of the earth have been examined for whatever might be found. Herein American farmers may take a valuable lesson, not only in experimenting with new grasses, and in the preparation of the soil, and in the quantity of seed sown, but in the great variety sown for pasture as well. The quantity of seeds sown per acre, at the rate we have indicated, will be something enormous when we recollect their extreme minuteness; but then it must be remembered that the finer the seed the more are lost from not germinating, and by killing before fairly established in the soil. It is poor policy to grudge seed in sowing a meadow, and especially a pasture. The following table will show the common and scientific name of some well known clovers and other plants, and the number of seeds per ounce:

Names of Plants.	Average number of seeds in one ounce.
Darnel, (*Lolium italicum*)	27,000
Orchard grass, (*Dactylis glomerata*)	40,000
Red clover, (*Trifolium pratense*)	16,000
Perennial clover, (*Trifolium pratense.. perenne*)	16,000
Foxtail grass, (*Alopecurus pratensis*)	76,000
Fescue, (*Festuca pratensis*)	26,000
Fescue grass, (*Festuca duriuscula*)	39,000
Meadow grass, (*Poa nemoralis sempervirens*)	133,000
Lotus corniculatus	28,000
Common Yarrow or Milfoil, (*Achillea millefolium*)................................	200,000
Common Darnel, or Rye grass, (*Lolium perenne*)	14,850
White clover, (*Trifolium repens*)	32,000

Below we give lists of varieties that in England have been found to do well on various soils, with the quantities to be sown. In experimenting with these and other grasses, we would advise that each species be sown on some trial patches separately, noting their adaptability, season and growth. With this held in view, the following varieties and quantities will be found interesting, remembering that when trial patches of single varieties are sown that the rate of one pound to twenty-five feet square will be sufficient seed for an experimental plot.

LIST ONE. FOR A SANDY SOIL.

Names of Plants.	Pounds.
Timothy, (*Phleum pratense*)	2
Red top, (*Agrostis vulgaris*)	6
Velvet grass, (*Holcus lanatus*)	4
Rough Meadow grass, (*Poa trivialis*)....	6
White clover, (*Trifolium repens*)	12
Lucerne, (*Medicago maculata*)	3
Running Vine, (*Lathyrus pratense*)	3
Per acre	36

LIST TWO. FOR SANDY SOIL WITH A SLIGHT MIXTURE OF CLAY.

Names of Plant.	Pounds.
Phleum pratense	2
Poa trivialis.........	6
Festuca elatior	6
Lolium perenne	4
Avena pubescens	3
Vicia sepium	2
Lotus corniculatus	2
Trifolium pratense	10
Per acre	36

LIST THREE. FOR CALCAREOUS SOILS.

Names of Plants.	Pounds.
Meadow Brome, (*Bromus pratensis*)	5
Orchard grass, (*Dactylis glomerata*)	4
Variety of Oat grass, (*Avena elatior*)	4
Rye grass, (*Lolium perenne*)	2
Rough Meadow grass, (*Poa trivialis*)	9
Kentucky Blue grass, (*Poa pratensis*)	2
Poa augustifolia	2
Lucerne, (*Medicago maculata*)	2
Red clover, (*Trifolium pratense*)	6
Italian clover, (*Trifolium fragiferum*)	4
Per acre	40

LIST FOUR. FOR STIFF CLAYEY SOILS.

Names of Plants.	Pounds.
Timothy, (*Phleum pratense*)	2
Foxtail, (*Alopecurus pratense*)	4
Rough Meadow grass, (*Poa trivialis*)	9
Meadow Fescue, (*Festuca pratensis*)	4
Festuca elatior	3
Fowl Meadow, (*Poa serotina*)	3
Lucerne, (*Medicago maculata*)	2
Red clover, (*Trifolium pratense*)	10
Wild Pea, (*Lathyrus pratensis*)	2
Vetch, (*Vicia sepium*)	2
Per acre	41

The time of flowering of the following grasses in England, their height, and soil adapted thereto, has been prepared, by which the time of flowering of any one of the species, (*Dactylis*, Orchard grass for instance) being known in any locality, that of the others may be very nearly computed. The table is as follows:

Names of Plants.	Time of Flowering	Height.	Lands best adapted.
Muhlenbergia	August.	2 to 3 ft.	Low grounds.
Dactylis glomerata	June.	2 to 3 ft.	Meadow and pasture
Poa annua	Apr. Nov.	3 to 8 in.	Cultivated.
Poa serotina	June.	2 to 3 ft.	Moist land.
Poa trivialis	July.	1 to 3 ft.	Meadow and pasture
Poa pratensis	May, July.	1 to 2 ft.	Pasture.
Poa compressa	June, Aug.	9 to 18 in.	Pasture.
Anthoxanthum odoratum	May.	12 to 18 in.	Meadow and pasture
Festuca elatior	June.	3 to 5 ft.	Moist land.
Agrostis alba	July.	1 to 2 ft.	Moist land.
Muhlenbergia mexicana	August.	2 to 3 ft.	Moist land.

PASTURE THISTLE. (See Thistle.)

PATELLA. The knee pan.

PATENS, PATENT. Spreading.

PATHOGNOMIC. Symptoms which are characteristic of a disease.

PATHOLOGY. A dissertation on the effects of disease on the body.

PAVILION. In architecture, a projecting apartment on the flank of a building, usually higher than the rest of it. Summer-houses in gardens are sometimes, but improperly, termed pavilions.

PEA. *Pisum.* The cultivated pea is one of the most important of the pulse family, ranking next the bean, (*Phaseolus,*) in value. In Canada and the extreme northern portions of the United States where it escapes the ravages of the pea weavil, which further south stings the young pods, depositing its eggs therein, and hatching, the young find their way to the peas, which they burrow, avoiding the germ, but entirely ruining the seeds for food. When the crop escapes the ravages of this pest the crop is valuable and large quantities are exported. The chick pea, (*Cicer,*) has long been known in gardens and in India it has been known and cultivated as food for horses since the earliest historical times. So also the cow pea of the South, but which is really a bean, or a species of *dolichos*, of which asparagus bean is one of the cultivated varieties. The cow pea is considered one of the most valuable plants in the South for fodder, for its ripe seeds, for cattle, swine and horses, and also as a manurial crop for turning under green. It will thrive on land too poor for clover, and leaves the soil in admirable condition for an after crop. When sown among corn it affords valuable pasturage after the corn is ripe. Care, however must be taken that stock is not allowed to eat too freely of it at first, since like green clover it sometimes kills them from hoven or bloat, that is from the gas generating from the fermenting mass in the crowded stomach. The pea is cultivated all over the civilized world, in gardens, for eating green, or at the time the seeds are fully formed but yet not ripe. There are two distinct classes, the dwarf and the running. The dwarfs are sown about two feet apart between rows by half an inch in the rows, and need no brush. Among the best varieties are Tom Thumb, Little Gem and Yorkshire Hero, the latter a large, wrinkled pea of great excellence of flavor. If Tom Thumb or Little Gem are planted at the same time they will furnish a succession, Yorkshire Hero coming in about the time the others fail. For the general crop, however, the taller kinds are planted. Among the best varieties of these sorts for family use, are Daniel O'Rourke, Early, Champion of England, Medium, and Missouri Marrow, a late pea. The first named require brush about three feet high, although they are often left without brushing. Indeed market gardeners seldom brush them. Champions and Marrows require brush fully five feet high. In the kitchen garden it will pay to brush all the running varieties; Daniel O'Rourke should be sown in drills, early in the spring, three and a half feet apart, Champion five feet apart and Missouri Marrow six feet apart. If sowings are made later, the seed should be covered four or even five inches deep, since it is found that this deep planting assists the plants in withstanding drought. When the peas are to be brushed to support their growth, and all varieties that grow over two and a-half feet high are better for brushing, it is usual to sow in double rows—rather thinly—the double rows to be twelve to fourteen inches apart.

PEACH. *Persica vulgaris.* The original country of the peach is not certainly known. It is, however, indigenous to Persia, and was taken from thence to Italy by the Romans, in the time of the Emperor Claudius. Hence its name Persica, from Persia. In China it seems to have been cultivated from time immemorial, and their traditions in relation to the peach are not essentially dissimilar to our biblical account of the tree of knowledge, as generally understood.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Class.	Color.	Quality.	Glands.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
1	Allen's October						L.	Am.				
2	Alexander	m.	F.	w.	s. j.	g.	V. E.	Am.				
3	Alexandra Noblesse	l.	F.	w.	m.j.v.	g.	M.	F.				
4	Amelia	l.	F.	w.	m.j.r.	r.	E.	Am.				
5	Amsden's June	m.	F.	w.	s. j.	g.	V. E.	Am.				
6	Austin's Late Red	l.	C.	w.	j. v.	r.	L.	Am.				
7	Baldwin's Late	l.	F.	w.	j. m.	r.	L.	Am.				
8	Barnard	m.	F.	y.	j. v.	g.	E.					
9	Beer's Smock	l.	F.	y.	j. v.		L.	Am.				
10	Bellegarde	l.	F.	g.	s. j.	g.	M.	F.				
11	Bergen's Yellow	m.	F.	y.	j. v.	r.	M.	Am.				
12	Bordeaux	l.	C.	y.	j.	r.	E.	Am.				
13	Briggs' May	m.	F.	w.	m.		V. E.	Am.				
14	Catharine	l.	C.	y. g.	j. r.	r.	M.	Am.				
15	Chinese Cling	l	C.	g.	j. v.	r.	M.					
16	Cole's Early Red	m.	F.	w.	m.j.r.	g.	V. E.	Am.				
17	Columbia	l.	F.	y.	j. v.	r.	M.	Am				
18	Con's Cling											
19	Coolidge's Favorite	l.	F.	w.	s. j. h.	g.	M.	Am.				
20	Cook's Late White	m	F.	w.	m.j.v.		L.	Am.				
21	Counts	l.	C.	w.	m. j.		M.	Am.				
22	Crawford's Early	l.	F	y.	j. v.	g.	M.	Am.				
23	Crawford's Late	l.	F.	y.	j. v.	g.	L.	Am.				
24	Crockett's Late White	m.	F.	w.	s	r.	L.	Am.				
25	Deming's Orange (Deming's Sept.)	l.	C.	y. v.	j. r.		L.	Am.				
26	Druid Hill	l.	F.	g.	m.j.r.	g.	V. L.	Am.				
27	Duff Yellow	l.	C.	y.	m. j.	g.	E.	Am.				
28	Early Albert	m.	F.	w.	m j.v.	r.	E.	F.				
29	Early Admirable	l.	F.	w.	m. j.	g.	M.	F.				
30	Early Beatrice	s.	F.	w.	m. j.	r.	V. E.	Eng.				
31	Early Grosse Mignonne	m.	F.	w.	m.j.v.	g.	E.	F.				
32	Early Louise	m.	F.	w.	m. j.	r.	E.	Eng.				
33	Early Newington Free	l.	F.	g.	j. v.	g.	E.	Am.				
34	Early Rivers	l.	F.	p. y.	m. r.	r.	E.	Eng.				
35	Early Tillotson	m.	F.	g.	m j.r.	s.	V. E.	Am.				
36	Early York	m.	F.	w.	m.j.r.	s.	V. E.	Am.				
37	Eaton's Golden	m.	C.	y.	s. j.	r.	L.	Am.				
38	Flewellen	l.	C.	y.	j. r.		E.	Am.				
39	Foster	l.	F.	y.	j. v.	g.	L.	Am.				
40	George the Fourth	m.	F.	y.	m.j.r.	g.	M.	Am.				
41	Grosse Mignonne (Royal Kensington).	l.	F.	w.	s. j. h.	g.	M.	F.				
42	Haines' Early Red	m.	F.	g.	s. j.	g.	V E.	Am.				
43	Hale's Early	m.	F.	w.	m.j.r.	g.	V. E.	Am.				
44	Harker's Seedling	l.	F.	y.	s. j.	g.	M.	Am.				
45	Heath Cling	l.	C.	g.	s. j. h.	r.	V. L.	Am.				
46	Hill's Chili	m.	F.					Am.				
47	Honeywell	m.	F.	w.	s. j.		E.	Am.				
48	Hoover's Late Heath											
49	Hyslop Cling	l.	C.	w.	m.j.r	r.	V. L.	Am.				
50	Indian Blood Cling	l.	C.	y.	j. v.	r.	L.	Am.				
51	Indian Blood Freestone	l.	F.					Am.				
52	Incomparable	l.	C.	w.	m. j.	r.	L.	Am.				
53	Jacques	l.	F.	y.	j. v.	r.	M.	Am.				
54	Kenrick's Heath (Heath Freestone).	l.	F.	g.	j. v.	r.	L.	Am.				
55	Keyport White	l.	F.	w. r.	m. j.	r.	V. L.	Am.				
56	Lady Parham	m.	F.	g.	j. v.	r.	V. L.	Am.				
57	La Grange	l.	F.	w.	s. j. h.	r.	V. L.	Am.				
58	Large Early York	m.	F.	w.	s. j. h.	g.	V. E.	Am.				
59	Large White Cling	l.	C.	w.	s. j.	g.	L.	Am.				
60	Late Red Rareripe	l.	F.	w.	s. j. h.	g.	M.	Am.				
61	Late Admirable	v. l.	F.	y. g.	m. h.	g.	M.	F.				
62	Lemon Cling	l.	C.	y.	j. v.	r.	L.	Am.				
63	Leopold I (Leopold Freestone).	l.	F.	y.	j. v.	r.	M.	F.				
64	Malta	l.	F.	g.	m.j.r.	s.	M.	F.				
65	Mammoth Freestone	v. l.	F.									
66	Mitchell's Mammoth	l.	C.	g. w.	m. j.		L.	Am.				
67	Molden's White	l.	F.	w.	s. j.	r.	L.	Am.				
68	Montgomery's Late	l.	F.	w. r.	m. j.	r.	L.	Am.				
69	Morris White	m.	F.	w.	m.j.r.	r.	M.	Am.				
70	Mountain Rose	m.	F.	w.	s. j.	g.	M.	Am.				
71	Noblesse	l.	F.	w.	s. j.	s.	M.	F.				

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4 This originated in South Carolina, and differs from the Missouri Amelia.

15 Berckmans thinks it is same as Shanghae.

25 Resembles Lemon Cling.

Number.	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland & D. C.	Virginia,	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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66 Resembles Heath Cling, but later.

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Class.	Color.	Quality.	Glands.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine	New Hampshire.
72	Old Mixon Free	l.	F.	g.	s. j. h.	g.	M.	Am.				
73	Old Mixon Cling	l.	C.	w.	m. j. r.	g.	M.	Am.				
74	Pavie de Pompone	l.	C.	w.	m. j.	r.	L.	F.				
75	Petite Imperial	l.	F.	w.	m. j. v.	r.	L.	Am.				
76	Picquett's Late	l.	F.	y.	s. j.	r.	M.	Am.				
77	President	l.	F.	w.	m. j. r.	g.	M.	Am.				
78	Prince of Wales	l.	F.	w.	m. j.	r.	M.	F.				
79	Princess of Wales	l.	F.	w.	m. j. v.	g.	M.	F.				
80	Pucelle de Malines	l.	F.	w. r.	m. j.	s.	M.	Am.				
81	Raymond Cling	l.	C.									
82	Red Cheek Melocoton	l.	F.	y.	j. v.	g.	M.	Am.				
83	Reeves' Favorite	l.	F.	y. r.	m. j.	g.	M.	Am.				
84	Richmond	m.	F.	w.	m. j.	r.	M.	Am.				
85	Rodman's Cling	l.	C.	w.	j. v.	r.	L.	Am.				
86	Royal George	m.	F.	w.	m. j. r.	s.	E.	F.				
87	Salway	l.	F.	y. r.	m. j.	r.	M.	Am.				
88	Scott's October	m.	C.	y.			V. L.					
89	Shockley's Early											
90	Smock	l.	F.	y.	j. v.	r.	L.	Am.				
91	Snow	m.	F.	w.	s. j.	r.	M.	Am				
92	Snow's Orange	m.	F.	y.	m. j.	r.	M.	Am.				
93	Stump the World	l.	F.	w.	s. j. h.	g.	L.	Am.				
94	Sturtevant	m.	F.	y.	s. j. h.	g.	M.	Am.				
95	Strawberry	m.	F.	w.	m. j.	r.	M.	Am.				
96	Susquehanna	l.	F.	y.	s. j. v.	g.	M.	Am.				
97	Tippecanoe	l.	C.	y.	j. v.	r.	L.	Am.				
98	Troth's Early	m	F.	w.	s. j.	g.	E.	Am.				
99	Tuskena Cling											
100	Van Zandt's Superb	m.	F.	w.	m. j. r.	g.	M.	Am.				
101	Ward's Late Free	l.	F.	w.	r. j. s.	r.	L.	Am.				
102	Washington Cling	m.	C.	y. r.	m. j.	r.	L.	Am.				
103	Wheeler's Early	s.	F.	w. r.	m. j.		V. E.	Am.				
104	White Imperial	m.	F.	w.	m. j. r.	g.	E.	Am.				
105	Yellow Alberge	m.	F.	y.	s. j.	g.	E.	F.				
106	Yellow Rareripe	l.	F.	y.	j. v.	g.	E.	Am.				
107	Yellow St. John (Fleita's or Flater's St. John.)	l.	F.	y.	s. j.	g.	V. E.	Am.				

The peach began to be generally cultivated in England about the middle of the sixteenth century, and was brought from hence to America about 1680. In England, peaches can not be raised without the protection of a wall, the trees being trained along the south side. Even in France their cultivation is not entirely successful without the aid of protection, except in the southern portions. China and the United States are the only temperate climates where the peach arrives at full perfection. In Michigan, the northern line of cultivation is Grand Traverse bay, near the foot of lake Michigan. West of lake Michigan they can not be grown north of central Illinois and southern Iowa. Yet if it were not for winter killing, the summers would ripen them up to the latitude of St. Paul, Minn. There are none of our fruit trees so easily propagated as the peach. If the stones are placed in a thick layer in a shallow trench, in the autumn, and covered with eight inches of earth, and then planted in April, they will be ready for budding in September. This should be done quite near the ground. The following spring the top should be cut back near the bud. The growth will often reach six feet the first season, and the third year they will bear. In the North they are sometimes budded on the plum, since this stock is hardier than the peach, and the trees are dwarfed thereby. Budded upon the Mirabelle plum stock they become quite dwarf, and thus are suitable for orchard houses. The soil best adapted to the peach is a rich, deep, dry, sandy loam; but they grow well on a strong, mellow loam, or even in light sand. In fact, any dry, good soil, except a heavy clay, does well for the peach. On very light soils the trees are quite subject to the yellows. (See Yellows in Peach.) So severe has this disease become within the last few years in Michigan, that most stringent laws have been passed for its eradication. In some otherwise good peach growing districts, the blossoms are killed by late spring frosts. Where this is the case, the trees should be planted on northern slopes, or on high, airy situations, or along the banks of deep streams, lakes, or bluffs. The most noted peach region in the West is the Michigan lake shore region, in Michigan; next, the bluffs about Alton, Ill., and then the whole timbered region south of Centralia. South of the Ohio river, and in Missouri and Kansas, and south, the peach is everywhere at home. The peach orchard should have good cultivation early in the season, and the pruning should consist simply in shortening in the branches, to keep the head as dense as possible. The peach is so easily grown that it seems strange that Western farmers should not plant them more for home use. They will, with care, bear two or three years in five, up to the northern limits of Illinois, and when

	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
Number.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland & D. C.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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the trees are winter killed they may be easily renewed. We have seen finer peaches nowhere than used to be grown on the sandy soils in protected situations near Chicago. Above we give the list of varieties supposed to be adapted to various sections of the United States, as lately revised by the American Pomological Society, in which will be found varieties adapted to any climate where the peach will flourish.

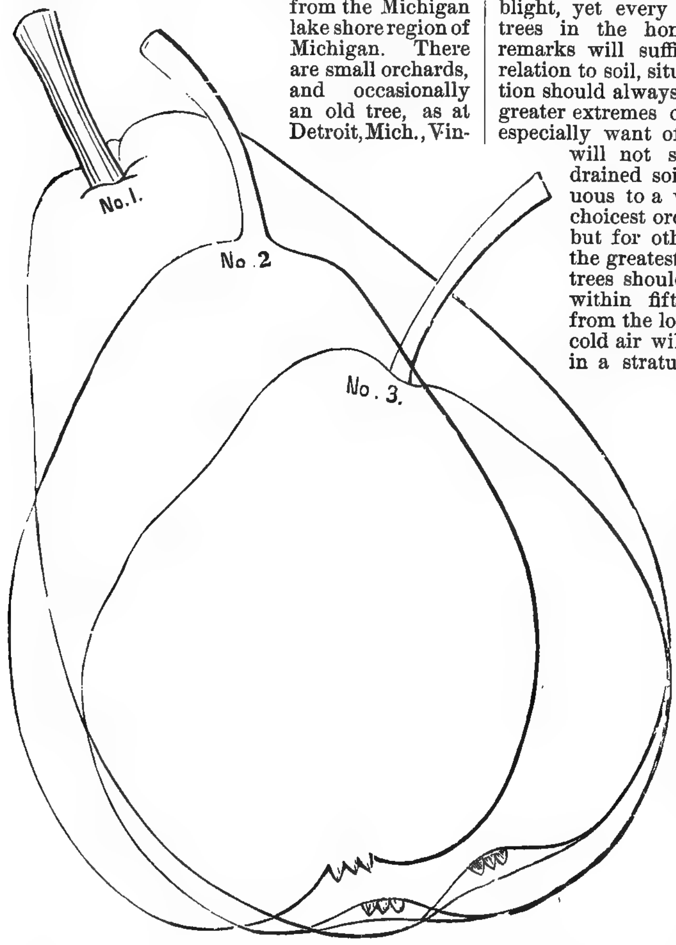
The columns explain: Size—l., large; m., medium; s., small. Class—F., freestone; C., Clingstone. Color—relative to the flesh, w., white or pale colored; y., yellow or yellowish; g., greenish white, red at stone. Quality—j. v., juicy, vinous; m. j. r., melting, juicy, rich; s. j.. sweet and juicy; s. j. h., sweet, juicy and high flavored. Glands—s., serrated, without glands; g., glands globose; r.,glands reniform, Season —the season of maturity, as Early, medium or Late, those designated as Early, ripen in lat. 43° previous to or about Sept. 1; Medium; those ripening from 1st to 15th Sept., and Late those after that period; a few of the Very Early and Very Late are so designated—E., early; M, medium; L., late; V. E., very early; V. L., very late. Origin—Am. American; F., Foreign. *, signifies doing well; * *, great superiority and value; †, new and recently introduced for trial.

PEA-NUT. Goober, Pindar, Ground Pea, Ground Nut. *Arachis hypogœa.* In Tennessee and down the Mississippi, it is known by the name of Goober, and on the Atlantic coast as Ground-pea; commercially, however, the word pea-nut is the usual term. It is a native of India, but is now extensively raised in Virginia and North Carolina, and in Kentucky and Tennessee and Southern Illinois. Those raised in the sandy soils of the Atlantic coast are the best. A peculiarity of the pea-nut is that when the plant flowers, the young seed pod enters the soil where the seed ripens, as is shown in the cut. The seed is sometimes planted all over the surface at a distance of a foot apart each way, and if not earthed up, the vines will yield a ton of dry fodder per acre, considered fully as good as clover. The usual way of cultivation is to plant in drills three feet apart, one nut in a place, at a distance of twelve inches apart. The earth is kept free of weeds and at the time of blossoming the drills are bedded up so as to make a mellow surface for the young nuts to strike in. When ripe, the vines are pulled and dried, without getting wet, the peas whipped off, cleaned up in a common fanning mill and sacked for market. The produce varies from sixty to ninety bushels and even more per acre. The seed produces a most excellent oil, superior to olive oil for salads. As an illuminating oil it is excellent, burning with a clear flame and pleasant fragrance. The seed produces from forty to fifty per cent. of oil, and the nuts are largely used in the adulteration of chocolate, and especially in chocolate preparations of confectionery. The following is from a practical cultivator in Virginia: Any soil that can be put in a friable condition, and kept in that state, will produce peanuts; but that which is best adapted to their growth is a light, gray soil, without being very sandy. The color of the pods always partakes of the color of the soil; and as the brightest pods always bring the most money, so the gray land is to be preferred. When harvested they are perfectly clean, scarcely a particle of soil adhering to them. Not so with red or chocolate-colored lands. They leave a stain on the pods, of which they can not be divested even by washing—a practice frequently resorted to for the purpose of getting a fancy article. When taken to market the bright nuts will command from ten to fifteen cents more per bushel than the brown, though equal in all other respects. The gray soil is therefore to be selected when there is freedom of choice, but the brown soil, when of the right texture, is equally productive. In choosing a site for planting, reference should be had to the crop of the previous year. Peanuts require a clean soil; they will follow any hoed crop to advantage, with the exception perhaps of sweet potatoes. Corn land is generally preferred. In tide-water Virginia much of the land was heavily marled in former years, and whenever this is the case an important and perhaps the chief requisite to success has been already provided. The peanut will not fruit except on a calcareous soil. The vines may grow with the greatest luxuriance, covering the whole ground, but in the absence of lime or marl the pods do not fill; they turn out to be nothing more than what is popularly called pops. If, then, the land has not been previously marled or limed, it will be necessary to apply say a hundred and fifty bushels of marl or fifty bushels of lime, to the acre. The kind of lime chiefly used of late years is burned oyster shells, which may be had in abundance in all the large towns. It is applied in either of several ways, according to the convenience of the planter, and with about equally good effect. If there is any choice, spreading broadcast is perhaps the best, to be done before the land is plowed; in which case the quantity should be about fifty bushels to the acre. A favorite mode, where a large surface is to be planted, is to strew the lime in the furrow over which the bed is to be raised for planting. In this case a less quantity will answer, by reason of its being more concentrated—say twenty bushels. Other planters, again, who are hurried in their work, spread the lime over the beds after the crop is planted, at the rate of about thirty bushels to the acre. Either mode is attended with good success; but wherever it is practicable to have a choice of land that has been sufficiently marled or limed in former years, and preserved by judicious culture, the best results are found to follow. In such cases the yield not unfrequently reaches a hundred bushels to the acre. The product ranges from the quantity stated down to twenty-five or thirty bushels to the acre, according to the skill, or want of skill, of the planter—a fair average of the whole being estimated at fifty bushels. Few persons make peanuts part of a regular system of rotation, but the pre-eminent success of a gentleman who has followed the plan is worthy of special reference. The lot intended for peanuts, say next year, has been seeded in stock peas this year, the vines to be plowed in sometime in September. The vines afford a great quantity of vegetable matter, which becomes thoroughly decomposed by the time for planting the crop. When the season for planting is at hand, the ground is replowed and laid off, and ten bushels of lime and a hundred and fifty to a hundred and seventy-five pounds of superphosphate strewn in the furrows to be ridged over. The year following peanuts the land is planted in sweet potatoes, with a liberal dressing of stable manure. The third year it is laid down in stock peas again, to be followed by peanuts as before, always repeating the lime and superphosphate. Having selected the ground, it is to be plowed with a one-horse plow in March or April to a depth not exceeding four or five inches. The advantages of shallow culture will be apparent from the fact that the peduncles continue to penetrate the earth until a firm bed is reached on which to deposit the nut; and the still further fact of the increased facility afforded in harvesting as will appear when we come to treat of that branch of the subject. About the 10th to the 20th of May is the time for planting. If the land is thin and needs manuring, open furrows three feet apart, and strew in a hundred to a hundred and twenty-five pounds of Peruvian guano, or from a hundred and fifty to two hundred pounds of superphosphate of lime. The former is generally used, because of the greater certainty of getting a pure article, but nothing can be better than the latter when well prepared. The furrow is then to be ridged over and the whole surface thrown into three-feet beds, which should be reduced to within two or three inches of the general level of the field. Then mark off the rows, and at distances of

PEA-NUT.

eighteen inches plant two seeds, covering them an inch to an inch and a half deep—not more. In ten days or two weeks according to the weather, the young plants begin to come up. As it is very important to get a good start, the missing hills should be replanted at the earliest moment. It is the custom of some planters to put an extra quantity of seed in every fourth or fifth row, to furnish plants for transplanting, if needed; if not needed, they can be thinned out. As soon as the grass makes its appearance give a light plowing, throwing the earth from the vines, and following with the hoe, thoroughly removing all the grass from the row. Plow again as soon as the grass reappears, this time using a double shovel or cultivator, and the hoe as before directed. If the season should prove to be very wet, a third working may be necessary, making use of the cultivator and hoe again. Next comes the time for laying by, the vines having extended nearly half way across the space between the rows. This is done by running a mold-board once in the middle between the rows, and drawing the earth up to the rows with a hoe, care being taken not to cover the vines and to disturb their position as little as possible, as the fruit will now be forming. It will be necessary also to guard against making the bed too high. When there is grass in the row it must be pulled up by hand. Soon after this the vines will cover the whole ground, and repress every other growth, unless it may be a chance weed that escaped notice at the former working. The time for harvesting the crop is from the 15th to the 30th of October, immediately after the first frost. When the crop is forward, or when it is an object to get a portion of it early in market, the operation may be commenced in the latter part of September; but the longer the vines continue to grow, the greater will be the number of sound pods. Select a time when the weather is settled and favorable, and with three pronged hoes loosen the vines along the rows. Hands follow the digger, pull up the vines, shake the dirt from them, and leave them in the same place. In dry weather they will be sufficiently cured in two days to be shocked. Showery weather, though it may somewhat delay the curing, does no injury. One of the advantages of shallow culture becomes apparent in harvesting. When the fruit is deposited only a few inches below the surface, the vine is detached from its position with little or no loss; when the depth is greater, the stems or pedicels are liable to be broken off. In shocking, provide stakes seven feet long, made sharp at both ends; then lay two fence rails on the ground as a foundation, but with supports underneath to afford free access to the air. The stakes are stuck in the ground at convenient intervals between the rails, the stacks built up around them, and finished off by a cap of straw to shed the rain. The diameter of the stack is made to conform to the spread of a single vine. After remaining about two weeks in the stack the picking should be begun, taking off none but the matured pods. These are to be carried to the barn, and prepared for market by finishing the drying process, and then fanning and cleaning. The most tedious part of the work is the picking, An expert discriminates at a glance between the mature and immature pods, but can not pick more than two and a half or three bushels per day. A machine to perform the operation would be a most valuable invention. Unless the management in the barn is carefully conducted, there is great danger, where there is much of a bulk, that the peas will become heated and moldy. The condition in which the early deliveries are often received at market renders this caution quite necessary. In fact, there is as much slovenliness in the handling of this crop as there is in regard to any other; perhaps more, for the reason that so many inexperienced persons engage in the culture every year. Until the pods are thoroughly seasoned, the bulk should be frequently stirred and turned over. A certain classification, in respect to quality, obtains in peanuts as in every other article of agricultural produce. The descriptive terms in general use are inferior, ordinary, prime, and fancy; but these are not so definite as to admit of no intermediate grades. Assuming prime to be the standard, and that the prime are $2.75 per bushel, then inferior will be worth, say $1.00 to $1.50; ordinary, $2.00 to $2.50; and fancy, $3.00. Seed peanuts always command an extra price; ranging from $3.25 to $3.50. There are two very distinct varieties of peanuts, known respectively by the names of the Virginia, and the Carolina or African. The diversity between them, however, does not amount to a specific difference, the chief characteristic being that the one has a large pod and bean, and the other a small one. The Virginia is cultivated almost exclusively for eating, while the Carolina is principally used for the manufacture of oil, which can not be distinguished from olive oil, and is, accordingly, sold as such. The standard weight of the Virginia peanut is twenty-two pounds to the bushel; that of the Carolina twenty-eight pounds. In the markets they are always sold by weight. A matter of primary importance is to provide seeds of good quality for planting; and in order to be assured of their excellence, the planter should either raise them himself, or buy them of a person on whose fidelity he can rely. If, after the vines are dug and they are lying in the field, they should be exposed to frosty weather, the germinating principle would be destroyed or impaired. As a merchantable article, however, their value is not affected. Neither should the nuts become the least heated or moldy; nor should they be picked off the vines while wet, or before they are thoroughly cured. It is obvious, therefore, that the most careful attention is requisite in this matter. Previous to planting, the pods should be carefully shelled and every faulty bean thrown out; not even the membrane inclosing the seed should be ruptured. It takes about two bushels of peanuts in the pod to plant an acre.

PEAR. *Pyrus communis.* The pear would undoubtedly be the favorite dessert fruit of the day, were it not, that, owing to the blight and other disabilities neither uniform crops, nor the life of the tree itself can be depended on even in the most favored localities in the United States. The delicious varieties of the present day leave little to be desired as a fruit to be eaten out of the hand. Pears are older than history, and yet it is only within the last 150 years that the exquisite qualities of this fruit have been developed, and only within the last fifty years that it has really been brought to perfection. This indeed may be said of the apple, the plum, the cherry and the

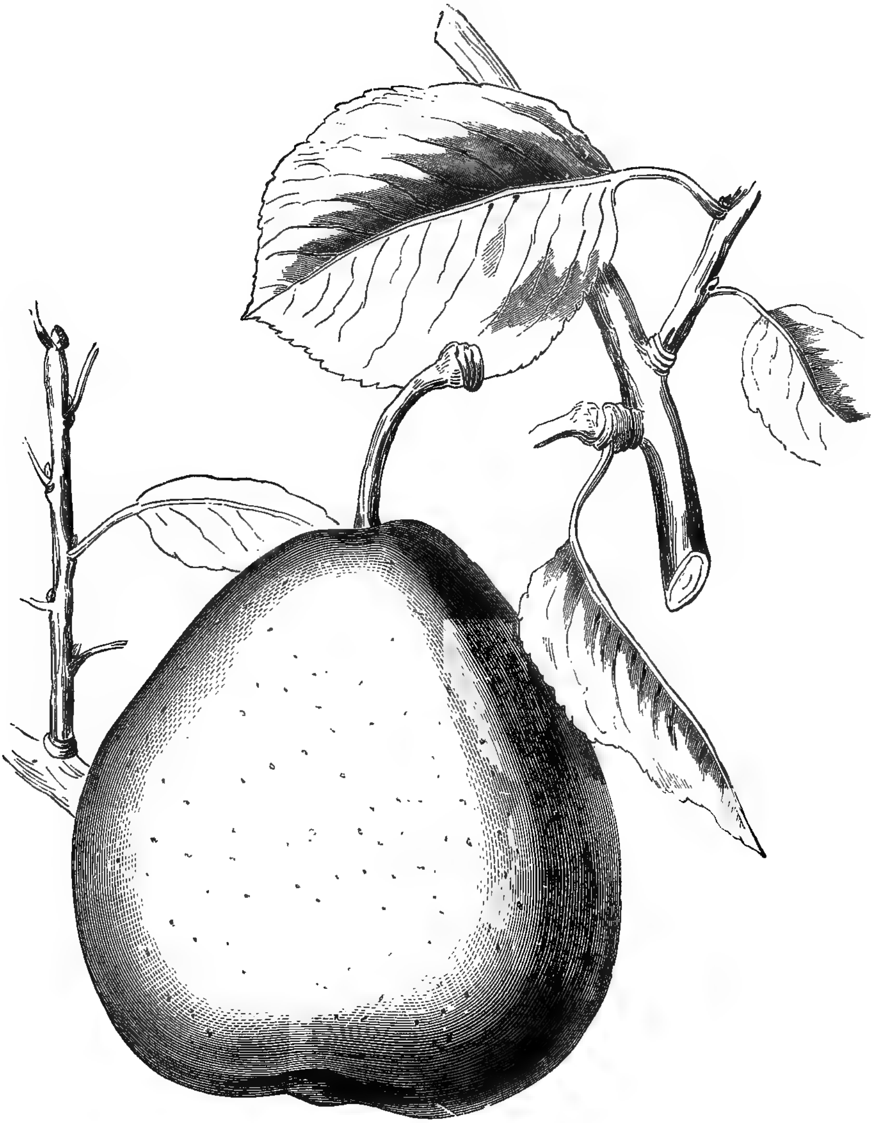


OUTLINE OF PEARS.

peach, and yet not to the same degree. Although Belgium has been called the Eden of the pear, yet neither there nor elsewhere has a fruit been produced that will equal our Seckel, a chance seedling found in a hedge row in Pennsylvania, yet the average citizen will pass it by on our fruit stalls. They want big pears, and they get them, while the wise take the little russet red Seckel, and laugh in their sleeves. California is now the most famous pear growing district in the United States. In the vicinity of Boston, they do fairly well. Large quantities are sent from the Michigan lake shore region of Michigan. There are small orchards, and occasionally an old tree, as at Detroit, Mich., Vincennes, Ill., and near Indianapolis, Ind. We wish we could advise the general planting of pear orchards. We can not. Nevertheless every farm orchard should have a small collection of pears. Among the varieties of good pears that succeed measurably well in various parts of the country are: 1. Bartlett; 2. Belle Lucrative; 3. Beurre d'Anjou; 4. Duchesse d'Angouleme; 5. Flemish Beauty; 6. Howell; 7. Lawrence; 8. Onondaga; 9. Seckel; 10. Sheldon; 11. Winter nelis. 1, 3, 4, 5, 6, 7, 9 and 11, are favorites in the West. Winter nelis, however, wants age to make it productive. The outline cut given above will show the forms of pears from obovate to oblong-ovate-pyriform. No. 1 being a representation of Pitmaston Duchess; 2. Duhamel du Morceau, and 3. Hoosic. The pear is peculiar in its growth, as a rule, inclining to pyramidal in the form of the tree, though they vary considerably. The cuts on page 716 represent two dwarf trees which will explain themselves. So on page 717 we give an illustration of the Howell pear showing the form and distinctive markings of the fruit, and also a branch and leaf. While we can not advise the planting of pear orchards except in peculiar soils and localities, subject to blight, yet every farm should have some pear trees in the home orchard. The following remarks will sufficiently cover the ground in relation to soil, situation and care: A low situation should always be avoided, on account of the greater extremes of temperature, humidity and especially want of deep drainage, for the pear will not succeed except on a deeply drained soil. A sloping hillside, contiguous to a well defined valley, forms the choicest orchard site, not only for pears, but for other fruits as well. To insure the greatest advantage from position the trees should not be planted lower than within fifty feet of upright elevation from the lowest point in the valley. The cold air will then settle during the night in a stratum below the trees, and the warm air accumulated in the lower ground during the day will be pressed up to the higher altitude occupied by the orchard, and thus afford considerable protection in cold nights. The obvious necessity of shelter to pear orchards has led, in some instances, to the mistake of selecting low grounds for their apparently well-protected position, which, for the reasons given above, are the worst possible localities. Contrasted with valley planting, even what might be termed bleak exposures have the preference, and the unsatisfactory results attending orchards in low protected grounds has led to a supposition that shelter is injurious rather than beneficial. The addition of shelter to an otherwise judiciously selected site is quite different from endeavoring to secure it by choosing a low situation. The efficacy of protection is now generally well understood, especially by those who attempt pear culture in regions that are comparatively treeless. Even the White Doyenne, the famed Virgalieu, or butter pear, worthless in exposed situations, is produced in all its pristine excellence, where the tree is protected, as may be seen in many old gardens in cities, where this variety is still common. The shelter required is not so much to repel or alleviate mere thermometric cold, as it is to arrest evaporation and its accompanying exhaustion of vitality, by checking the rapid and penetrating action of dry winds. Evergreen trees afford the most perfect shelter in the least space. A single row of Norway firs, Austrian pines, or other equally hardy evergreen trees will give shelter for a considerable distance; thickly planted belts of deciduous trees will also render effective service. How far apart these belts and hedges should be placed, and in what direction they will be most useful, will depend upon the surroundings and local specialities. As the best mode of draining a field will depend upon its surface undulations, so the best mode of sheltering will be guided by the general aspect and position of the orchard. The pear will exist in a variety of soils, but attains greater perfection in clayey loam. Even on stiff clays the tree will grow and produce very satisfactorily under the ameliorating influences of the preparation and culture which such soils require. Draining first and subsoiling afterwards are the chief requisites for gradual amelioration; in short, while a water-soaked clay soil is the most utterly worthless of all lands for the growth of any crop, a properly drained and aerated clay soil is by far the most valuable, and only requires careful management to render it available for the best productions of the orchard, farm, or garden. The prominent precaution in managing a clay soil is never to work on it while wet, but only when it is dry to friability. No expedient or process of culture will compensate for the injury sustained by working clay soils during summer, when they are saturated with water; the injury can not be remedied except by a winter's freezing, which will again produce friability under proper treatment. Soils of a sandy or gravelly character are not well adapted to the pear. In these soils, so variable in their degree of moisture, the trees ripen prematurely and drop their foliage early, if the weather proves dry toward the end of summer; then, in the event of moist weather following a period of drought, a late secondary growth will be produced, which, failing to mature, induces a tendency to blight, and predisposes to other diseases. Surface dressings of compost, repeated cultivation, or constant mulching, will counteract to some extent, the effects of uncongenial soil for the pear roots, but where it is impracticable to select any but a thin gravel or sand for the growth of this fruit, the dwarf tree is preferable, as the roots of the quince can be confined to a small area, which may be prepared and maintained to meet all requirements of growth. Where the soil has been prepared by deep tillage it will not be necessary to dig holes deeper than required to merely cover the roots of the plant. In heavy soils that have not been prepared in the most thorough manner the holes should be made wide rather than deep. In gravelly subsoils pits may be dug eighteen inches in depth, the surface soil and subsoil being thrown out at opposite sides, and filled in equally until the proper height is reached for setting the plant. In either case about a bushel of compost made up of leaf mold, rotted manure, and light soil if carefully spread around the roots, will form an admirable rooting medium; this should be finely pulverized and rather dry than wet when used. Deep planting and shallow planting are the injurious extremes in setting trees. The plain and incontrovertible rule is to set the plant so that the point from whence the stem and roots proceed in opposite directions will be about one inch below the level of the surface of the ground. It is infinitely better to plant so that some future surface dressing may be required to cover the swelling exposed roots, than to have them buried below the ready influence of atmospheric heat and air. The preservation of a proper degree of moisture in the soil surrounding the roots of the tree is the principal object of culture during the first summer after planting. Both the kind and amount of care will depend upon the nature of the soil and the condition of the weather; something will also depend upon the first preparation of the ground. Where the soil has been drained, deepened, and pulverized, and the surface is loose and mellow, nothing further will be required than merely to prevent a growth of weeds. If the surface is tenacious, frequent stirring, especially after rains, will probably suffice, but where the soil is shallow and largely composed of sand or gravel, mulching will most effectually accomplish the purpose. Any loose material will answer as a mulch, such as coarse manure, strawy litter of any kind, or short grass as cut from lawns; where a few trees only are to be cared for, tan bark and refuse charcoal dust are frequently employed. Mulch should not be applied before the middle of June, unless the weather proves very dry and warm previous to that time, and on clean ground it may remain during the following winter, or be renewed if exhausted; but in rough soddy ground, where field mice may lurk, the soil around the trees should be fine and kept clean and compressed. The best mode of treating the soil in pear orchards is an important question both in regard to the health of the tree, and the production of fruit. Laying aside all special circumstances, it appears evident that the condition of the plants will indicate the treatment required; the object being to maintain health and encourage fruitfulness, and the measure of successful accomplishment of these conditions will greatly depend upon the knowledge of the principles governing vegetable growth possessed by the cultivator. When the trees are young the chief object is to encourage judicious growth, by employing expedients known to favor vegetable extension, such as the application of manures, breaking up and pulverizing the soil, surface stirring, and other similar operations. By judicious growth is meant a luxuriance not incompatible with maturity, and as this will depend upon climate and locality, it is evident that a discriminating knowledge of cause and effect will largely influence success. In northern latitudes where the season of growth is confined to five months duration, it will be impossible to mature the same amount of wood that can be produced on trees in a locality having seven months of growing season. In the latter case stimulating appliances may be used with the best effects that would only tend to dissolution in the climate of short summers. The great desideratum in fruit culture is ripened wood; all useful cultivation begins and ends with this single object in view, and is the criterion of good or bad management. To cultivate, or not to cultivate, is a question to be determined by climate and condition of soil. Where it is deemed advisable to encourage growth, it will be proper to employ such appliances of culture as are known to produce that result; and again, when ample luxuriance is secured, and the tendency is still in that direction, all surface culture should be abandoned, and the orchard be laid down in grass, cultivation

VAN INGEN-SNYDER.

DWARF PEAR TREES.



HOWELL PEAR.

to be again practiced when the trees indicate its necessity. The pear tree is usually a victim of excessive pruning. It is pruned in winter to make it grow, and pruned and pinched in summer to make it fruit. Why is it that the pear, more than other spur-bearing fruit trees should be supposed to require so close and continued pruning does not appear of easy explanation. It is evident that this immoderate pruning is not followed by satisfactory results, for while apple, plum, and cherry trees fruit with abundant regularity, with but little attention to pruning, unfruitfulness in the pear is a frequent cause of complaint, especially with those who pay the strictest attention to pruning rules, showing clearly that successful pear culture is not dependent upon pruning alone. While it is perhaps equally erroneous to assert that pear trees should not be pruned at all—an extreme which no experienced cultivator will indorse—it is worthy of inquiry whether unpruned trees do not exhibit a better fruit-bearing record than those which have been subject to the highest pruning codes. How far the proverbial liability of the pear to suffer from blight may be due to the interference and disarrangement of growths caused by summer pruning it may not be possible to decide, but the tendency to late fall growths, and the consequent immaturity of wood which is thereby encouraged, is well known to be of much injury, and greatly conducive to disease. Perhaps no advice that has been given is so fruitful a cause of failure and disappointment in fruit culture as that embodied in the brief sentence, Prune in summer for fruit. The physiological principle upon which this advice is based is that which recognizes barrenness in fruit trees as the result of an undue amount of wood growth, and that, in accordance with acknowledged laws, any process that will secure a reduction of growth will induce fruitfulness. The removal of foliage from a tree in active growth will weaken its vitality, by causing a corresponding check to the extension of roots, but the removal of the mere points of strong shoots has no palpable effect in checking root growth, the roots proceed to grow, and the sap seeks outlets in other channels, forming new shoots, which in no way increase the fruitfulness of the plant. While it may be confidently stated that, as a practical rule, easily followed, and of general application, summer pruning for fruit can not be recommended except as an expedient rarely successful, it is also true that there are certain periods in the growth of a plant when the removal of a portion of the shoots would tend to increase the development of the remaining buds, without causing them to form shoots. For example, if the growing shoots of a pear tree are shortened or pruned by removing one-third of their length, say, toward the end of June, the check will immediately cause the remaining buds on these shoots to push into growth and produce a mass of twigs—as far removed as may be from fruit-producing branches. Again, if this pruning is delayed until August, and the season subsequently proves to be warm and dry, the probabilities are that the remaining buds will develop into short spur-like shoots, from which blossom buds may in course of time be formed; but if the season continues wet, and mild and growing weather extends late into the fall, these same shoots will be lengthened into weakly, slender growths, which never mature, and are of no use whatever. There is no certainty as to the proper time to summer prune, because no two seasons are precisely alike, and trees vary in their vigor from year to year; and yet this uncertain, indefinite, and constantly experimental procedure is the basis upon which the advice to prune in summer for fruit is founded. The pear tree, in fact, requires very little pruning, and that only so far as may be necessary to regulate branches in either of two exigencies. In the first place, when the young tree is placed in its permanent position in the orchard, its roots will be greatly disturbed and many of them destroyed; it will therefore be expedient in this exigency to abridge the branches, so as to restore the balance of growth that existed between the roots and branches previous to removal. This pruning at transplanting has its opponents on the theoretical grounds that, as the formation of roots is dependent upon the action of leaves, it must follow that the more branches and leaves left upon a plant the more rapidly will new roots be produced; but there is one important element overlooked in this reasoning, namely, this loss of sap by evaporation, which speedily exhausts the plant, while it has no active roots to meet the demand. The proper practice is to reduce the branches so as to give the roots the preponderance, and many kinds of trees can only be successfully removed by cutting the stem off close to the ground. If the tree has been pruned close back at planting, the first summer will develop the foundation for a well-balanced, symmetrical plant, but as this result depends upon a good start, it is well to keep an eye on the young growths during the first season, and if any of the shoots appear to be developing to the detriment of others equally necessary for future branches, the points of such shoots should be pinched off, but in doing so, let there be as small a removal of foliage as possible, the object being not to weaken, but merely to equalize growth. It is claimed, as a general rule, that no advantage will be gained by pruning any portion of the shoots after the first season, unless in the case of weakly trees, which will be strengthened by pruning down during winter. The removal of branches during summer weakens growth, but when a portion of the branches are removed after growth is completed, the roots, not having been disturbed, will have the preponderance, and the number of buds being diminished, those that are left will receive increased vigor. It should never be forgotten that there is nothing more certain than that by shortening in or pruning back the ends of shoots, either in summer or winter, the fruit-producing period is retarded, and the fruit-producing capabilities of the trees abridged. Fruiting spurs will not form where the growths are constantly interrupted and excited by pruning; but, after the third or fourth year, young shoots will, in the majority of varieties, become covered with fruiting spurs the second year after their formation, if left to their natural mode and condition of growth. Of course this refers to trees in soils of moderate fertility, grown in a climate favorable to the plant. The only pruning, then, that is really essential, after the plant has become established, will be confined to thinning out crowded branches; and this forms the second exigency for pruning. If low-headed trees are preferred, those branches that have become destitute of fruiting spurs near the body of the tree may be cut out and a young shoot be allowed to take the place of the one removed. There will be no lack of young shoots for this purpose, as they will be produced from the base of the cut branch, selecting the strongest and best placed to occupy the vacancy, if such occupancy is desired. This mode of cutting back branches will be more particularly essential in the case of dwarf pears, as the quince roots are unable to support a tall, heavy-headed tree, but in all other respects dwarf pears should be treated the same as standards. In comparing remarks and observations made by different cultivators with reference to the merits of varieties, their growth, productiveness, size, and quality of fruit, and other characteristics, there is found so great a disparity as to lead to a supposition that different varieties are being discussed under the same name. No doubt this is occasionally the case, but the difference caused by the influence of the stocks upon which they are worked is frequently to blame for these discrepancies Every nurseryman is aware of the great irregularity of growth in plants of the same variety; they may have been grafted at the same time on stocks of equal size—planted on the same day and in the same soil, yet their comparative growths will vary considerably; so much difference exists that the plants will be classed into two or more sizes, and held at different valuations. Although the vigor of growth imparted is thus varied, the habit of the variety is not changed, the upright form of growth will still characterize the Buffum, and the spreading habit of the Rostiezer will remain with each individual of that variety; but in a plantation of fifty of any sort there will be some weak growers, and an occasional specimen that, after lingering on in a sickly condition for several years, will finally be removed. It is reasonable to expect these diversities in the growth of stocks produced from seed, and the influence they impart to the graft, but it is seldom that allowance is made for the many peculiarities that may undoubtedly be traced to this cause. This is still further confirmed by the more uniform growth of dwarf pears, the stocks of which are produced from cuttings or layers, and are consequently of more uniform vigor, being an extension of one individuality, instead of the separate individualities of seedling plants. The greatest drawback to extended pear culture is the disease familiarly known as blight. The predisposing cause of this malady has not been specifically determined; the active cause of dissolution is known to be parasitical fungi. This much, however, experience seems to confirm, that trees placed in positions and under circumstances of soil and climate that insure a growth of moderate vigor, which growth shall become perfectly matured and solidified before the advent of winter, are so seldom attacked by this disease as to be, for all practical purposes, exempt. A safe practice, and one that will probably become general when further and extended experiments prove its value, is to cover the body of the tree and all the principal branches, but not the buds, with a wash, formed by placing one peck of lime and two pounds of sulphur in a vessel, and adding sufficient boiling water to slake the lime. If the white color is objectionable it can be changed to any other more suitable. The spread of fungi on the bark of trees has been arrested by timely application of this mixture. The opinion is now becoming prevalent that close planting, so that the trees shelter each other, is advantageous. For standard trees, eighteen feet apart is considered a good maximum, and ten feet for dwarfs. These distances preclude the practicability of using horse-power in the culture of the soil, at all events after a few years' growth; which, all things being considered, may be regarded as a step in the right direction.

PEAT. A fibrous earth, the remains of the decomposition of aquatic grasses, in a transition state toward the formation of coal. Localities where found, are termed peat bogs, and when other fuel is scarce it is commonly used, burning with a clear flame or smouldering, according to its quality. It is cut, with a peculiarly shaped tool, in the form of large bricks, and after being thoroughly dried, is stored away for use. Peat is not common in the United States on account of the rarity of the peculiar swamps where it is found. In northern Indiana, and in some portions of Wisconsin, there are rather extensive bogs of peat, but the cheapness of other fuel renders its use unprofitable. Probably the abundance and cheapness of wood and coal in the United States has prevented the development of the resources of our peat bogs. Peat, according to various analyses, presents a general similarity in composition, the difference in quality being sand of accidental mixture. Air-dried peat usually contains from fifty to sixty per cent. of carbon, although the best samples reach seventy-five per cent. Thus from one and a quarter to one and a half tons of peat should be equal to a ton of good coal. The top of the best peat bog is always composed of a spongy mass, consisting of decaying vegetable matter, roots, etc.; deeper it becomes more and more homogeneous in its nature, until, at length, all trace of vegetable structure is lost, and we find a dense black mass of hard and compact peat, ranging in specific gravity when dried, from that of water to considerably less. That near the top of the bog may not have a specific gravity of more than 0.28, but some dense Irish peats have shown a specific gravity of 1,058. In curing peat it is essential that it be thoroughly dried, since if moist, it will generate heat, and undergo spontaneous combustion. The same fact is observed in some of our soft coals that become air-slaked, and thus take fire.

PECK. A dry measure of two gallons; a quarter of a bushel.

PECORA. The *Ruminantia.*

PECTIN. The jelly of fruits, roots, and plants; it is soluble, transparent, insipid, and much like gum. Pectic acid is very similar, isomeric, and bibasic; the salts are called pectates.

PECTINATE. Divided so as to resemble the teeth of a comb.

PECTORAL. Relating to the chest.

PEDATE. Resembling the foot of a bird.

PEDICEL. The foot stalk of the flower, not of the bunch of flowers, which is the peduncle.

PEDIMENT. The triangular ornament over a building, door, window, etc.; it is often sculptured, and seldom exceeds in height two-ninths of its width.

PEDIPALPS. Spiders and other arachnidans, with the feelers in the shape of claws.

PEDUNCLE. The main flower stem.

PELLICLE. A delicate covering, film, or membrane.

PELLITORY OF SPAIN. *Anthemis pyrethrum.* A perennial herbaceous composite, the root of which is very pungent, and is chewed for toothache. It is very similar to chamomile.

PELTA. A shield; the seed shield of some lichens. A peltate leaf is shield-shaped.

PELTRY, PELTS. The dry, unprepared skins of animals.

PELVIS. The bony cavity situated at the lower part of the belly, formed by the sacrum and innominata bones.

PENCIL OF LIGHT. A divergent beam of small size.

PENDANT. In Gothic architecture, an ornamented polygonal piece of stone or timber hanging down from the vault or roof of a building. In ancient writers the springers of arches, which rest on shafts or corbels, are called pendants.

PENDENTIVE. In architecture, the portion of a vault between the arches under a dome.

PENDULOUS. Hanging, branching over.

PENDULUM. Any weight suspended by an inflexible rod, and moving freely about a point. Its oscillations, whether wide or limited, are always performed in the same period of time; but the period is directly as the square root of the length of the rod.

PENICILLATE. Furnished with small bunches of hair.

PENNYROYAL. *Mentha pulegium.* A kind of mint cultivated for its essential oil; used in medicine. The American plant is *Hedeoma pulegioides;* not a true mint, but its odor is similar to that of the European plant; many insects, among which especially ticks, are remarkably annoyed by its presence.

PENNYWEIGHT. Twenty-four grains, or one-twentieth of an ounce troy.

PENTAMERANS. Coleopterous insects, with five joints on the tarsus of each leg.

PENUMBRA. The partially dark outer shadow.

PEPO. The form of fruit similar to the melon and other cucurbitaceæ.

PEPPER. *Piper.* The black and white pepper of commerce is the fruit of a vine, grown principally in Java, Sumatra, Ceylon, and other tropical Asiatic countries. White pepper is the black pepper divested of its skin. There are numerous species of the genus. Red pepper, *capsicum,* is a name given to numerous herbaceous plants natives of tropical countries, but some varieties of which are cultivated in almost every garden for pickling. The pods are the parts used, being red or yellow when ripe. The red (cayenne) pepper of commerce, is the long, small, red pepper. The best soil is one that is rich, mellow, dry, and in a warm situation. One ounce of seed will yield between two and three thousand plants. The earliest sowing can be made in March, upon a gentle hot-bed; or delayed until the first part of May, in a sheltered border. Cover the seed near half an inch deep. When the plants are two inches high, they should be removed to their final location, to be set in rows two feet apart each way. Until they become established, protect them from the noonday sun; and occasionally, during all dry weather, give them gentle sprinklings of water. Keep the soil open and clean.

PEPPER GRASS, PEPPERWORT. Garden cress.

PEPPER, INDIAN. *Piper nigrum.* An endogenous climbing shrub of Sumatra, the fruit of which appears on spikes at three years, and forms the black pepper of commerce. The same, hulled by rubbing, constitutes white pepper. The celebrated betel, or intoxicating pepper, chewed by the natives of India with lime, (*chunam,*) is the fruit of the *Piper betel.*

PEPPERMINT. *Mentha piperita.* The genus mentha is an extensive one, comprising about sixty species. Among the more important, for use, are peppermint, spearmint, (*M. viridis,*) and pennyroyal, *M. pulegium.* Spearmint is used for sauces, salads, and in soups and stews, also for mixing with liquors; pennyroyal used to be employed in cooking; peppermint is distilled, and its oil formed into essence, in which form it partakes of the nature of all the labiate plants. The mints are all cultivated in a similar manner, only peppermint is much cultivated for commercial purposes. The soil should be rich, mellow, and moist. Divisions of the roots are dropped about six inches apart, about corn-planting time, in rows two feet apart and kept clear of weeds. When the plants come in blossom is the proper time to cut them, when they are carried immediately to the laboratory, where they are distilled. In case either of the mints are to be dried for use, it must be done in the shade, and the branches must not become wet in drying. For garden culture, plants may be set one foot apart each way. A plantation will last for years, but it is usual to renew it every three or four years.

PEPPER, WATER. (See Smartweed.)

PEPSIN. Albuminous matter of the stomach and gastric juice in a state of change. It forms the active agent of rennet; and, with muriatic acid, has been made to produce artificial digestion.

PER. A chemical prefix to those compounds which contain the highest proportion of the element against which it is placed; as peroxide, perchloride, etc.

PERCH. The one-fortieth of a rood, thirty and a quarter square yards; in long measure, five and a half yards.

PERCHERON HORSE. (See French Horses.)

PERCHERS. The Incessores, birds which perch on trees, including the Scansores and Passeres.

PERCHLORIC ACID. An acid consisting of one equivalent of chlorine with seven of oxygen, which forms a sparingly soluble compound with potash, the perchlorate, and has hence been used as a test for that alkali.

PERCOLATION. The slow oozing of water through rocks, earths, or other slightly porous structures.

PERENNIALS. Herbaceous plants whose roots live several years.

PERFOLIATE. Leaves through which the stem passes.

PERGAMENOUS. Parchment-like.

PERI. A common affix of descriptive terms, meaning about, or around.

PERIANTH, PERIANTHUM. A flower which has no distinct calyx.

PERICARDIUM. The membrane surrounding the heart: its inflammation is called pericarditis.

PERICARP. The outer portion of the fruit surrounding the carpels.

PERICRANIUM. The membrane which is attached to the bones of the skull.

PERIGYNIUM. The case formed in carices by the union of two bracts. The disk.

PERIGYNOUS. Stamens which are attached to the sides of the calyx.

PERIOSTEUM. The fibrous membrane attached to the surface of all the bones.

PERIPHERY. The circumference.

PERIODIC OPHTHALMIA. (See Eyes, Inflammation of.)

PERISPERM. The testa or covering of a seed.

PERISTALTIC. A worm-like motion of the intestines, produced by a contraction and dilation of their circular fibers, whereby their contents are pushed forward into the colon and rectum.

PERISTOMIUM. The fringed membrane surrounding the capsule of mosses.

PERITONEUM. The membrane which envelopes the organs of the abdomen; it is serous: its inflammation is called peritonitis.

PERMEABLE. Permitting the passage of fluids or gases.

PERRY. The cider of pears.

PERSIAN GOAT. (See Goat.)

PERSIMMON. *Diospyros.* The American persimmon, *D. Virginiana*, is a small tree, though sometimes it is found from forty to fifty feet high. It is common south of forty degrees and rare North, seldom being found as high as forty-two degrees. Grown if there is plenty of room, the tree is round topped or conical, rather open, and with the branches more or less twisted. The fruit varies from the size of a small plum to that of a medium sized peach, and when green is very astringent. When ripe or when mellowed with the frost, it is sweet and luscious, and generally liked. It is very much prone to sport, and hence it is supposed that it may be capable of wide improvement. In fact, in Japan there are exceedingly fine varieties in cultivation. Those imported have not proved hardy in the North. It is the *Diospyros kaki*, of the nurseries. The Japanese, by a course of cross fertilization and selection, it is said, have brought this fruit to great perfection. It is there a regular commercial fruit, and those not consumed at home are dried like figs which they resemble, and are exported. In the Indian Territory, where the persimmon is at home, and grows abundantly, the Indians use large quantities, and also preserve the fruit, making of it a preparation, after the manner of making apple butter. It is to be hoped that horticulturists, at the North, will select hardy varieties, and improve this fruit, so we may have it fresh in our markets. In fact the trade in shipping this fruit from southern Indiana and Illinois, during its season, to Chicago, has been considerable in former years, and is still continued; much of it, however, was unripe, and this prevented its use. To introduce any new fruit, especial care should be taken to have it prime. The wood of the persimmon is fine, hard grained, elastic and heavy, and is valuable for turning and other purposes. As an ornamental tree it is fine, and should be found in every collection up to the latitude of forty-two degrees, where it can have some protection in winter. The seed should be sown in the fall and transplanted at one year old. It is a tap rooted plant and therefore does not transplant well when older.

PERSONATE FLOWERS. Irregular, monopetalous flowers like the snapdragon, (*Antirrhinum*,) with an upper and lower lobe, but with the faux or throat closed; in this respect it differs from the labiate corolla.

PERSPIRATION. The function of the skin whereby a saline fluid with a little gaseous matter is thrown out of the body. It is increased by taking much fluid in summer; and the state of this excretion is closely connected with health.

PERUVIAN BARK. The bark of several varieties of cinchona trees of Central and South America; they furnish the alkaloid, quinine.

PETALS. The divisions of the flower; the leaves of the flower, usually of bright colors. Petaloid is a derivative.

PETIOLE. The leaf stalk.

PETROLEUM. Mineral or rock oil from which kerosene is distilled, giving rise to many by-products.

PETROSILEX. Hornstone, sometimes compact feldspar.

PETUNIA. This is one of the most valuable of garden plants, for planting in masses. It comes into bloom early, and continues to give a profusion of bloom until killed by frost in the autumn. The seeds are very minute, and hence require care in germinating. The best way is to sow them in a finely prepared bed, made pretty compact and simply press the seeds into the earth, keeping the surface moist until they germinate. When large enough, they may be transplanted where they are to bloom, at a distance of twelve inches apart each way. Some varieties show handsome striped single flowers; others are quite double. The plant should not be allowed to run. This may be accomplished by pinching back, and then training to stakes or a trellis, but for rich masses of bloom, they are most brilliant when allowed to run together. If the seeds be planted in July, and the plants potted and kept dwarfed by pinching back, they make handsome plants for pots or hanging baskets, giving a profusion of bloom all winter, but they should have a warm, sunny aspect and plenty of water, but with good drainage below to ensure the best success.

PETUNTZE. Porcelain clay and decayed feldspar.

PEWEE. Phebe-bird. *Sayornis fuscus.* A common and useful bird all over the North, arriving among the earliest in the spring. It is quite domestic and innocent of mischief, its food being seeds and insects. The nest is built under the eaves, or other projections where it may be dry, fine roots, moss, hair, and grass are used, being plastered together and also fastened to the support with mud. The eggs are five in number, white, with a delicate cream tint, and usually one or two are found in the nest with a few spots of reddish-brown thinly scattered on the larger end. Incubation lasts thirteen days, and usually two broods are reared in a season. The Wood Pewee (*Contopus virens*) makes its appearance later and prefers the solitude of the forest. It is, therefore, seldom seen. The nest is built on a horizontal limb composed of lichens, pine leaves, and mosses, the body of the nest being of wiry grasses or root fibers, bound together, says Nuttall, by cobwebs and caterpillar's silk, moistened with saliva; externally it is so coated over with bluish, crustaceous lichens as scarcely to be distinguished from the limb on which it is fixed.

The bird comes North rather late and leaves early. One brood only is reared in a season, incubation lasting fourteen days. The eggs are about the size of the Pewee, about three-quarters of an inch long by one-half inch broad, of a delicate cream color, spotted with two shades of lilac, one brown and the other lavender. Its food is insects and seeds.

PHAGEDENIC. Corroding ulcers.

PHALANGES. The small, long bones of the fingers and toes.

PHANEROGAMIA, PHANEROGAMOUS. Plants bearing flowers.

PHARYNGITIS. (See Sore Throat.)

PHEASANT. In some sections of the Middle States and in the South the ruffed grouse (*Tetrao umbellus*) is improperly called pheasant, just as it is called partridge in New England and some other sections of the North and West. The true pheasant (*Phasianus*) is not a native of the United States, but is kept in a semi-domesticated state in parks in England and on the continent of Europe, and occasionally in the United States. An observer, at the French exposition, writing to the Department of Agriculture, describes some of the varieties seen, as follows: The common pheasant (*Phasianus colchicus*) found in the wild state in the Caucasus and near the Caspian sea, is the most common species in Europe. It is a most beautiful bird, and has for a very long time been kept in a semi-domesticated state in the parks, woods, and pleasure grounds of wealthy persons, where it breeds almost as well as domesticated fowls. It roosts at night on elevated trees, and, like our domesticated Guinea fowls, loves to wander about the woods and fields. These birds ought by all means to be introduced into our ornamental parks and pleasure grounds, being at the same time useful as an article of food, as well as highly ornamental. There are five varieties here, viz: the common, the ring-necked, ash color, white, and parti-colored. The ring-necked pheasant is said to be originally from China. The male of the silver pheasant (*Phasianus nycthemerus*) originally from the north of China, is a most beautiful bird, of a silver white color, with regular, slender, lace-like black markings on the feathers of the back, while the under parts are of a black color; the long, drooping tail is also silver white, barred with black. This bird is said to be completely domesticated in France, where it is bred and reared with perfect ease. The female is by no means as beautiful as the male, being of a dull reddish color, and of a smaller size. The golden pheasant (*Phasianus, thaumalea, pictus*) is one of the most beautiful and bizarre birds, bred in a state of half-domestication, and is much smaller than either of the pheasants before mentioned. The under part of the male is of a red color, the head is ornamented with a splendid golden yellow crest, the neck is hidden or overhung by a somewhat projecting ruff of feathers of a bright yellow color, striped or barred with black. The wings are of a dull blue, the hind parts of the body are of a golden color, set off with red, and the tail is long and brown, barred with black. The female of this species is also very inconspicuous in color. These birds have bred well in some forests in Europe, and in a state of domestication have produced three varieties, viz: the ordinary golden and red color, the black, and the Isabella or fawn.

PHEBE-BIRD. (See Pewee.)

PHOSPHATE. A salt formed by a combination of phosphoric acid and a salifiable base, as lime, for instance. It is one of the most valuable of the mineral manures, since it is absolutely necessary in the formation of bone. Hence soils deficient in phosphate, plants cannot take it up, and hence again, grazing animals suffer for the want of this necessary constituent of bony matter. Phosphite is known as a salt formed by phosphorus and a salifiable base. Phosphorus is a yellowish transparent substance like wax, which in common air burns with great rapidity and vehemence. At ordinary temperatures it naturally attracts the oxygen of the air and burns spontaneously, emitting a luminous vapor originally obtained from wine. It is now chiefly obtained from bones, those of sheep being the richest. The principal sources of the phosphates of commerce are the minerals and rocks containing them and the bones of animals daily slaughtered, and also fossil bones. There are numerous phosphatic rocks and beds of fossil bones. The beds of fossil bones and rocks near Charleston, S. C., have of late years become celebrated, being principally the remains of fossil marine animals. They are extensive, easily worked, containing from twenty-four to thirty per cent. of phosphoric acid, ten to fifteen per cent. of which is available, being crushed and ground to powder in powerful mills, and then subjected to treatment by sulphuric acid.

PHOSPHITE. (See Phosphate.)

PHOSPHORUS. (See Phosphate.)

PHOTOMETER. An instrument to measure the intensity of light.

PHRENITIS. Inflammation of the brain.

PHRYGANIDÆ. Tricopterous insects, case-worm flies.

PHYCOMETER. The gelatinous matter in which the sporules of the lowest plants germinate.

PHYLLODIA. Leaves in which the petiole is very much expanded and the lamina absent.

PHYLLOXERA. (See Grape Insect.)

PHYSICS. Mechanical philosophy. The study of the properties of objects and their motions.

PHYSIOLOGY. The investigation of the properties and functions of plants and animals.

PHYTOGRAPHY. Descriptive botany.

PIA MATER. The delicate membrane covering the brain.

PIAZZA. An arcade.

PICAMAR. A bitter substance found in tar.

PICIDÆ. *Picæ.* The family of woodpeckers.

PICK. A pickaxe.

PICKLING. The preservation of vegetables or meats in vinegar or brine.

PICROMEL. Sugar of bile; bile changed by the action of acetic acid. The characteristic principle of bile.

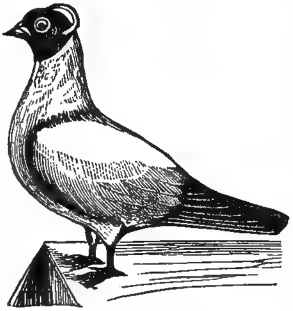
PICROTOXIA. A poisonous alkaloid in *Cocculus Indicus.*

PIER. In architecture, the solid between the openings of a building, or that from which an arch springs. An abutment pier, in a bridge, is that next the shore.

PIG. (See Swine.)

PIGEON. The pigeon is bred in a domesticated state in every civilized country in the world, and is now broken up by breeding into an almost infinite variety of forms and characteristics.

Their powers of flight are most astonishing, the carrier pigeon having been known to traverse 800 miles without food or rest. The wild pigeon (*Ectopistes migratoria*), is remarkable for its symmetry of form, the extreme rapidity and elegance of its flight, as well as for the incredible numbers which at times pass over different portions of our land, affording, seemingly with but little diminution in their crowded ranks, the millions killed during their flight. It propels itself by repeated flappings of the wings, bringing these at times closely to the body with firm strokes, and, before alighting, breaks the force of its flight by several rapid beats, as though fearing injury from coming too suddenly into contact with the object upon which it may desire to rest. It is supposed to be capable of moving through the air at the rate of a mile a minute; and it has been killed in New York with its crop yet filled with the rice collected in the fields of Georgia and South Carolina, which it must have left only five or six hours before meeting its death, because, as they digest their food rapidly, they must necessarily have traveled the distance within the time allowed, in order to have arrived with the rice still in its perfect state. The shape of their body is oval, with a sharp-pointed tail, admirably constructed for rapid evolutions, and also furnished with a pair of long wings, moved by large and powerful muscles. The rapidity with which this bird will pass through a wood is perfectly astonishing, threading its way amid the closely grown branches with unerring course, it flashes upon the sight like a meteor, and is gone. A pigeon-roost is a curiosity well worth a visit from any one who has the slightest fancy for the strange things in nature. No language can give a perfect idea of the appearance of one of these places, when occupied by its millions of tenants. Instances are known where these birds have covered the trees for a distance of forty to fifty miles in length, by three to five in breadth, every limb of every tree within that spacious extent loaded and groaning with the weight of the numberless pigeons clustered on it. When approaching these roosts their advance is heralded by a sound like the gale when it sweeps over the ocean in uncontrolled fury, the sky is darkened by their inconceivable numbers, and the noise of their flapping wings, as they stay the rapidity of their course, is like the sound of many waters. They come by thousands in a flock, and settle on the trees around, while frequently the confusion reigning everywhere is increased by great limbs breaking from the weight of the birds upon them, and falling with a crash, carrying death and destruction among those which have alighted beneath. Some of these places are resorted to annually by the birds, and the farmers, just before the time the pigeons usually appear, will assemble for the purpose of obtaining them. Sometimes the hogs are driven to the roost to be fattened on the birds which are slain. Guns are used to kill them, but often long poles are equally effective, for the pigeons make little or no effort to escape. They continue to arrive often until the night has far advanced, and the uproar is continued until daybreak, when they begin to move off, and when the sun rises the majority have departed. The flesh of the wild pigeon is dark, and by some is much liked. The young, or squabs, as they are termed, are very tender and delicate, and much more esteemed as food than the adult bird. The pigeon generally selects the tallest and largest trees to breed in, and as many as fifty nests may be counted upon a single tree. They lay only two eggs, elliptical in form, and of a pure white. When the young are about half grown, their enemies of every kind come to these places, and disturb the peaceful birds by endeavoring to get possession of them in all manner of ways. The quickest is to cut the trees down, and as one falls, by coming in contact with another, it shakes all the squabs out of the nests, which may be on it, and soon the ground is covered with the little helpless things, and immense numbers are thus destroyed. The wild pigeon never rests at any great distance from water, to which it resorts several times during the day, and when it drinks immerses its bill up to the eyes, and so remains until its thirst is satisfied. Immense flocks of these birds are not so often seen now as formerly; the diminution of their number may be attributed equally to the destruction of our forests as to the birds themselves, and it is a rare thing in these days to witness, near the cultivated districts, any very great flight of pigeons. The skin is very tender and easily torn, while the feathers fall off at the least touch—characters peculiar to this family. The male of this species has the throat, breast, and sides brownish red, sometimes with a purplish tint, rest of under parts bluish white. Head blue; hind part and sides of neck changing to gold, green, and bright crimson. Upper part of body blue; wing coverts marked with black spots; quills blackish, tipped with white. Inside tail feathers dark brown, rest blue on the outer web, white on the inner. Bill black; feet red. The female has a similar distribution of colors, but very much duller than the male. These are olivaceous above and beneath pale blue instead of red; a slight tinge on the neck and the throat of a whitish color.



PIGEON.

PIGEON BERRY. Poke. Poke-weed. Garget. *Phytolacca decandra.* A plant found growing in fence corners and other waste places. The root actively emetic; the stalk stout, smooth, and generally purple; leaves, ovate-oblong, bearing bunches of berries containing a dark purple juice, used sometimes as a substitute for red ink. The quite young shoots are sometimes used like asparagus, and a tincture of the ripe berries have been used as a remedy for chronic rheumatism. The root is also used in decoction as a local remedy for garget in cows. It is generally regarded and should be treated as a weed.

PIGGERY. (See Hog House.)

PILASTER. A square pillar situated in a wall, usually projecting not more than one-fifth or one-sixth of its width. Pilasters are subject to the same rules of proportion as columns.

PILCHARD. A small kind of herring.

PILE. The hair on furs.

PILES. Timbers driven into a marshy soil to afford a better foundation. In surgery, enlargement of the veins of the rectum.

PILEUS. The cap of a mushroom.

PILOSE. Hairy, set with hairs.

PIMENTO. *Myrtus pimenta.* Allspice. The aromatic berries of an evergreen tree of Jamaica and the tropics of America.

PIMPERNEL. *Anagallis arvensis.* A pretty, indigenous annual.

PINDARS. *Arachis hypogœa.* The ground pea. (See Peanut.)

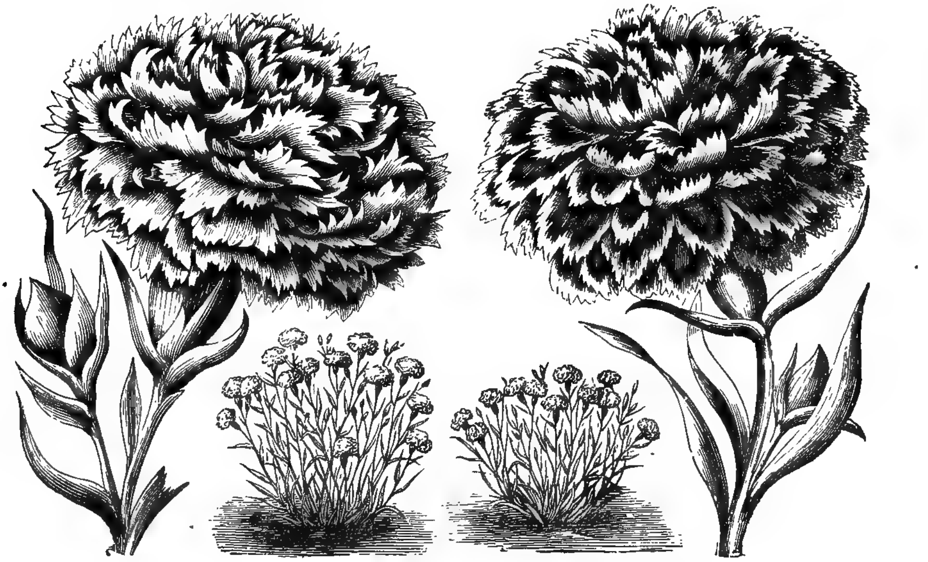
PINE. *Pinus.* The pine is perhaps the most valuable of any single genus of trees to man. It embraces a great number of species, including those from which tar, pitch, and turpentine are manufactured, others furnishing masts, and deck timber for ships, and the white pine, *P. strobus,* furnishing the soft, easily worked, and valuable lumber for dwellings, and a great variety of uses in carpentry and joiner work. So again, many of the species are highly ornamental, and are used extensively in planting. Some of the finest of these are natives of the Rocky mountains. Among foreign trees the Austrian pine and Scotch pine are well known. Of our native species, one from the Pacific coast, the ponderous pine, (*Pinus ponderosa*) is hardy and of rapid growth, see illustration, page 726. The wood is very heavy, as its name indicates, and is of rapid growth. The white pine a native of the entire North and Canada, is, however, one of the best of trees for prairie planting, being quite hardy, doing well on a variety of soils, and it also bears the shears or cutting well. The pines have been divided as follows: 1. White pine, five leaves in a sheath, which includes the Cembran pine and the Bhotan pine. 2. Pitch pine, three leaves in a sheath, which includes Loblolly and ponderous pine. 3. Two leaves in a sheath, as Scotch pine, Austrian pine, red pine, gray pine, scrub pine, yellow pine, etc. The white pine species like a rather moist, rich soil. The pitch pines grow on the most blowing sands, and the two leaved pines do well as a rule on rather a stiff soil.

PINEAL GLAND. A gland of the brain.

PINE APPLE. *Bromelia ananas.* A refreshing fruit of tropical America, with dry, spiny, leaves. It is an annual growing from the crown of the fruit. From the leaves, by maceration, a delicate filament is obtained, from which exceedingly fine fabrics are made.

PINION. A small wheel playing in the teeth of a larger one. It is only a spindle or arbor.

PINKS. *Dianthus.* A class of highly ornamental plants, biennials and perennials, all, however, requiring protection in the winter in the North, and some like the carnation, requiring to be kept in the house in winter. The characteristics of excellence in pinks are that the flowers should be circular in outline when viewed in front, semi-globular in profile, and uniform in size on the same plant. The petals should have good substance whether the edges be cut or smooth each row smaller than that preceding it. Self colors, should be uniform in tint, variegated colors should have the ground white, lacing, whatever the tint, should be unbroken and have a border of white beyond it, and the color of the lower limb of the petal extending so as to be seen above the white edge of the petals above. (See Floriculture.)



CHINA PINKS.

PINK ROOT. *Spigelia Marilandica.* Carolina pink. A handsome perennial, growing about the borders of woods in the South; the roots are used in infusion as a powerful vermifuge; the dose for children of three years is ten grains of the powder; in very large doses it proves a dangerous narcotic.

PINNACLE. A square or polygonal pillar rising above a building, and terminating in an ornamental pyramid.

PINNATE. Leaves with separate leaflets arranged along the midrib, or petiole; some are doubly pinnate.

PINNATIFID. Imperfectly pinnate. In this case the leaflets are not distinct, but a portion of the lamina runs along the central petiole. Cut-leafed.

PINT. The eighth part of a gallon; half a quart.

PIP. The seeds of apples, pears and similar fruits. (See Nuts.) In poultry, a disease or rather the result of disease. The formation of a dry, horny scale on the tongue of the fowl; the beak grows yellow at the base, the plumage ruffled, and untidy, the bird is moping, and eats but little and very soon refuses food altogether, and at length dies of fever. A remedy is to give the bird two or three grains of black pepper, twice or three times a day, in fresh butter for a week. The treatment, however, should vary with the cause, and the disease treated as for any malignant disease, as catarrh, gapes or roup, which close the nostrils, obliging the fowl to breathe through its mouth will cause the occurrence of this dry horny scale.

PIPE. A wine measure, 105 imperial, or 126 wine gallons.

PIPE CLAY. White clay, disintegrated feldspar, with which the white smoking pipe and coarse pottery are made.

PIPE DRAIN. (See Draining.)

PIPERIN. A white, crystalline, inactive alkaloid, obtained from black pepper.

PIP FRUITS. (See Nuts.)

PISCICULTURE. (See Fish Breeding.)

PISE. In building, a wall constructed of stiff earth or clay, carried up in moulds, and rammed down as the work is carried up. The expression, building *en pise*, is common.

PISOLITE. Native limestone moulded into grains, like peas.

PISTACHIO NUTS. *Pistachia vera.* A turpentine tree, a native of Syria; the nuts are the size of small filberts, of a sweet taste and pleasant flavor resembling almonds. There are edible nut-bearing pines in the Rocky mountains, and in the Sierra Nevada mountains, in the United States.

PISTIL, PISTILLUM. The central organ of flowers, it is divided into an ovarium, or lowest part, a style, and stigma, which last is the uppermost surface, and receives the fertilizing pollen. It is called the female organ, because flowers in which it is absent are barren. Pistils are made of one or more carpels, the styles of which unite. Flowers with pistils only are termed pistillate.

PISTON. A short cylinder of wood or metal, which fits exactly the cavity of a pump or barrel, and is worked up and down in it alternately. Two sorts of pistons are used in pumps: one hollow, with a valve, used in the sucking pump; and the other solid, which is employed in the forcing pump.

PITCH. The substance that remains after boiling or distilling tar.

PITCH OF A ROOF. Its inclination to a level plane.

PITHING. The operation of killing animals suddenly and without loss of blood, by driving a knife into the spinal marrow; this is done by directing the knife to the space between the first and second vertebra, next the head.

PITTACALL. A blue substance obtained from oil of tar.

PITUITARY GLAND. The pineal gland, situated in the base of the brain.

PITUITARY MEMBRANE, SCHNEIDERIAN MEMBRANE. The mucous membrane of the nostrils.

PITYRIASIS, DANDRUFF. A scurfy disease of the skin.

PIVOT. The extremity of an axle which revolves in a socket or hole.

PLACENTA. The afterbirth. A large spongy organ which receives the blood of the mother, and supplies, by the umbilical artery, the fœtus. In botany, cellular tissue developed within a carpel, to which the ovules are attached sometimes by an umbilical cord.

PLAITED, PLICATE. In botany, folded like a fan.

PLAGUE. A name locally applied to various malignant diseases of live stock, as Rinderpest, Pleuro-pneumonia, Texas, or Spanish Fever, Murrain, and various diseases. (See articles on these various subjects.)

PLANARIA. A genus of flat entozoic animals, which do not, however, inhabit the bodies of other animals.

PLANE. A flat surface.

PLANE TABLE. A square board, furnished with a compass, and with lines drawn on its upper side, used in taking angles and in measuring land.

PLANE-TREE. The button-wood.

PLANER-TREE. *Planera ulmifolia* (*aquatica.*) A tree of twenty-three to thirty feet height, growing in swampy places, in the South and Southwest, and resembling the elm. The wood is hard and strong, but there is only a small amount of it.

PLANIPENNATES. Neuropterous insects with flat wings, the lower pair of which equal the upper.

PLANKS. Boards of nine inches or more in width, and two or more inches thick.

PLANO-CONCAVE. A thin disk, having one surface flat and the other curved inward.

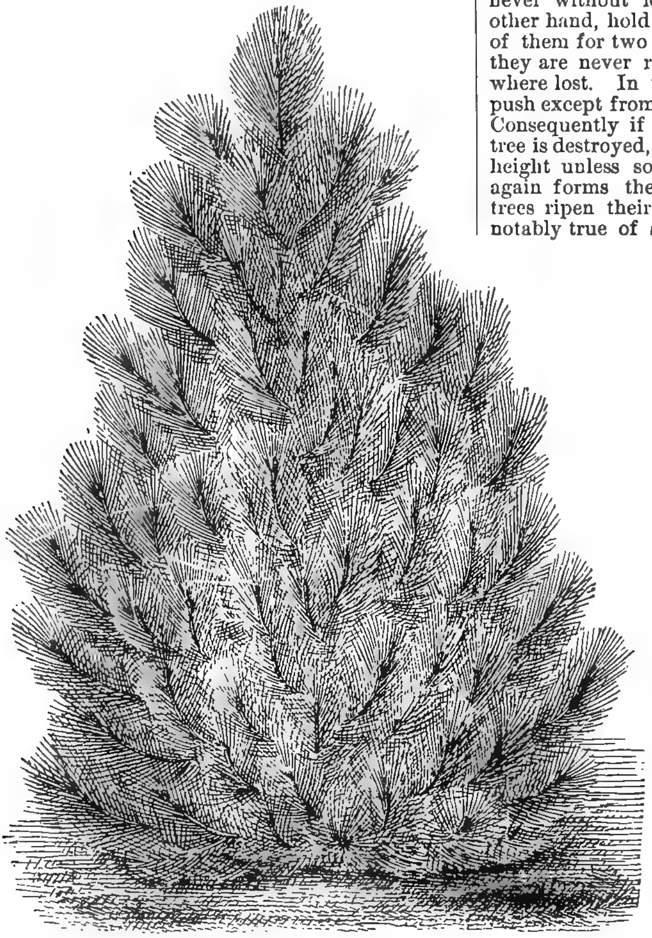
PLANT. An organized vegetable body, adhering to another body, and drawing nourishment therefrom, or which grows in water without any fixed hold. Thus the term includes any vegetable substance which has life, including trees, shrubs, bushes, herbs, grasses, vines, orchids—which fasten to trees—fungus mosses, lichen, algæ, vegetables and flowering plants. The term however is generally applied to the smaller herbaceous vegetables, and flowering plants.

PLANTAIN. *Plantago.* The common plantain of roadsides, door-yards and waste places, has been called by the Indians the white man's foot, from its being an attendant on emigration; the seeds being found carried in a variety of ways. It is a worthless weed, though its leaves are convenient and excellent for dressing blisters and sores. It is an introduced biennial weed from Europe. Rib grass, or English Plantain (*P. lanceolata*), has a perennial root, and is found in meadows and pastures, seeding in midsummer and again in the autumn. Stock eat the plant freely. It is difficult to eradicate once in the land, since the seeds are of the size and weight of red clover.

PLANTATION. A term used: 1. To denote a large farm, devoted to special crops as sugar, cotton, rice, tobacco, etc.; 2. Any nursery or plot of trees of a given kind. In the North it is used in the latter sense chiefly, and in the South, to denote the farm or estate of the owner.

PLANTER. 1. In the South, the owner of a farm or estate devoted to special crops. In the North, one who plants by dibbling, or otherwise transplants any plant. 2. Any machine for planting special seeds, in hills; or machines for planting a variety of seeds in contradistinction to a drill which sows consecutively in a continuous line.

PLANT LIFE IN WINTER. It would seem that the freezing point of the sap—the blood in a sense—of a tree or plant may not be really frozen without destroying the life, or at least severely injuring its vitality. So different plants have different freezing points, that is, the degree of cold that will destroy one class of plants, will not injure others. For instance, a white frost will kill sweet potato, egg plant, and various other tender natives of the tropics, while corn—a semi-tropical plant—resists a greater degree of cold. Celery will survive until the thermometer sinks to fifteen degrees Fahrenheit. Cabbage and other plants of the brassica tribe have their freezing point still lower, while many of our conifera remain active during our severest winters. It is more than probable that the active principle in the sap may not be frozen without killing the tree, and that notwithstanding the fact that the sap of our deciduous trees seems frozen in the winter, the circulation goes on to a greater or less extent. Certainly it does in our cone-bearing trees, or evergreens, as they are generally termed. A very popular error is the belief that evergreens hold their leaves persistently. This, however, is not the case. The so-called evergreens of the North—we are now speaking of true leaved plants—as the holly, ivy, laurel, etc., change their leaves as do the strictly deciduous trees, that is, the mature leaves drop off, and are replaced with others, but this change is made gradually, and the replacement goes on as the mature leaves are lost. So the tree is never without leaves. The conifera, on the other hand, hold their leaves persistently, some of them for two or more years. Once they fall they are never replaced by foliage in the place where lost. In these plants leaf buds do not push except from the extremity of the branches. Consequently if the leading branch of such a tree is destroyed, it never thereafter increases in height unless some branch turns upward and again forms the leader. Some of our forest trees ripen their seeds in the winter. This is notably true of some of the cone-bearing trees. These trees are positively active with the thermometer far below the freezing point. A half active circulation goes forward at all times, just as it does with hybernating animals. During mild spells in winter, this circulation becomes easily apparent, as may be shown by chipping the wood. The sap will immediately exude, and this is by no means confined to the evergreen species. It is known to take place with many of our deciduous varieties, the maples being notable examples of this kind. This circulation is in fact necessary to support and mature the buds. If the buds are killed, then indeed active circulation ceases, and the plant dies. All perennial plants, therefore, have a summer medium and a winter medium of activity. Exhalation is going on to a greater or less extent, constantly through the buds, and the green surfaces of the bark, and this activity is entirely governed by the degree of heat. Thus a season of mild weather in winter will cause such activity in the sap, that the buds will sometimes break into leaf. If we carefully dissect and examine one of these, even when apparently dormant and inactive, we shall find it to be composed either of the blossom or blossoms, or else of a cluster of true leaves, exactly folded and compressed together—and in the smallest possible space—and air and water tight, so far as outward influences are concerned; the outer layers being covered either by a system of hairs, or else with a resinous or glutinous secretion, which resists the direct action of water. All



PINUS PONDEROSA.

living trees, therefore, have their summer and their winter foliage. The buds that are now maturing to develop into full foliage next spring and summer, were started early last spring, and have been the growth of the whole summer and autumn. During the season of active growth of the tree, or in late spring and summer, but little sap is needed for their growth. The demands of the leaves and the other portions of the plants are then almost supreme. They, however, come on slowly, and as the summer wanes and autumn comes on, and as the leaves become mature, the sap is diverted more strongly to the buds, until at last they are perfected. These germs contain the future glory and beauty of blossom, foliage, growth and fruit of the coming year. Thus when we speak of trees or plants being bare of foliage during winter, we mean only relatively. Growth is constantly going on while the tree lives, though to the superficial observer it may not be apparent. The winter foliage requires but little nutrition, it is true. It requires protection during the inclement season; this the envelopes afford, holding life intact until the advancing sun of the succeeding spring again calls the full powers of the tree or plant into renewed activity,

PLANTS, EFFECT OF AIR AND LIGHT ON. White is said to be no color at all. It is, however, tangible enough to our sense of sight. It would seem to be the primary color, because the so-called decolorization of a substance results in white. Air and water, in a fluid state, are colorless, but they reflect any color that may be placed against them. Frozen water—pounded ice and snow—however, becomes white from its power of reflecting that color. One of the effects of air and light upon plants, is to cause them to change color. The embryo plant, as formed within its integuments, is usually white or nearly so, and a plant, colored by contact with light and air, may usually be blanched by shutting out the light, the blanching being perfect or otherwise, according to the thoroughness with which the light is excluded from the plant. Thus, in blanching celery, it is covered with earth to such a depth as to entirely shut out the light when it becomes thoroughly white, and also crisp. Lettuce or endive, however, is blanched by tying the leaves together, and is only partially blanched and crisped, for, it is blanched only in proportion to the quantity of light excluded. But some plants—such as rhubarb—develop color although grown in the dark, but this is from the pre-existence of color in the root from whence the stalk sprang. Or the deposition of coloring matter may take place as in some varieties of potatoes, beets, carrots, etc., being first formed by parts developed in the light. Flavor, as well as color and nutritive matter, is dependent also upon light for its presence, because flavor is produced by chemical alterations, caused by the exposure of the plant to the light. A very curious fact connected with this, is that the portion of a fruit, as a watermelon, shielded from the light, will not be as sweet as that portion receiving the full effect of light. It will also be remarkably retarded in the development of saccharine matter, from the absence of light and heat. Hence gardeners sometimes place slates or some other conductor beneath such fruits as they wish to be very fine and well developed. On the other hand, the sugar-beet is remarkably deficient in saccharine development in that portion growing above ground, and contains instead certain salts, which neutralize, partially in the manufacture of them, the saccharine contained in the portion below. It is a curious fact, and well worthy the investigation of agricultural scientists, from the possibilities which may be wrought out from its study. Light is also indispensable to the development of the nutritive matter which is formed by the exposure of the leaves to the light. Thus the potato, when forced in the dark, is said to contain no more farinaceous matter than was contained in the original tuber, and it is also a well known fact that fruits grown in illy-lighted and unventilated houses, are innutritious and flavorless. Light being so powerful a stimulus in vegetative economy, its energy in exciting the vital action of plants is in direct proportion to its intensity; hence the superior quality of fruits grown in a sunny and equable climate like California over those cultivated in less favored zones. So also the intensity of color in the leaves of a plant is in proportion to the light and heat which they receive, being paler in a more diffused light than when they are exposed to the more direct solar rays. During the prevalence of light, the leaves of plants absorb carbonic acid, and part with oxygen, and thus purify the atmosphere for the use of man and animals, and this process again, goes on just in proportion to the intensity of the sun's rays to which the leaves are exposed. The decomposition of carbonic acid, and the acquisition of carbon in a solid state by the plant, is hastened or retarded in proportion to the amount of light received. So also the intensity of color and quantity of secretions are in proportion to their exposure to the light and air, as is shown by the deeper color of the upper portion of the leaves of plants. This is further proved by the fact that plants grown in a medium from which light is excluded, form neither color nor secretions—as in the blanching of celery, previously noticed. As plants derive an essential portion of their food from the air by the action of light, therefore those greenhouses and conservatories that admit most light are best adapted to the forcing and cultivation of plants. It has been found by experiment that light passes more freely through a curvilinear than through a plain roof, and through glass forming an acute angle with the horizon than through glass placed perpendicularly. Consequently a plane roof, with perpendicular glass sides, is the worst possible form for greenhouse purposes. As light passes more freely through clear, thin, colored glass, the former should only be used. Poisonous gases, in very minute quantity, act with great energy upon vegetation. A ten thousandth part of sulphuric acid gas is quickly fatal to the health of plants. Hence the sickly appearance of many forms of vegetation, especially evergreens in cities. The trouble with gases from the old-fashioned flue, has pretty generally led to their abolition in greenhouses, and to the introduction, instead, of heating by means of hot water. The process has now become so simplified, and so easily worked, that a man who should put up a permanent greenhouse or a conservatory to be heated by the old-fashioned flue, would be laughed at by practical men. They are only admissible, at best, in temporary structures. It is only within a comparatively few years that scientific men have given their attention to the practical investigation of the phenomena connected with agriculture. The conclusions of mere book theorists have done much to retard the progress of real agricultural science. Governments have waked up to the importance of scientific agricultural investigations. When the mere theorizing stage shall have passed away with us, as it is passing away in Germany and some other European countries, then and not till then shall we begin to make true progress in the right direction.

PLASHING. A mode of repairing or making a hedge by bending down a portion of the shoots, cutting them half through near the ground, to render them more pliable, and twisting them among the upright stems, so as to render the whole effective as a fence, and, at the same time, preserve all the branches alive. For this purpose, the branches to be plashed or bent down must not be cut more than half through, in order that a sufficient portion of sap may rise, to keep alive the upper part of the branches. (See Fences.)

PLASTER. (See Gypsum.)

PLASTIC. Capable of being moulded, adhesive.

PLATBAND. A square moulding, projecting from the wall less than its width.

PLATE. In building, a timber lying horizontally on a wall to receive the ends of girders, joists, rafters, etc.

PLATFORM. A level structure of any materials, to receive a superincumbent building.

PLATINUM, PLATINA. A metal, of the appearance of silver, but very infusible, and of specific gravity 21.5. It resists most chemical reagents, and is used in chemistry for crucibles, and in foil and wire for numerous purposes.

PLATYPHYLLUM. The *Katydid*, which see.

PLATYSOMES, PLATYSOMA. A family of coleoptera with wide and flat bodies, living under the bark of trees

PLEASURE GROUNDS. Grounds laid out in shrubberies, groups of trees, winding walks, and lawns. (See Landscape Gardening.)

PLESIOMORPHISM. A term used to denote a similarity between different crystals in their angles, but not an identity.

PLETHORA. An unnatural condition from rich food, and little exercise, and especially impure air in the stable. There will be a variable appetite, a dull eye, sometimes more or less bloodshot, languor, and loss of glossiness in the coat. In extreme cases, in connection with gentle exercise and pure air, two or three ounce doses of aloes may be given twice a week, and an ounce of saltpetre given in the water as often. Generally, a few bran mashes, in connection with gentle daily exercise and good ventilation, will set all right.

PLEURA. The serous membrane surrounding the cavity of the chest, lungs, and heart; it consists of two parts, which are united along the middle, and forms the *mediastinum*. Its inflammation is called *pleuritis*, or pleurisy.

PLEURISY. This is an inflammation of the membrane lining the chest and lungs, followed by watery exudation pressing on the lungs, and may occur on one or both sides. It is occasioned by a variety of causes, direct violence, colds, or it may follow pleuro-pneumonia and bronchitis. The attack is characterized by a chill, coldness of the skin, and great pain, followed by stiffness, soreness, rapid and incomplete breathing, hard, quick pulse, and a short, hard dry cough. At the first symptoms, give at a dose three ounces of laudanum in half a pint of linseed oil, and repeat in a few hours if it do not check the disease. Clothe the animal warmly, foment the sides over the pain faithfully with hot water, and give plenty of water to drink, with an ounce of saltpetre to the bucket, once or twice a day. If the attack be followed by weakness, scanty urine, and a pulse of seventy or eighty beats a minute, apply a mustard liniment to the chest sufficient to produce considerable heat, but not to blister. In connection with this give twice daily half an ounce of chloride of iron in a bucket of water. If effusion of water takes place in the chest, it must be drawn off by a trochar. Divide the skin with a lancet between the eighth and ninth rib; stretch the opening so that when it returns it will cover the place punctured by the trochar; plunge it into the sac, and allow the water to flow. Sometimes a second tapping is necessary.

PLEURO-PNEUMONIA. Simple pneumonia is one of the most common of the dangerous inflammations attacking, either the human family or animals. It is the name given to an inflammation of the parenchyma, (the spongy substance contained in the interstices between the blood vessels of the viscera). In acute pneumonia, the first stage is engorgement; the second stage is hepatization, (the red softening of Andral, or converting the lung into a substance resembling the liver): the third and fatal stage is purulent infiltration of the lung. In the first stage the lung is externally of a dark or livid red color, sometimes accompanied with a violet hue, from a slight whitish opacity of the pleura. (The membrane which covers the inside of the thorax, and also invests the lungs.) On cutting into the lung during this stage, a bloody serum flows from it more or less clear, and containing numerous air bubbles. The substance cut into will be red, of various shades of crimson, dark red, brown red, chocolate red, or of a livid puce color approaching to black; and the progress of the inflammation may be known by the defect of air in the tissue, and consequent crepitation (crackling sound) upon pressure or tapping; the more crepitation the less the inflammation. The progress toward the second stage being marked by a paler color, a diminished quantity of both serum and air, and an increasing solidity. In another variety of inflammatory engorgment, the lung is extremely lived, and being cut, exudes more or less slowly a dark grumous (clotted) blood. This especially occurs in cases of pneumonia complicated with other acute affections, as fevers. It is supposed also to have relation to the state of the blood, more than to the degree of inflammation present. In the second stage the lung is solid, elastic to the touch, of the consistence and weight of liver, and portions of it sink in water. There is no longer crepitation. Neither when cut does it yield bubbles of air, but when pressed a bloody fluid exudes sparingly from it. Its friability is increased, the fingers readily rupturing its substance, and if a portion of it be pressed between the fingers, it becomes a homogeneous pulp. It is apparently larger than natural, and when taken out it retains its full size, while a healthy lung, when cut from the body, collapses. Its color is seldom so deep as in the first stage; cut into, it is also lighter, the shade varying from a blood or livid red, to a light pinkish purple, or the color of muscle, these colors will mottle the lungs, as is seen in some specimens of marble, and scattered through the hepatized portion, lines are visible, of a lighter color, and specks almost white. Generally when cut and examined with a lens, a number of points can be distinguished, like grains of a somewhat lighter color than the intervening spaces; if the surface be wiped or lightly scraped, these grains appear slightly elevated, as though they were of a more solid nature. If the hepatized lung be torn these granules will be little ovoid bodies, and may be detached from the tissue. Generally these grains are pressed closely together so as to form the chief portion of the lung; sometimes there are interstices of a darker color, and sometimes the granular appearance is altogether absent; the granular appearance, however, is one of the evidences of hepatization, but there is a variety of hepatization. Thus sometimes a lung in a state of red hepatization will weigh ten times that of a healthy lung. The advance of a hepatized lung toward the third stage is marked by its becoming lighter in color and less humid, supposed to be produced by a substitution of more of the yellowish-white semi-solid albumen of the red particles in its substance, by which the deep red or dull red of hepatization passes into a salmon-color or a dingy pink, variously marbled in the degree of its progress, as well as by the mixture of black pulmonary matter. At this time the hepatized lung attains its greatest solidity, and, when pressed slightly, exudes a turbid red liquid; greater pressure reduces the substance to a thick pulp. Minute yellowish-white specks can be discerned, the first development of pus (matter,) then the third stage, or rather the third effect of inflammation, is purulent infiltration. The red tinge assumes a yellowish hue or stone color, varied with red in parts less advanced, and with gray, blue, or bluish-green, from the admixture of black pulmonary matter. On cutting into it during this early stage of suppuration, no matter exudes; the cohesion of the texture is still sufficient to retain it, but slight pressure reduces it to a state in which pus forms the principal part. At first yellow, as the stage progresses the color changes to a straw or sulphur yellow, beginning in patches and spreading through the mass; cutting into the lung shows no granular texture, but a greater or less oozing of a yellowish, opaque purulent will take place, according to the progress of the suppuration, the solid matter diminishing, as the pus is secreted, and squeezing this out nothing remains but the debris of pulmonary tissue, except so far as granulation may remain in which suppurations have not advanced. The softness of the lung in this state is so great that a slight pressure of the finger will make a cavity which is immediately filled with pus. In a more advanced stage of purulent infiltration, a lens will sometimes enable us to detect that only a remnant of texture is left, consisting of an irregular network, composed chiefly of vessels, bronchi, and the septa (partitions) of lobules (lobes). Pneumonia may be lobar, lobular, or vesicular, according as it affects whole or continuous parts of lobes or certain polygonal subdivisions of these, or single bunches of vesicles. Lobar inflammation is the most common, and inflammation of the upper lobes is the most fatal in the human subject. Inflammation often attacks single, or a few isolated lobules, being abruptly limited by the interlobular cellular tissue, so that lozenge shaped or polygonal patches of red, engorged or hepatized tissues are found in the midst of healthy structures. The inflammation in lobular pneumonia seems to originate in several points at once, and not to be sufficiently intense to traverse the barrier of the interlobular membrane. This form sometimes occurs subsequent to injuries, and to the young. Vesicular pneumonia presents itself in the form of little red spots, from the size of a pin's head to that of a hemp seed, and showing upon dissection blood red or livid red, more fragile than the rest of the tissue, which is sometimes quite healthy. In ordinary cases of pneumonia the pleuritic affection is slight, scarcely modifying the disease, and like the inflammation of the bronchi, which is as usual an accompaniment of pneumonia, is to be viewed as incidental rather than essential to the disease. The pleuritic inflammation will be modified by the seat and extent of the pulmonary disease. When partial that portion of the pleura which covers it has upon it an albuminous deposit, which is generally thin, and the disease being of sufficient duration will show signs of organization. When the pulmonary inflammation is of small extent, there is commonly a small sero-purulent effusion into the pleural sac; extensive hepatization prevents this by filling the pleural cavity with its own unyielding substance, and the lung is then partially covered with a thin, false membrane, thicker along the edges, in the interlobular fissure, and occasionally at some points when the inflammation was first extended to the pleura. We have thus stated the appearance and conditions as seen by the anatomist in various stages of pneumonia in the human subject. The same disease will present nearly similar conditions in farm animals. Inflammation of the lungs, or pneumonia, may be produced by causes producing other acute diseases of the chest. From over exertion, acute congestion, or the result of parasites in the lungs. The first stage of pneumonia may be acute congestion of the lungs. The nostrils will be dilated; the breathing will be quick, wheezy, labored and convulsive; the head will be extended, the eye staring, blood shot, and indicating intense pain: the nasal membranes will be deep red or blue, and the pulse feeble, and often scarcely indicated at the jaw. By feeling behind the left elbow, the heart will be found beating tumultuously, perspiration will break out on different parts of the body, but the limbs will be cold. Auscultation, listening with the ear to the chest, will show a loud murmur of respiration, and a slight crepitation or crackling. If the case is extreme, blood letting from the jugular vein will be indicated. It will be dark or tarry in appearance. Remove all that may interfere with easy breathing and comfort. Keep the head of the animal to the wind and give immediately a strong stimulant, five or six ounces of whisky for the horse, and double this dose for the ox; or, liquid ammonia, one-half ounce for the horse, and double this for the ox or, ginger, or pepper tea, if these be not at hand. Cover the animal with thick blankets wrung out of hot water, and cover over all with dry ones. Give friction by rubbing to the limbs and all parts not enveloped by the blankets. If the animal get better, feed on light but nourishing food, including grass, if possible, and give rest, warmth, and good care until entirely recovered. If the animal does not soon show signs of recovery, the attack will probably end in pneumonia. There will be shivering if the attack be not preceded by congestion of the lungs, and, usually, a dry cough. There will be quick, labored breathing, hot skin, the pulse full and rolling, but oppressed. The membranes of the eyes, nostrils, and mouth will be red; the cough deep, but, perhaps, not especially hard or painful. If the legs be held apart, it denotes a severe case. There will be crepitation, by auscultation, over the affected part of the lung, which will show the extent of the inflammation. Percussion (striking) over the affected part will cause extreme pain. Thus, when there is no sound by auscultation, percussion will show a dull, solid sound, while the rest of the chest retains a healthy, drum-like resonance. Thus, by listening and tapping (percussion) the hepatization (solidification) of the lung may be followed, and the increase or diminution of the disease followed from time to time. As the disease becomes worse a yellowish or whitish discharge may come from the nose. In cattle, as the breath is expired, there will be a moan; the horns and ears will be hot, the muzzle dry, the skin tight, the dung hard, if any, and the urine scant and high colored. Give the animal a dry, airy, but warm stall, if the weather is cold, avoid all drafts, clothe the animal warmly, rub the limbs with ammonia liniment (ammonia and oil), and bandage with flannel, and apply a mustard poultice to the sides of the chest, also to the sides. If cattle or hogs, mix turpentine with the mustard poultice, or cover with blankets wrung out of hot water, and when taken off, let it be a little at a time, and rub thoroughly dry, and clothe warm, following with the mustard plasters, if necessary. Give injections of warm water, and warm gruel to drink. A laxative will be good if there is not a low fever and depression. If there is much depression, give tincture of aconite, twenty to thirty drops for a horse, and thirty to forty drops for an ox. For swine, give tartar emetic, five grains. If there is great prostration after the fever has subsided, give sweet spirits of nitre, one ounce three or four times a day, and for the ox, two to three ounces. As the animal recovers, give light, nourishing food, with rest, and often moderate exercise, avoiding drafts. Pleuro-pneumonia contagiosa, the dreaded cattle plague of England, contagious pleuro-pneumonia, or contagious lung fever of the United States, is the most to be dreaded, as it is the most insidious of all our animal scourges, and one, once it gets a general foothold in a country, has never yet been known to be radically stamped out. In 1839, this dread disease was communicated to stock in Ireland from some Dutch cattle taken there. It appeared in England in 1842, in various parts of Europe, the Cape of Good Hope and Australia, since that time. It was first brought to Brooklyn in 1843, and again in 1850, to New Jersey in 1847, to Massachusetts in 1859, and again it made its appearance in New York a few years since, and spread throughout the adjacent States, even reaching Virginia in the South. The most energetic measures were taken by the several States, the cattle of which were infected, for the purpose of stamping it out. Whether this will really be accomplished successfully, remains to be seen. If not it must eventually overrun the whole country. So far as we have been able to learn, no well authenticated case has yet been found, or at least it has not spread, west of the Alleghanies. There have been reports of cases from time to time, and one during, the summer of 1880, that it had made its appearance in Kansas. Upon following the matter closely there was found no good foundation for the report, and like the rest, the report was probably started by persons who sought to make money by passing cattle through Canada for exportation. In view of the necessity of accurate information in relation to this disease, and its characteristic symptoms, we append sufficient information in relation thereto, for if once it gets a firm foothold among the great herds of the West, it will remain indefinitely, and cost millions of dollars annually in the attempt to keep it in check. No successful remedy has yet been found for treating this dread disease. Isolation, and good nursing may save some cattle, but generally at a cost greater than their value for beef. Its period of incubation is from ten days to three months, by a low fever, the occurrence of inflammation in the air passages, lungs and their coverings, followed by exudation into the lungs and pleura. Infection may be by contact with animals infected; by inoculation, through contact with the remains of diseased animals or their excretions, or by inoculation of the virus of an infected animal. It is fairly well authenticated, that the infection may be carried in the air for considerable distances, and very certainly the vitality of the virus may remain indefinitely in infected situations, as fields and especially in stables, if they be not most thoroughly disinfected. It is more than probable that in the majority of cases the infection is taken into the lungs by breathing, since the disease begins when the inspired air may lodge the germs. The lesions are concentrated there, beginning with cloudiness and swelling of the smaller air tubes and the surrounding connecting tissues. However taken the poison is multiplied, and in an immeasurably greater degree when taken into the lungs, than by other means. When the fever has run its course, if the animal become apparently well to the ordinary observer, the ox may have a good appetite and gain flesh, the cow may give milk freely, and seem in perfect health, yet from three, even to fifteen months after, it is claimed the disease may be transmitted. How? The circulation in the most severely infected portion of the lungs is interrupted; the exudation is developed into a tough fibrous envelope, which shuts off the dead mass from the adjacent lung, and from communication with the adjacent air. This dead mass now undergoes a process of breaking down, liquefaction, and absorption commencing at the surface and advancing slowly toward the center. Thus as it undergoes no change, except that of liquefaction, and exhales at no time a putrid odor, it remains infectious so long as it retains the solid form. Therefore whenever there are indications of the existence of these encysted masses, the animal must be infectious, and kept from contact with others precisely as in the acute stages of this dread disease. Hence we say that once an animal is found infected it is cheaper for the owner to kill it at once, slash the hide—to make it worthless to ghouls who might dig up the body—and bury it deeply in the earth, covering it, if possible, with quicklime. The following is the diagnosis of the disease as seen by a committee appointed to investigate this disease in New York. They say: The first symptoms of pleuro-pneumonia seldom attract much attention, and the disease commonly steals on without manifesting any great violence; the animal appears dejected, and, when in the field, separates itself from its fellows, often getting behind a wall, hedge or other shelter to keep out of the wind. As the disease progresses, it becomes uneasy, loses its appetite, and stops chewing the cud; the eyes appear dull, the head is lowered, the nose stuck forward, the nostrils expanded, and the horns and skin are warmer than common. With failure of the appetite, thirst may continue and increase. In cows, the milk falls off, either gradually or altogether. It is seldom that the first progress of the disease attracts much notice until the animal stops eating. Cough, although often accompanying the disease, is by no means a constant symptom. When, however, the pleura or lining membrane of the windpipe or the bronchial tubes become inflamed, loud and harsh coughing is a never-failing symptom. Pressure between the ribs and along the spine causes the animal to wince. The breath grows warmer and often fetid, the danger rapidly increasing, of course. The animal will often press her muzzle very hard against the partition, as if for support, will breathe with great difficulty, and soon dies. The progressive symptom varies greatly, however, in different animals, but the cough is the key-note of the disease, and appears in all. There can be no longer room to doubt that the disease is contagious or infectious. It seems to be communicated by animal poison in the air, proceeding from the lungs and breath or respiratory surfaces of a diseased animal, and any animal of the same species coming in contact or within the influence of this vitiated air, is very liable to be infected. In relation to the treatment of the disease, we have fully stated our opinion that killing and burying infected animals is the only safe plan, and isolating the herd containing it or them, and continuing to kill and bury all that give evidence of the disease. The better way would be to immediately kill all that were fat, and not affected with the disease, bury the viscera and sell the meat. Of course no person would sell the meat or hide of a diseased animal. To be a common highwayman or murderer, would be innocence as against such a fiend. If the infected ones are to be killed and the rest isolated, Prof. Gamgee advises in the first stage of the disease, to an ox, daily doses of sulphate of iron, linseed, and aniseed, of each from one-half to one drachm, the whole to be well mixed and given in bran. The food throughout the disease should be light and nutritious In the second stage give copious warm water injections, and, as a stimulant two or three times a day, one-half ounce carbonate of ammonia, and one quart linseed oil. For the cough and debility during convalescence the following tonic to be given daily is advised: Oxide of magnesia, one-quarter ounce; iron filings, very fine, one-half ounce; tincture of gentian one and a half ounces; rain-water, one pint. Yet we again advise the cheapest as well as the most humane way, to kill every animal infected. All authorities agree that both lungs being affected there is no hope of recovery, and we may add, the infection from an animal with one lung, or one lobe of a lung infected is as deadly as though both of them were completely rotten. The latest report to the United States Government, 1879, gives much matter that will be of special interest everywhere among all classes of farmers, the gist of which we give: The virulence and infectious nature of the disease does not seem to have been lessened by its transplantation to this country. Many instances are given which show conclusively that it is equally as fatal to-day in those localities in the United States, in which it exists, as it is in its home in the far East, or in those nations of Europe which it has invaded. Speaking of the contagious and infectious nature of the malady, Dr. Law says: No one who has studied the plague in Europe can truthfully claim that it is less infectious here than in the Old World. What misleads many is, that during the cooler season many of the cases assume a subacute type, and others subside into a chronic form with a mass of infecting material (dead lung) encysted in the chest, but unattended by acute symptoms. But this feature of the disease renders it incomparably more insidious and dangerous than in countries where the symptoms are so much more severe, that even the owners are roused at once to measures of prevention. In moderating the violence of its action, the disease does not part with its infecting qualities, but only diffuses them the more subtilely in proportion as its true nature is liable to be overlooked. A main reason why unobservant people fail at first sight to see that the lung fever is contagious is, that the seeds lie so long dormant in the system. A beast purchased in October passes a bad winter, and dies in February; after having infected several others. She has had a long period of incubation, and when the disease supervenes actively, she has passed through a chronic form of illness, so that when others sicken, people fail to connect the new cases with the infected purchase. Then, again, in an ordinary herd of ten or twenty head the deaths do not follow in rapid succession, but at intervals of a fortnight, a month, or even more, and those unacquainted with the nature of the disease suppose that it can not be infectious, or all would be prostrated at once. The disease may be communicated by immediate contact, through the atmosphere for some considerable distance, by the inhalation of pulmonary exudation when placed in the nostrils, from impregnated clothing of attendants, through infected buildings, infected manure, infected pastures, infected fodder, etc. Healthy cattle have been contaminated after being lodged in stables that were occupied by diseased ones three or four months previously. Hay spoiled by sick cattle has induced the disease after a long period, and pastures grazed upon three months before have infected healthy stock. The flesh of diseased animals has also conveyed the malady; and it is recorded by Fleming that the contagion from cattle buried in the ground infected others fifty or sixty feet distant. There seems to be much difference of opinion with regard to the power of the virus to resist ordinary destructive influences. Under ordinary circumstances, it will be preserved longest where it has been dried up and covered from the free access of the air. In close stables and buildings having rotten wood-work, or deep dust-filled cracks in the masonry, and in those with a closed space beneath a wooden floor, it clings with the greatest tenacity. Again, in buildings which contain piles of lumber, litter, hay, fodder, or clothing, the virus is covered up, secreted, and preserved for a much longer period than if left quite empty. In such cases it is preserved as it is in woolen or other textile fabrics, when carried from place to place in the clothing of human beings. As carried through the air, the distance at which the virus retains its infecting properties varies much with varying conditions. Dr. Law states that he has seen a sick herd separated from a healthy one by not more than fifteen yards and a moderately close board fence of seven feet high, and in the absence of all intercommunication of attendants, the exposed herd kept perfectly sound for six months in succession. At other times infection will take place at much greater distances without any known means of conveyance on solid objects. Röll quotes fifty to one hundred feet, while others claim to have known infection transmitted a distance of from two hundred to three hundred feet. But the author questions whether, in such cases, the virus had not been dried up on light objects, like feathers, paper, straw, or hay, which could be borne on the wind. Because the lesions are concentrated in the lungs, and begin with cloudiness and swelling of the smaller air tubes and surrounding connective tissues, the presumption is favored that the virus is usually taken in with the air breathed. Its progress and the results of all attempts at inoculation would seem to confirm this. The exudation into the interlobular tissue, the congestion of the lung tissue itself, and the implication of the lung covering, are regarded as secondary phenomena, or, in other words, the disease begins where the inspired air must lodge the germs. The inoculation of the virulent lung products on distant parts of the body transfers the seat of the disease to the point inoculated, and in such cases the lesions of the lungs are not observed, or at least are not greatly marked. A diseased animal is more likely to infect a healthy one at that period when the fever runs highest and the lung is being loaded with the morbid exudation. Proof appears to be wanting as to the infecting nature of the affection during the incubation stage, but it must not be inferred that with the subsidence of the fever the danger is removed. It is a matter of frequent observation that animals which have passed through the fever, and are again thriving well and giving a free supply of milk, and to ordinary observers appear in perfect health, retain the power of transmitting the disease to others. This may continue for three, six, nine, twelve, or, according to some, even fifteen months after all signs of acute illness have disappeared. The number of animals infected by contact or exposure to the contagion is somewhat irregular, as is also the virulence and fatality of the disease. The French commission of 1849 found that of twenty healthy animals exposed to infection sixteen contracted the disease, ten of them severely. Dr. Lindley gives examples, from his South African experience, in which whole herds of eighty, one hundred and thirty, and even of several hundred died without exception, showing that in warm climates the mortality is greatest. Dr. Law found the disease much more virulent and fatal during the hot summer months in New York, and says that during the winter season it is far less violent in its manifestations, and a great number of animals resist it. Lung plague confines its ravages entirely to the bovine genus, and no race, breed, or age is exempt from its attacks. Sex gives no immunity; bulls suffer as much as cows; and oxen and calves, if equally exposed, furnish no fewer victims than bulls and cows. As in rinderpest, measles, scarlatina, and the different forms of variola, an animal once afflicted with lung plague is usually exempt or impervious to a second attack. Only occasional instances are given where an animal has suffered from a second attack. The losses caused by the plague ranges all the way from two to sixty-three per cent. of all the animals in the country or locality in which it prevails, the losses varying according to climate, surroundings, condition of stock, etc. The period of latency, that is, the time that elapses between the receiving of the germs into the system and the manifestation of the first symptoms of the disease, varies greatly. Veterinarians differ as to their experience and statements, and set this period at from five days to three months. Dr. Law has seen cases in which cattle have passed three or four months after the purchase in poor health, yet without cough or any other diagnostic symptom, and at the end of that time have shown all the symptoms of the lung plague. It is this long period of latency that renders the disease so dangerous. An infected animal may be carried half way around the world before the symptoms of the malady become sufficiently violent to attract attention, and yet all this time it may have been scattering the seeds of the disease far and wide. The average period in inoculated cases is nine days, though it may appear as early as the fifth, or it may not till the thirtieth or fortieth day. In the experimental transmission of the disease by cohabitation, under the French commission, a cough, the earliest symptom, appeared from the sixth to the thirty-second day, and sometimes continued for months, though no acute disease supervened. Hot climates and seasons abridge the period of latency, as the disease has been found to develop more rapidly in summer than in winter, and in the South than in the North. A febrile condition of the system also favors its rapid development. Of the symptoms of the disease, Dr. Law says: These vary in different countries, latitudes, seasons, altitudes, races of animals, and individuals. They are, *cæteris paribus*, more severe in hot latitudes, countries, and seasons, than in the cold; in the higher altitudes they are milder than on the plains; in certain small or dwarfed animals, with a spare habit of body, like Brittanies, they appear to be less violent than in the large, phlegmatic, heavy-milking, or obese short-horn Ayrshires and Dutch. A newly-infected race of cattle in a newly-infected country, suffer much more severely than those of a land where the plague has prevailed for ages; and finally certain individuals, without any appreciable cause, have the disease in a much more violent form than others which stand by them in precisely the same conditions. Sometimes the disease shows itself abruptly with great violence and without any appreciable premonitory symptoms, resembling in this the most acute type of ordinary broncho-pneumonia. This, however, is mostly in connection with some actively exciting cause, such as exposure to inclement weather, parturition, overstocking with milk, heat, etc. Far more commonly the symptoms come on most insidiously, and for a time are the opposite of alarming. For some days, and quite frequently for a fortnight, a month or more, a slight cough is heard at rare intervals. It may be heard only when the animal first rises, when it leaves the stable, or when it drinks cold water, and hence attracts little or no attention. The cough is usually small, weak, short and husky, but somewhat painful and attended by some arching of the back, an extension of the head upon the neck, and protrusion of the tongue. This may continue for weeks without any noticeable deviation from the natural temperature, pulse, or breathing, and without any impairment of appetite, rumination or coat. The lungs are as resonant to percussion as in health, and auscultation detects slight changes only, perhaps an unduly loud blowing sound behind the middle of the shoulder, or an occasional slight mucous rattle, or a transient wheeze. In some cases the disease never advances further, and its true nature is to be recognized only by the fact that it is shown in an infected herd or on infected premises, and that the victim proves dangerously infecting to healthy animals in uninfected localities. It may be likened to those mild cases of scarlatina which are represented by sore throat only, or to the modified variola known as chicken-pox. In the majority of cases, however, the disease advances a step further. The animal becomes somewhat dull, more sluggish than natural, does not keep constantly with the herd, but may be found lying alone; breathes more quickly, twenty to thirty times per minute in place of ten to fifteen; retracts the margins of the nostrils more than formerly; the hair, especially along the neck, shoulders, and back, stands erect and dry; the muzzle has intervals of dryness, and the milk is diminished. The eye loses somewhat of its prominence and luster; the eyelids and ears droop slightly, and the roots of the horns and ears and the limbs are hot or alternately hot and cold. By this time the temperature is usually raised from 103° F., in the slightest or most tardy cases, to 105° and upward to 108° in the more acute and severe. Auscultation and percussion also now reveal decided changes in the lung tissue. The ear applied over the diseased portions detects in some cases a diminution of the natural soft-breathing murmur, or it may be a fine crepitation, which has been likened to the noise produced by rubbing a tuft of hair beween finger and thumb close to the ear. Where this exists it is usually only at the margin of the diseased area, while in the center the natural soft murmur is entirely lost. In other cases a loud blowing sound is heard over the diseased lung, which, though itself impervious to air and producing no respiratory murmur, is in its firm, solid condition a better conductor of sound and conveys to the ear the noise produced in the larger air-tubes. Percussion is effected by a series of taps of varying force delivered with the tips of the fingers of the right hand on the back of the middle finger of the left firmly pressed on the side of the chest. Over all parts of the healthy lung this draws out a clear resonance, but over the diseased portions the sound elicited is dull, as if the percussion were made over the solid muscles of the neck or thigh. All gradations are met with as the lung is more or less consolidated, and conclusions are to be drawn accordingly. In other cases we hear on auscultation the loud, harsh, rasping sound of bronchitis, with dry, thickened, and rigid membranes of the air-tubes, or the soft, coarse, mucus rattle of the same disease when there is abundant liquid exudation, and the bursting of bubbles in the air passages. In others there is a low, soft, rubbing sound, usually in jerks, when the chest is being filled or emptied. This is the friction between the dry, inflamed membrane covering the lungs and that covering the side of the chest, and is heard at an early stage of the disease, but neither at its earliest nor its latest stage. Later there may be dullness on percussion up to a given level on one or both sides of the chest, implying accumulations of liquid in the cavity, or there is a superficial dullness on percussion, and muffling of the natural breathing sound with a very slight, sometimes almost inaudible, creaking, due to the existence of false membranes (solidified exudations) on the surface of the lung or connecting it to the inner side of the ribs. This is often mistaken for a mucous rattle that can no longer take place in a consolidated lung in which there can be no movement of air nor bursting of bubbles in breathing. The mucous rattle is only possible with considerable liquid exudation into the bronchial tubes, and a healthy, dilatable condition of the portion of the lung to which these lead. In rare cases there will be splashing sounds in the chest, or when the patient has just risen to his feet a succession of clear ringing sounds, becoming less numerous and with longer intervals until they die away altogether. These are due to the falling of drops of liquid from shreds of false membrane in the upper part of the chest through an accumulation of gas into a collection of liquid below. It has been likened to the noise of drops falling from the bung-hole into a cask half filled with liquid. Peculiar sounds are sometimes heard, as wheezing, in connection with the supervention of emphysema, and others which it is needless to mention here. In lean patients pressure of the tips of the fingers in the intervals between the ribs will detect less movement over the diseased and consolidated lung than on the opposite side of the chest where the lung is still sound. As seen in America, in winter, the great majority of cases fail to show the violence described in books. The patients fall off rapidly in condition, show a high fever for a few days, lie always on the same side (the diseased one) or on the breast, and have a great portion of one lung consolidated by exudation and encysted as a dead mass, and yet the muzzle is rarely devoid of moisture, the milk is never entirely suspended, and may be yielded in only a slightly lessened amount as soon as the first few days of active fever have passed. During the extreme heats of summer, on the other hand, the plague manifests all its European violence. The breathing becomes short, rapid, and labored, and each expiration is accompanied by a deep moan or grunt, audible at some distance from the animals. The nostrils, and even the corners of the mouth are strongly retracted. The patient stands most of its time, and in some cases without intermission, its fore legs set apart, its elbows turned out, and its shoulder-blades and arm-bones rapidly losing their covering of flesh, standing out from the sides of the chest so that their outlines can be plainly seen. The head is extended on the neck, the eyes prominent and glassy, the muzzle dry, a clear or frothy liquid distils from the nose and mouth, the back is slightly raised, and this, together with the spaces between the ribs and the region of the breast-bone, are very sensitive to pinching; the secretion of milk is entirely arrested, the skin becomes harsh, tightly adherent to the parts beneath, and covered with scurf, and the arrest of digestion is shown by the entire want of appetite and rumination, the severe or fatal tympanies (bloating,) and later by a profuse watery diarrhœa in which the food is passed in an undigested condition. If the effusion into the lungs or chest is very extensive, the pallor of the mouth, eyelids, vulva, and skin betrays the weak, bloodless condition. The tongue is furred, and the breath of a heavy, feverish, mawkish odor, but rarely fetid. Abortion is a common result in pregnant cows. During the summer the disease shows its greatest violence, and it is then that its mortality is not only high but early. The great prostration attendant on the enormous effusion into the organs of the chest, the impairment of breathing, and the impairment or suspension of the vital functions in general, causes death in a very few days. In other cases the animals die early from distension of the paunch with gas, while in still others the profuse scouring helps to speedily wear out the vital powers. In certain severe cases the rapid loss of flesh is surprising. Dr. Law says that in such cases a loss of one third of the weight in a single week is by no means uncommon, and even one-half may be parted with in the same length of time in extreme cases. In fatal cases all symptoms become more intense for several weeks, the pulse gradually becomes small, weak, and accelerated, and finally imperceptible; the breathing becomes rapid and difficult, the mucous membranes of the mouth, eyes, etc., become pale and bloodless, emaciation goes on with active strides, and death ensues in from two to six weeks. Sometimes, in cold and dry weather, a portion of dead lung may remain encysted in the chest, submitting to slow liquefaction and removal, and such animals will go on for months, at last to sink into such a state of debility that death ensues from exhaustion and weakness. In still other cases the retention of such diseased masses, and the consequent debility, determines the appearance of tuberculosis, from which the animal dies. Purulent infection and rupture of abscesses into the chest are also causes of death, but the author states that no such cases have come under his observation. Dr. Law gives the following description of the *post mortem* appearances, which we give for the information of those somewhat versed in physiology. If the disease is seen in its earliest stages, the changes are altogether confined to the tissue of the lung. From the examination of the lungs of several hundred diseased animals, I can confidently affirm that the implication of the serous covering of the lung (pleura) is a secondary result. In all the most recent cases we find the lung substance involved and the pleura sound, while in no one instance has the pleura been found diseased to the exclusion of the lung tissue, or without an amount and character of lung disease which implied priority of occurrence for that. Yet, in all violent attacks the disease will have proceeded far enough to secure implication of the pleura as well, and hence we may describe the changes in the order in which they are usually seen when the chest is opened. The cavity of the chest usually contains a quantity of liquid varying from one or two pints to several gallons, sometimes yellowish, clear, and transparent, at others slightly greenish, brownish-white, and opaque, or even exceptionally slightly colored with blood. This effusion contains cell-forms and granules, and gelatinizes more or less perfectly when exposed to the air. On the surface of the diseased lung, and, to a less extent, on the inner side of the ribs, is a fibrinous deposit (false membrane) varying from the merest rough pellicle to a mass of half an inch in thickness, and, in the worst cases, firmly binding the entire lung to the inside of the chest and to the diaphragm. These false membranes are usually of an opaque white, though sometimes tinged with yellow, and, in the deeper layers, even blood-stained, especially over an infarcted lung. A feature of these false membranes, and one that serves to distinguish them from those of ordinary pleurisy, is that they are commonly limited to the surface of the diseased portion of lung, or, if more extensive, that portion which covers sound lung tissue is much more recent, and has probably been determined by infection from the liquid thrown out into the chest. In the lung itself the most varied conditions are seen in different cases and at different stages of the disease. The diseased lung is solid, firm, and resistant, seems to be greatly enlarged, because it fails to collapse like the healthy portion when the chest is opened; is greatly increased in weight, and sinks in water. When cut across it shows a peculiar linear marking (marbling) due to excessive exudation into the loose and abundant connective tissue which separates the different lobules of the ox's lung from each other. This exudation is either clear, and therefore dark, as seen by reflected light, or it is of a yellowish-white, and when filled with it the interlobular tissue appears as a network, the meshes of which vary from a line to an inch across, and hold in its interspaces the pinkish-gray, brownish-red, or black lung tissue. When only recently attacked the lung may present two essentially different appearances. Most frequently the changes are most marked in the interlobular connective tissue, which is the seat of an abundant infiltration of clear liquid, a sort of dropsy, while the lung tissue, surrounded by this, retains its normal pinkish-gray color, and is often even paler, and contains less blood than in health. It has, in short, become compressed by the surrounding exudation, and air and blood have been alike in great part expressed from its substance. This extreme change in the tissue surrounding the lobules and the comparatively healthy appearance of the lobules themselves, have led many observers to the conclusion that the disease commenced in the connective tissue beneath the pleura and extended to the proper tissue of the lung. There is, however, as pointed out by Prof. Yeo, a coexistent disease of the smaller air-tubes corresponding to the lobules that are circumscribed by this infiltration, and there is every reason to believe that the infiltration in question is the result of antecedent changes in the air-tubes. Less frequently we find the lobules of the lung tissue presenting the first indications of change. The lobules affected are of a deep red, and more or less shining, yet tough and elastic. They do not crepitate on pressure, yet they are not depressed beneath the level of the adjacent healthy lung-tissue, as they would be if collapsed. The interlobular connective tissue, devoid of all unhealthy exudation, has no more than its natural thickness, and reflects a bluish tint by reason of the subjacent dark substance of the lung. Here the lung tissue itself is manifestly the seat of the earliest change—congestion—and the interlobular exudation has not yet supervened. Specimens of this kind may be rare, but a number have come under the writer's observation, and in lungs, too, that presented at other points of their substance the excessive interlobular exudation. Both of these forms show a tendency to confine themselves to particular lobules and groups of lobules of the lung. They correspond, in short, to the distribution of particular air-tubes and blood vessels. The fact, however, is noteworthy as characteristic of the disease, that it attacks entire lobules, and the limits of the diseased lung tissue are usually sharply marked by the line of connective tissue between two lobules, so that one lobule will be found consolidated throughout, and the next in a perfectly natural condition. The two forms just described differ also in cohesion and power of resistance. The lung saturated with the liquid exudation has its intimate elements torn apart, and is more friable, giving way readily under pressure, while that in which there is red congestion, but no extensive exudation, retains its natural elasticity, toughness, and power of resistance. Another condition of the diseased lung-tissue, more advanced than either of those just described, is the granular consolidation or hepatization. In this condition the affected regions of lung are as much enlarged as in the dropsical condition, but they are firmer and more friable, and on their cut surface present the appearance of little round granules. These granules are not peculiar to the lung tissue proper, though most marked on this; they characterize the interlobular connective tissue as well. They consist mainly of lymphatic cell growths, filling up the air cells, the smaller air-tubes, the lymph spaces, and the meshes of the connective tissue. The color of these portions varies from a bright reddish-brown to a deep red, according to the compression to which the lung tissue has been subjected by the exudation in the early stages. Another form of lung consolidation is of a very dark red or black, and always implies the death of the portion affected. The dark aspect of the diseased lobules forms a strong contrast with the yellowish-white interlobular tissue, except where that also becomes blood-stained, when the whole presents a uniform dark mass. This form has the granular appearance of that last described, and on microscopic examination its blood-vessels are found fully distended with accumulated blood globules. This black consolidation is always sharply limited by the borders of certain lobules or groups of lobules, which are connected with a particular air-tube and its accompanying blood-vessels, and the artery leading to such lobules is as constantly blocked by a firm clot of blood. The mode of causation is this: the artery, being in the center of a diseased mass, becomes itself inflamed. As soon as the inflammation reaches its inner coat, the contained blood coagulates; the vein is usually blocked in the same way. The blood formerly supplied by the artery to certain lobules is now arrested; that in the capillary vessels of those lobules stagnates; nutrition of the walls of the capillaries ceases, and these, losing their natural powers of selection, allow the liquid parts to pass freely out of the vessels, leaving the globules only in their interior. More blood continues to enter them slowly from adjacent capillaries supplied from other sources, and as this is filtered in the same way by the walls of the vessels, these soon come to be filled to repletion by the globules only; and hence the intensely dark color assumed. The color is often heightened by the escape of blood from the now friable vessels into the surrounding tissue, and it is by this means that the interlobular tissue is usually stained. This black hepatization, or, as it is technically called, infarction, is an almost constant occurrence in the disease as seen in New York, and the death and encysting of large portions of lung is, therefore, the rule. If too extensive, of course, the patient perishes, but not unfrequently a mass of lung measuring four or six inches by twelve is thus separated without killing the animal. If at a later stage we open an animal which has passed through the above condition, the following may be met with: A hard, resisting mass is felt at some portion of the lung, usually the lower and back portion, and on laying it open it is found to consist of dead lung tissue, in which the hepatized lobules and interlobular tissues, the air-tubes, and blood-vessels are still clear and distinct, but the whole is separated from the still living lung by a layer of white pus-like liquid, outside which is a dense, fibrous sac or envelope, formed by the development of the surrounding interlobular exudation. From the inner surface of this dense cyst, the firm, thick bronchial tubes and attending vascular systems project in a branching manner like dirty white stalactites, and these, with the interlobular tissue thickened by its now firmly organized exudation, may form bands extending from side to side of the cavity. At a still more advanced stage the dead and encysted lung tissue is found to have been entirely softened, and the sac contains nothing but a mass of white liquid debris, or, still later, a caseous mass of its dried, solid matters, upon which the fibrous covering has steadily contracted, so as to inclose but a mere fraction of its original area. In hundreds of *post mortems* we have only once seen the dead and encysted lung the seat of putrid decomposition, and never found the cavity opening into a previous air-tube. There remains to be noticed the condition of the air-tubes and accompanying vessels in the diseased lungs. In all cases where we see the starting point of the disease we find in the small tubes leading to the affected lobules a loss of the natural brilliancy of the mucous membrane, which has become clouded and opaque, and the tissue beneath it infiltrated and thickened. In more advanced cases, and above all in those showing the dropsical condition of the interlobular tissue, we find a similar infiltration into the connective tissue around the air-tubes and their accompanying vessels, and in the hepatized lung this is always seen as a thick, firm, resistant, white material, having the compressed and contracted and often plugged air-tubes and vessels in the center. These thickened masses have already been referred to as standing out in stalactite form from the inner wall of the sac in which the dead (necrosed) lung is undergoing solution. As to the nature of the plague, Dr. Law states that there can be no doubt but it is determined by an infecting material conveyed in some manner from one beast to another. The intimate nature of this material has never been determined. No special anatomical element, no specific organism of animal or vegetable origin, has been detected as constant in the diseased organ and peculiar to it, yet the presence of a specific contagium has been fully demonstrated in all the experience of the disease by the author and others. This infecting material, as shown by the records of inoculation, rarely affects the lungs when first lodged on a raw surface of some other part of the body, differing in this essentially from most other specific disease poisons, which have a definite seat of election in which their morbid processes are always established, no matter by what channel communicated. Since this contagium does not usually affect the lungs when introduced by some other channel, it follows of necessity that when it does attack the lungs it must have been introduced directly into them. If inhaled in the air breathed, it will fall upon one of two points—the air-tubes or the air-cells —and there begin its baleful and destructive course. This is exactly in accordance with the early lesions of the disease as found by Dr. Law in his post-mortem examinations. Following is given a brief summary of the work of the New York commisson in its efforts to stamp out the disease in that State; but as the department has later advices from the author in regard to the work actually accomplished by this commission, extracts from Dr. Law's letter are given in preference to quotations from this monograph work. The letter bears date of New York city, December 9, 1879, and contains, among other things, the following: To place our work in a nutshell, I would say that in the past ten months the inspectors of New York have examined 40,000 head of cattle, many of them several times; that we have slaughtered and indemnified the owners for 500 head of diseased cattle, and that we have all but exterminated the plague from seven of the counties in which we found it. At present the main center of the plague is in King's county and the adjacent border of Queen's county. In all country districts, where the cattle are kept on enclosed farms, and where the people heartily co-operated, the work has been easy, and in every case speedily crowned with success. In the cities and suburbs, on the other hand, where cattle had been accustomed to graze on open lots where interchange between different herds was frequent, and where the facilities for secret slaughter easily favored the covering up of the disease, the greatest difficulties had to be overcome. In New York city we secured the hearty co-operation of the police, and effectually arrested all movement between city stables, allowed only sound animals from healthy counties to enter these stables, and none to leave save to immediate slaughter, and, finally, promptly slaughtered all acute and chronic cases of the disease and saw to the disinfection of the premises and the most gratifying success crowned our efforts. In Brooklyn, on the other hand, where our work was systematically opposed, where the aldermen defied the State law by passing an ordinance authorizing the pasturage of cattle on open commons and unfenced lots, and some of them signed special permits for the movement of cattle in defiance of General Patrick's authority, and where magistrates dismissed offenders who were brought before them and reprimanded the policemen who had made the arrests, we soon lost the assistance of the police, which was at first all we could wish, and we naturally failed to meet with the splendid success seen in New York. It became evident early in the work that unless we could establish special inspection yards under our own control, and abolish the system of distributing cows and other store cattle from dealers' stables, our success would be very partial and slow. In New York we were enabled to do this through the liberality of the Union Stock Yard Company, who built new yards for this purpose, which we opened July 1. In Brooklyn no such favor awaited us, and as the appropriation made by the legislature would not meet the needful outlay and enable us to hold what we had gained until the legislature should again meet, we had to be content with a system which was confessedly ineffective. By the end of August the approaching exhaustion of the appropriation compelled the dissmissal of one-half of our veterinary force, and soon after we had to stop nearly all indemnities and consequently nearly all killing. Fortunately, New York City was now so nearly sound that we could continue the work there with but one inspector in addition to the one in attendance at the Union Stock Yard, and we could still kill and indemnify for all sick cattle in the city. Brooklyn, still widely infected, and with authorities still somewhat inimical, could only have her infected herds quarantined, and in her the scourge is but very partially abated. In certain outlying districts most gratifying results have been secured. In May we learned that animals from an infected herd had been turned on the Montauk pasture on the east end of Long Island. The range was visited and eighteen animals killed to save the 1,100 that remained. Later, two other cases developed in animals that had been in infected herds and had been overlooked at the first visit. Fortunately, for some months at first the cattle turned on this immense range kept apart from each other in small groups, composed of such only as had herded together prior to their coming on the range, and this most fortunate condition, coupled with the prompt disposal of each animal as it sickened, secured the escape of 1,100 animals. Had the occurrence been later in the season, when the cattle had learned to come together into one great herd, the results must have been most disastrous. A second case is that of Putnam county in which the plague had been smouldering since 1878. The State appropriation would not warrant us to offer indemnities, but the county authorities promptly assumed the responsibility, and every herd in which infection was found to exist was at once exterminated. In this way six herds have been disposed of, where sickness has existed for months. As regards the future, it is strongly urged that the National

Government assume not only the direction, but the execution of the work of stamping out the plague. The following among other reasons for this are given: The disease is an exotic, and if once suppressed could only reappear in America as the result of importation. It is gradually extending, and if neglected must lay the entire continent under contribution. If it reached our unfenced ranges in the West it would be ineradicable, as it has proved in the European Steppes, in Australia, and in South Africa. As the seeds remain latent in the system for three months, infected cattle may be moved all over the continent, from ocean to ocean and from lakes to gulf, and live for a length of time in a new herd before they are suspected. Old cases with encysted masses of infecting matter in the lungs may show no obvious signs of illness, and may be bought and sold as sound and mingle with many herds in succession, conveying infection wherever they go. There is, therefore, the strongest temptation for the owner to seek to secure a salvage by the sale of apparently sound but really infected animals. There is further the strongest probability that in a new locality these cattle would not be suspected until one or more herds had been irretrievably ruined. The infection of the South and West would inevitably spread the infection over the whole Middle and Eastern States, as infection would pour in continuously through the enormous cattle traffic, and all rolling stock, yards, etc., of railways would become infected. The live stock bears a larger proportion to the State wealth West and South than in the East, hence the West has most at stake in this matter, and should bear its share in the work of extermination. The plague is more violent in proportion to the heat of the climate, so that it will prove far more destructive in the semi-tropical summers of the South and West than on the Atlantic seaboard. No State can be rendered secure unless all States are cleared of the pestilence One remaining center of infection on the continent is likely to prove as injurious, as the one infected cow landed in Brooklyn in 1843, the sad fountain of all our present trouble. It has been decided by a United States Supreme Court in Illinois, that a State law forbidding the introduction of cattle from a neighboring State, because it is feared they may introduce disease, is unconstitutional. Therefore each State must keep a guard along its whole frontier, with quarantine buildings, attendants, and inspectors, and must quarantine all cattle as soon as they shall have crossed. Smuggling is inevitable so long as there are distinct authorities in two adjacent States. Rascally dealers have repeatedly run cattle into New York from New Jersey, sold them, and returned with their money before the matter could be discovered and the law officers of New York put on their track. Were the law and execution one for all the States, such men could be apprehended and punished wherever found. In Europe it is found that an armed guard with intervals of 200 yards patroling the whole frontier day and night is not always sufficient; how much less, therefore, with us a law that can be evaded with such impunity. Finally, there is little hope of Delaware, Maryland, and Virginia stamping out the plague at their own expense, so that unless the United States takes the matter up, the work of New York, New Jersey, and Pennsylvania will be but money thrown away. This is a matter which threatens with dire disaster the inter-State live-stock trade of the future, and the National Government is called upon to stamp out the scourge with the view of protecting the trade between States. As respects the organization that should be charged with the work, it certainly ought to have a responsible head, and while the live-stock interests should be represented, it should not be made too unwieldy to act at a moment's notice in any emergency. The conditions of success are well enough understood, and while special adaptations would be demanded in many localities, yet the work should be carried out actively without the necessity of calling together a large and unwieldy committee, before anything can be done. Another point of vital importance is that a sufficient sum of money should be appropriated for this exclusive purpose, to obviate the necessity of stopping the work or giving it a material check before success shall have been accomplished. Any material arrest or any entire cessation of the work and a renewed spread of the disease will bring the question of veterinary sanitary work into disrepute, and may be the means of indefinitely and fatally postponing further action. While a large sum should be appropriated, its expenditure may be sufficiently guarded, but above all, it should not be a common fund to be devoted to this and other objects. Aside from the moral question, this is of far more immediate importance than even yellow fever, the germs of which are destroyed by frost, and the neglect of which for one year places the sanitarian in no greater difficulty for the next. With a disease like the lung plague, which is favorably affected by no change of climate nor season, and the germs of which survive all extremes of heat and cold, the loss of a year, a month, or even a day, may make the difference between an easy success and a disastrous and irremediable failure—a live-stock interest which can supply the world with sound beef, and a general infection of the continent, and continuous embargo on the foreign trade. Repressive measures adopted in Pennsylvania are as follows: Mr. Thomas J. Edge, Secretary of the Pennsylvania State Board of Agriculture, after citing the history of the disease in Europe and in this country, and alluding to its long presence in Pennsylvania in a malignant and destructive form, states that finally, but not until after the farmers of the State had sustained heavy losses, a meeting of the dairymen of Delaware, Montgomery, and adjoining counties was called. This meeting was held in Philadelphia soon after and before its adjournment a committee was appointed to wait upon the secretary of the board of agriculture and urge the importance of legislative action. The veterinary surgeon of the board, in company with this committee visited herds supposed to be infected. Surgeons who had had years of experience with the disease in Europe and elsewhere were also called in; *post mortem* examinations were made, and the existence of the malady established beyond a doubt. The legislature being in session, the secretary of the board laid all the evidence before the joint committee of agriculture, and, after discussion and mature consideration, it was decided that the State should adopt a line of precautionary and preventive action, not only for the benefit of its own citizens, but also out of respect to the action of adjoining States. A sub-committee was, therefore appointed to consult with the governor and, if deemed expedient, they were instructed to draft an act providing for the suppression of the disease. After consultation, the following resolution was offered and adopted by both branches of the legislature:

> Whereas, The States of New York and New Jersey, by recently enacted laws to prevent the dissemination among live stock of the disease known as pleuro-pneumonia, now invite this State, by a concert of action, to assist them to eradicate this contagion: Therefore, Resolved by the Senate (if the House of Representatives concur), that the governor be, and he is hereby, authorized to take such preliminary action as may be necessary to prevent its further spread.

This resolution was approved by the governor March 27, 1879. At the same time, an act previously adopted by the committee was introduced, which, after amendment, passed both branches of the legislature. The law of New York, approved by Gov. Hoyt, May 1, 1879, and entitled, an act to prevent the spread of contagious or infectious pleuro-pneumonia among the cattle in this State, is as follows:

> Sec. 1. Be it enacted, etc., That whenever it shall be brought to the notice of the governor of this State that the disease known as contagious or infectious pleuro-pneumonia exists among the cattle in any of the counties in this State, it shall be his duty to take measures to promptly suppress the disease and prevent it from spreading.
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> Sec. 2. That for such purpose the governor shall have power, and he is hereby authorized, to issue his proclamation, stating that the said infectious or contagious disease exists in any county or counties of the State, and warning all persons to seclude all animals in their possession that are affected with such disease, or have been exposed to the infection or contagion thereof, and ordering all persons to take such precautions against the spreading of such disease as the nature thereof may, in his judgment, render necessary or expedient; to order that any premises, farm, or farms where such disease exists or has existed be put in quarantine, so that no domestic animal be removed from said places so quarantined, and to prescribe such regulations as he may judge necessary or expedient to prevent infection or contagion being communicated in any way from the places so quarantined; to call upon all sheriffs and deputy sheriffs to carry out and enforce the provisions of such proclamations, orders, and regulations, and it shall be the duty of all the sheriffs and deputy sheriffs to obey and observe all orders and instructions which they may receive from the governor in the premises; to employ such and so many medical and veterinary practitioners and such other persons as he may, from time to time, deem necessary to assist him in performing his duty as set forth in the first section of this act, and to fix their compensation; to order all or any animals coming into the State to be detained at any place or places for the purpose of inspection and examination; to prescribe regulations for the destruction of animals affected with the said infectious or contagious disease, and for the proper disposition of their hides and carcases, and of all objects which might convey infection or contagion (provided that no animals shall be destroyed unless first examined by a medical or veterinary practitioner in the employ of the governor aforesaid); to prescribe regulations for the disinfection of all premises, buildings, and railway-cars, and of objects from or by which infection or contagion may take place or be conveyed; to alter and modify, from time to time, as he may deem expedient, the terms of all such proclamations, orders and regulations, and to cancel or withdraw the same at any time.
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> Sec. 3. That all the necessary expenses incurred under the direction, or by authority, of the governor in carrying out the provisions of this act shall be paid by the treasurer, upon the warrant of the auditor-general, on being certified as correct by the governor: Provided, that animals coming from a neighboring State that have passed a veterinary examination in said State, and have been quarantined and discharged, shall not be subject to the provisions of this act.

Under authority of the act before quoted, and based upon the report of the commission, his excellency Governor Hoyt appointed a special agent to take charge of the matter, under a special commission, as follows: It having been ascertained that an infectious and contagious disease of neat cattle, known as pleuro-pneumonia, has been brought into and exists in certain counties of this State, I hereby appoint you as my assistant to carry out the provisions of the acts of 1866 and 1879, for the prevention of the spread of this disease. As such assistant you are hereby authorized—To prohibit the movement of cattle within the infected districts, except on license from yourself, after skilled veterinary examination under your direction. To order all owners of cattle, their agents, employés, or servants, and all veterinary surgeons, to report forthwith to you all cases of disease by them suspected to be contagious; and when such notification is received you are directed to have the case examined, and to cause such animals as are found to be infected with said disease to be quarantined, as also all cattle which have been exposed to the infection or contagion of said disease, or are located in any infected district, but you may, in your discretion, permit such animals to be slaughtered on the premises and the carcases to be disposed of as meat if, upon examination, they shall be found fit for such use. You may prohibit and prevent all persons not employed in the care of cattle therein kept from entering any infected premises. You may likewise prevent all persons so employed in the care of animals from going into stables, yards, or premises where cattle are kept, other than those in which they are employed. You may cause all clothing of persons engaged in the care, slaughtering, or rendering of diseased or exposed animals or in any employment which brings them in contact with such diseased animals, to be disinfected before they leave the premises where such animals are kept. You may prevent the manure, forage, and litter upon infected premises from being removed therefrom; and you may cause such disposition to be made thereof as will, in your judgment, best prevent the spread of the disease. You may cause the buildings, yards, and premises in which the disease exists, or has existed, to be thoroughly disinfected. You are further directed, whenever the slaughter of diseased animals is found necessary, to certify the value of the animal or animals so slaughtered, at the time of slaughter, taking into account their condition and circumstances, and to deliver to their owner or owners, when requested, a duplicate of such certificate. Whenever any owner of such cattle, or his agent or servant, has willfully or knowingly withheld, or allowed to be withheld, notice of the existence of said disease upon his premises, or among his cattle, you will not make such certificate. You are also directed to take such measures as you may deem necessary to disinfect all cars or vehicles or movable articles by which contagion is likely to be transmitted. You will also take such measures as shall insure the registry of cattle introduced into any premises on which said disease has existed, and to keep such cattle under supervision for a period of three months after the removal of the diseased animal and the subsequent disinfection of said premises. You are further authorized and empowered to incur such expenses in carrying out the provisions of the foregoing orders as may, in your judgment, appear necessary, and see to it that all bills for such expenses be transmitted to this department only through yourself, after you have approved the same in writing. [The editor considers it proper to state, in this connection, that the importance of repressive measures for the stamping out of the disease (and the impossibility of doing this, once it is distributed in the West), has caused him to collate largely on the subject of Pleuro-pneumonia]. In relation to preventive treatment, and for disinfection, Dr. Law, in his Veterinary Adviser, recommends the following, as instructions for the stables, etc. For stables instructions may embrace what follows: 1. Remove all litter, manure, feed and fodder, from the stables; scrape the walls and floor; wash them if necessary, remove all rotten wood.—2. For buildings take chloride of lime one-half lb., crude carbolic acid four oz., and water one gallon; add freshly-burned quicklime till thick enough to make a good whitewash; whitewash with this the whole roof, walls, floors, posts, mangers, drains, and other fixtures in the cow stables.—3. Wash so as to thoroughly cleanse all pails, buckets, stools, forks, shovels, brooms, and other movable articles used in the buildings, then wet them all over with a solution of carbolic acid one-half lb., water one gallon.—4. When the empty building has been cleansed and disinfected as above, close the doors and windows, place in the center of the building a metallic dish holding one lb flowers of sulphur; set fire to this and let the cow shed stand closed and filled with the fumes for at least two hours. The above should suffice for a close stable capable of holding twelve cows. For larger or very open buildings more will be required.—5. The manure from a stable where sick cattle have been kept must be turned over and mixed with quicklime, two bushels to every load; then hauled by horses to fields to which no cattle have access, and at once plowed under by horses.—6. The pits, where the manure has been, must be cleansed and washed with the disinfectant fluid as for buildings, (see 2).—7. The surviving herd should be shut up in a close building for half an hour once or twice a day, and made to breathe the fumes of burning sulphur. Close doors and windows, place a piece of paper on a clean shovel, lay a few pinches of flowers of sulphur upon it, and set it on fire, adding more sulphur, pinch by pinch, as long as the cattle can stand it without coughing. Continue for a month.—8. Give two drachms powdered copperas, green vitriol, daily to each cow in meal or grains; or, divide one pound copperas into fifty powders, and give one daily to each adult animal.—9. Do not use for the surviving cattle any feed, fodder nor litter that has been in the same stable with the sick. They may safely be used for horses and sheep. In certain cases further measures are needed, as removal of the flooring and soil beneath, or even the burning of the entire structure. Drains must also be cleansed.

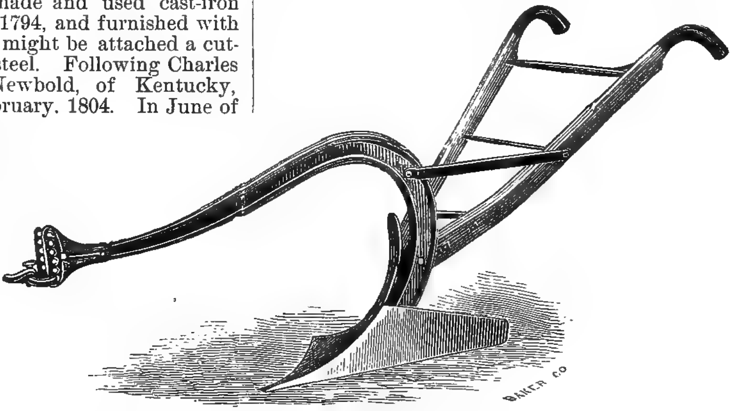
PLICIPENNATES, PLICIPENNES. Neuropterous insects, the inferior wings of many of which are larger than the upper pair, and are folded lengthwise, as the caddis flies.

PLINTH. The lowest form or member of the base of a column, of a square figure and small height.

PLIOCENE. The uppermost portion of the tertiary formation, containing recent fossils, for the most part.

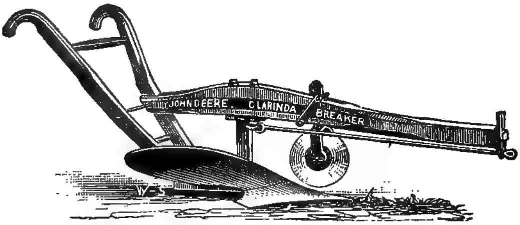
PLOTTING. In surveying, laying down on paper the angles and lines measured to calculate the contents of a given tract; it is done with a protracter or plotting scale.

PLOW. That the plow is the most important implement of tillage, is beyond question. Notwithstanding that we have historical evidence in the Book of Job (probably the most ancient of biblical writings) that the plow was used in his day, and through successive generations and centuries, evidence of its use until we come down to the time of the enlightened Grecian and Roman periods, the crude implement of Abraham, undoubtedly of Egyptian, if not of Chinese origin, was but little improved. An implement originally a fire hardened, pointed share, with a handle and beam for draft. In the article Agriculture will be found cuts of these most ancient implements. Notwithstanding the great antiquity of the plow, but little real improvement was made over the form of the Roman plow until within the last two hundred years, and like the history of all great inventions, the last forty years have witnessed the greatest practical improvement, in ease of draft, certainty in turning correct furrows, according to the nature of the soil; in deep tillage and the various conditions desired in culture, and, most important of all, the certainty of a surface to the metallic parts that shall scour and retain their polish even in the most adhesive soils, some of which, in the West, long baffled the practical science of our best inventors East and West. To show something of the state of plows and plowing in England in the last century, Adam Dickson, in his voluminous work on agriculture, in the early part of the century, speaking of the plows of the ancients, says: It is probable that I shall be considered as very partial to the ancients, if I do not allow the moderns to excel them in the construction of their plows. We are not, indeed, so well acquainted with the ancient plows as to make a just comparison. I shall only observe, that from the few passages in the rustic authors concerning them, it appears that the ancients had all the different kinds of plows that we have now in Europe, though not perhaps so exactly constructed. They had plows without mold-boards and plows with mold-boards; they had plows with coulters and plows without coulters; they had plows with wheels and plows without wheels; they had broad-pointed shares and narrow-pointed shares; they even had what I have not yet seen among the moderns, shares not only with sharp sides and points, but also with high raised cutting tops. Were we well acquainted with the construction of all these, perhaps it would be found that the improvements made by the moderns in this implement are not great as many persons are apt to imagine. While Mr. Dickson probably estimated the skill of the ancient plowmakers from the classical stand point of a scholar, he was certainly correct in a sense as compared with the plows in common use, just as we to-day, while every neighborhood contains plows adapted to every variety of work, nevertheless see the majority of small farmers using one plow for all work, and that perhaps not of the best pattern. Yet in England in Mr. Dickson's time, there were, it is probable, plows far superior to any the ancients ever used; for it is not to be supposed they would depict their inferior implements and leave unpictured the superior ones. So far as we of the present day are informed the plows of the ancients, and also of the moderns, for the first thousand years after Christ, and indeed up to nearly the eighteenth century, were of the rudest description, hardly two alike. The beams cumbrous, and, as were the handles, hewed from the branches of trees, the mold-boards and landsides and the shares even of wood, simply strapped and pointed with iron at the principal wearing points. Indeed we have ourselves seen within the last forty years, and have used for breaking prairie in Cook county, Ill., a plow but little better than this. The celebrated Daniel Webster plow, exhibited at our Centennial Exposition at Philadelphia, and which he helped to make and used, was mostly of wood, an uncouth, cumbrous implement requiring the force of several yokes of oxen to move. This plow might as well have left the impression of the improved plow of that day. It was made for a special purpose, to work among grubs and stones, and undoubtedly performed its work tolerably well. To-day, we have plows that with three horses will do more and better work than did this Leviathan of plows drawn by five or six yokes of oxen. As showing the improvements in progress in England, during the latter part of the eighteenth century, and the development of the draft rod, Small's chain plow was a notable improvement. The plow, as improved by Small, has since become celebrated by subsequent improvements, as the East Lothian plow. Taking up now the history of plows in America, Mr. A. B. Allen, in the Report of the New York State Agricultural Society for 1856, describes the plowmaker's art, in the early part of the century, in the United States, as follows: A winding tree was cut down, and a mold-board hewed from it, with the grain of the timber running so nearly along its shape as it could well be obtained. On to this mold-board, to prevent its wearing out too rapidly, were nailed the blade of an old hoe, thin straps of iron, or worn-out horse shoes. The land side was of wood, its base and sides shod with thin plates of iron. The share was of iron, with a hardened steel point. The coulter was tolerably well made of iron, steel edged, and locked into the share nearly as it does in the improved lock coulter plow of the present day. The beam was usually a straight stick. The handles, like the mold-board, split from the crooked trunk of a tree, or as often cut from its branches; the crooked roots of the white ash were the most favorite timber for plow handles in the Northern States. The beam was set at any pitch that fancy might dictate, with the handles fastened on almost at right angles with it, leaving the plowman little control over his implement, which did its work in a very slow and imperfect manner. Curious, is is not, that the same idea prevailed among the primitive American husbandmen, in the year 1800, that instigated the primitive husbandmen of 3,000 years previous, a crotched limb, natural crooks, roughly hewed, and the addition of bits of iron roughly fastened to the wearing points. To the scientific mind of Jefferson are we indebted for the first demonstration of the true principles upon which the plow should be constructed. Traveling in France and Germany in the year 1788, his spirit of observation led him frequently to alight and examine the working implements of the farmers there. Surprised at the uncouth forms of their plows and harness, at Nancy, the capital of ancient Lorraine, he made the following entry in his journal: Oxen plow here with collars and hames. The awkward figure of their mold-boards leads one to consider what should be its form. The offices of the mold-board are to receive the sod after the share has cut under it, to raise it gradually and to reverse it. The fore end of it should, therefore, be horizontal, to enter under the sod, and the hind end perpendicular, to throw it over; the intermediate surface changing gradually from the horizontal to the perpendicular. It should be as wide as the furrow, and of a length suited to the construction of the plow. Returning home, when secretary of state, under Washington's Administration, he consulted the celebrated David Rittenhouse, as to whether his plan was founded upon correct mathematical principles. After a careful examination it was decided to be demonstrated. In 1793, this theory of Jefferson's was reduced to practice. Some years after, the discovery of Jefferson was contested by William Amas. This was in 1808. Mr. Jefferson presented his ideas to the French Academy, and to the English Board of Agriculture, who having ample means of testing any imposture, acknowledged the invention of Jefferson, and he was subsequently elected an honorary member of the board. Jefferson, who experimented with the mold-board of the plow only, states his conclusions to be that the mold-board of the plow ought not only to be the continuation of the shield of the share beginning at its posterior edge, but it must also be in the same plane. Its first function is to receive horizontally from the sock the earth, to raise it to the height proper for being turned over; to present, in its passage, the least possible resistance, and consequently to require the minimum of moving power. Were its function confined to this, the wedge would present, no doubt, the most proper form for practice; but the object is also to turn over the sod of earth. One of the edges of the mold-board ought then to have no elevation, to avoid a useless wasting of force; the other edge ought, on the contrary, to go on ascending until it has passed the perpendicular, in order that the sod may be inverted by its own weight; and the inclination of the mold-board must increase gradually from the moment that it has received the sod. In this second function the mold-board then acts like a wedge situated in an oblique direction, or ascending, the point of which recedes horizontally on the earth, while the other end continues to rise till it passes the perpendicular. Or, to consider it under another point of view, let us place on the ground a wedge, the breadth of which is equal to that of the share of the plow, and which in length is equal to the share from the wing to the posterior extremity, and the height of the heel is equal to the height of the rear of the share above the sole; draw a diagonal on the upper surface from the left angle of the point to the angle on the right of the upper part of the heel; slope the face by making it bevel from the diagonal to the right edge which touches the earth; this half will be the most proper form for discharging the required functions, namely, to remove and turn over gradually the sod, and with the least force possible. If the left of the diagonal be sloped in the same manner, that is to say, if we suppose a straight line, the length of which is equal at least to that of the wedge, applied on the face already sloped, and moving backwards parallel to itself and to the two ends of the wedge, at the same time that its lower end keeps itself always along the lower end of the right face, the result will be a curved surface, the essential character of which is, that it will be a combination of the principle of the wedge, considered according to two directions, which cross each other, and will give what we require, a mold-board presenting the least possible resistance. This mold-board, besides, is attended with the valuable advantage that it can be made by any common workman by a process so exact that its form will not vary the thickness of a hair. One of the great faults of this essential part of the plow is the want of precision, because workmen having no other guide than the eye, scarcely two of them were constructed alike. Following Jefferson, Charles Newbold, of New Jersey, obtained a patent in 1797, said to be the first cast plow ever made in America. The idea of Newbold, as stated in his specifications, was to cast the plow, except the handles and beam, in one piece, consisting of a bar, sheath, and mold-plate, the sheath serving also for a coulter, and the mold-board serving also for the share. Previous to this cast-iron plow shares were used. Col. John Smith, of St. George's Manor, Suffolk county, N. Y., had made and used cast-iron plow shares as early as 1794, and furnished with a false edge, to which might be attached a cutting edge of iron or steel. Following Charles Newbold, Hezekiah Newbold, of Kentucky, patented a plow in February, 1804. In June of the same year, John Denver patented another. In 1807 a patent was granted to David Peacock for a plow, and this ended in a lawsuit, as an infringement on the Newbold patent. The special new feature was the lock coulter. The patents as recorded, succeeding are as follows, so far as is known: Hezekiah Harris, Ky., patent in 1808, and in the same year a patent to Richard B. Chenoweth, of Maryland. Then follows John Klay, of the same State, January 11, 1812. On the same day a patent was granted to Roswell Tousley, subsequently a partner of Jethro Wood, who took out his first patent in 1814, but to which he seems not to have attached much value. Then follows Mathew Patrick, New York, patent January 2, 1813; John Seltz, February 8, 1813; Horace Pease, New York, August 28, 1813. In 1814, besides the patent to Jethro Wood, there were patents granted to John Swaa, New York, J. Morgan and J. B. Harris; and to David Peacock, of New York, in 1817. In 1818, Gideon Davis is recorded as taking a patent for the first plow built on mathematical principles since the days of Jefferson. This plow was really a step ahead, as will be seen by the following extract from his specifications, in which he says: The great desideratum to be attained in the box share or shallow plow, is that it be so shaped and constructed as to detach the furrow slice from the solid ground, raise it up and turn it over, in the neatest and most uniform and effectual manner, with the least possible labor, both to the plowman and the team, combining at the same time the advantages of being simple in its structure, strong and durable, easy to keep in repair, and cheap. The mode of using, it is desirable, should be such as will cause the least trouble and inconvenience to the plowman. With a view to combine, as far as practicable, these various objects, he began by making the mold-board, land side, and standard, (or width for the beam to rest on,) all of cast-iron, and in a solid piece; this is done in the manner that Charles Newbold, of New Jersey, made his improved plow, patented in the year 1797, but with several alterations and improvements hereinafter particularly specified. Of the shape of the molding part, or what is commonly called the face of the mold-board, the general principle heretofore concurred in by all scientific men who have turned their attention to this subject, is that the furrow slice is detached from the solid ground, at a straight line, parallel to the surface, at such depth as may be required, that it should be raised up and turned over, so as to retain, as far as possible, the same flat shape. In order to accommodate the face of the mold-board to this idea of raising the furrow slice up and turning it over, it has been so constructed as to form straight lines lengthwise, either horizontal or a little inclined, and also to correspond with another set of straight lines at right angles with the land side, or nearly so, commencing at the point touching the edge of the share and lower edge of the mold-board These last mentioned straight lines, as they recede from the point of the commencement, gradually change from a horizontal or a perpendicular direction, and even pass beyond the perpendicular so far as to give the proper over-jet behind. It had been thought that mold-boards so constructed would fit and embrace every part of the furrow slice in the operation of turning it over, not observing that the furrow slice must necessarily assume a convex form on the under side during the operation by which it is raised up and turned over. The truth is, however, that in raising and turning over the furrow slice it always acquires a convex form on the under side, or else it is broken into pieces and thrown over; as might therefore be anticipated, it will be found that all those

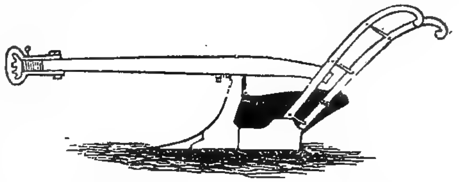


DEEP TILLER, STEEL BEAM.

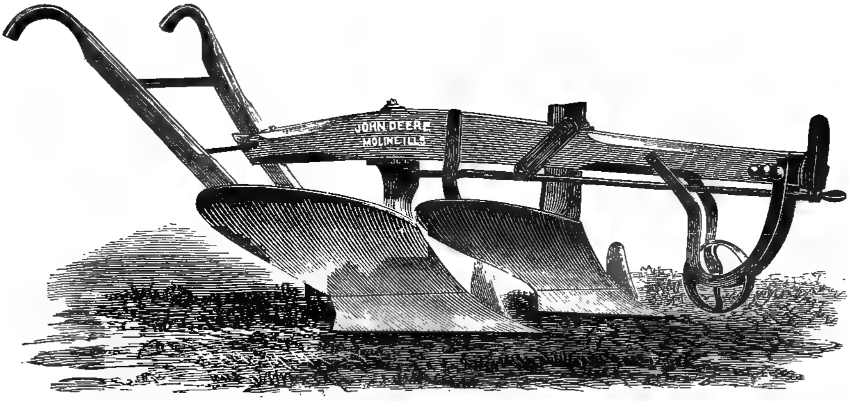
mold-boards which are constructed on this principle wear through, in the operation of plowing, about midway, whilst the upper and lower edges are scarcely rubbed. It also necessarily results that plows of this description work hard and also are of heavy draft, because the mold-board, not being adapted to the convex form which the furrow slice is disposed to assume, lifts the furrow slice at a single point, and that in the middle, instead of being equally applied throughout the entire operation. In order to meet and remedy the inconveniences arising from this form of structure, the mold-board was formed into a different shape, and instead of working the molding part or face of the mold-board to straight lines, the improvement was to work it to circular or sphere lines. Pickering, Hitchcock, Nourse, McCormick, and Knox were also careful laborers subsequently in the same field of invention, and extending the time to the year 1850. About the time of the Knox patent, Joshua Gibbs, of Canton, O., while plowing, observed the unequal wear on the plowshare. Selecting a block of wood, he fashioned it as nearly as possible to his idea of a correct mold-board, attached it to a beam and handles, plowed with it stopping now and then to hew away with his adze that part of the mold-board which he found scoured most by the soil. By successive trials, he obtained a wooden mold-board all parts of which presented equal resistance to the soil in its forward movement. August 15th, 1854, he obtained a patent for his mold-board. He thus describes it in his specifications: The working surface of the mold-board consists of about one-fourth of the interior surface of a hollow cylinder. If the plow is intended to turn a surface six inches wide, a mold-board made from a cylinder with about a twelve-inch bore is desirable; but if it is intended to turn a furrow twelve inches wide, the mold-board should be made from a cylinder with a bore of about twenty-four inches; as these plows have been found to work best when they turn a furrow about as wide as the radius of the bore of the cylinder from which the mold-board was made. It has been found from experience that these plows work best when the length of the mold-board is from one and a half to twice the diameter of the bore of the cylinder from which the mold-board is made. The advantages claimed were: 1. The plow draws easier. 2. It raises the furrow from the point and share more generally, naturally, and easily, turns and lays the furrow more uniform, smooth, and even, than any other mold-board, and leaves the trench wider in proportion to the width of the plow, and consequently the rear of the plow need not be set so wide as when a different mold-board is used. 3. It breaks the sward or furrow far less than any other. 4. The mold board, being more arched is stiffer and stronger than others of the same size and weight; and, making the working surface of the mold-board in the form of a section of a hollow cylinder; the center or axis of the cylinder being parallel or nearly parallel horizontally to the base of the mold-board, substantially as described. We now return to Jethro Wood, whose name will always be remembered for his improvements in the manner of casting and fitting the working parts of plows. In 1819, his ideas were matured on the subject of plows, and from the views then set forth in his specifications for the patent then issued to him, he never deviated. The illustration we give, an accurate copy deposited by him in the Patent Office, will explain itself by means of the lines. The figure of the mold-board being, he says, as observed from the furrow side, a sort of irregular pentagon, or fine sided plane, though curved and inclined in a peculiar manner. While Mr. Wood did not add materially to the working value of the plow, he did perform this inestimable service. Before he perfected his inventions, plows were huge, uncouth, and clumsy, costly in the repairs needed, and did not perform good work. Mr. Wood did lighten the weight of the plow, and made a better plow, that cost less money than the others. Coming to the year 1840, the Messrs. Ruggles, Nourse, and Mason, commenced improving the cast plow, through the patient experiments of Mr. Nourse. In 1842, the Eagle plow No. 2, was produced. In 1845, Gov. Holbrook, of Vermont, interested himself with Mr. Nourse, devising a system by which the lines of the mold-board, if the longitudinal ones are carefully laid on the pattern, the vertical ones will be certain to be correct. Since 1850, the great point in improving plows has been rather in the matter of detail, in adapting them to every variety of soil, and every purpose imaginable, and also to the invention of plow fixtures of various kinds. It is said that plows of over 1,200 different patterns are now made and adapted to every conceivable work, including trench plowing, subsoiling, ditching, road making, and excavating great ditches and canals, by means of attachments to plows of peculiar shapes. (See article Road-making.) The East, years ago, had their plows well adapted to the work required of them. In the average soil there the cast-iron plow would scour perfectly. The Nourse, the Holbrook, the Colins, cast cast-steel and other steel plows, were quite satisfactory in more adhesive soils. With the settlement of the great West, and the failure of Eastern plows to scour in peculiar humus prairie soils, wonderfully light and porous, and yet with scarcely any apparent grit, great difficulty was experienced. This early led many inventive minds, even forty years ago, toward devising a mold-board that would cast



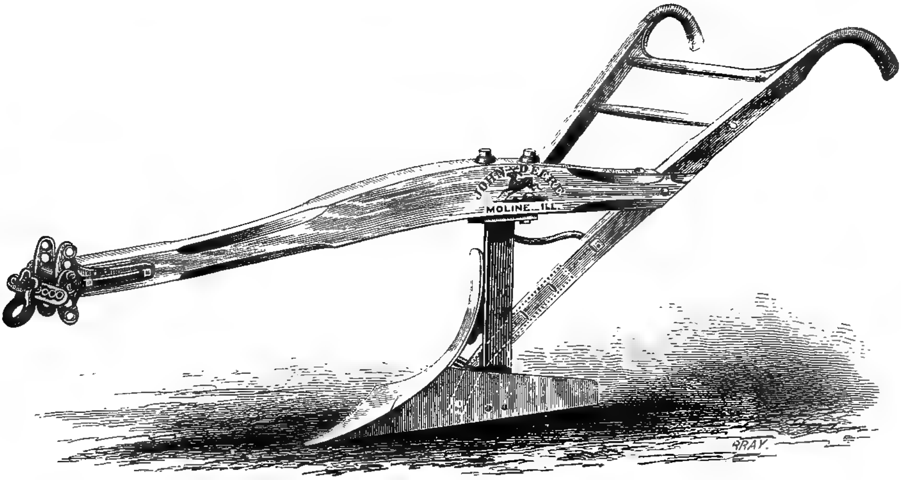
BREAKER, ROLLING COULTER.



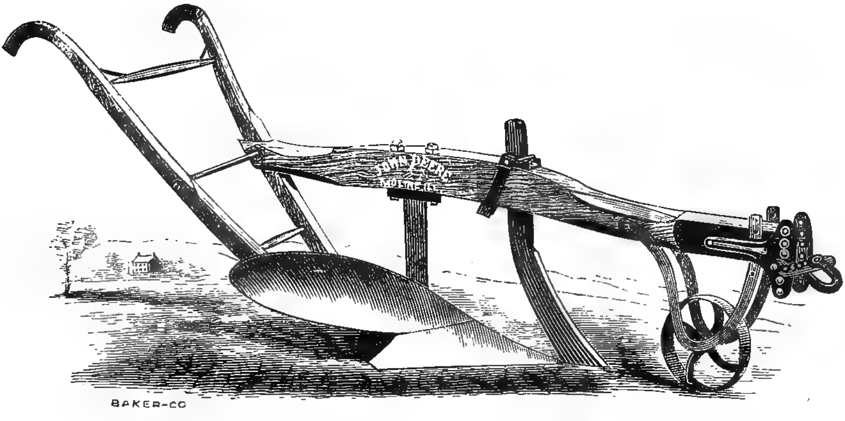
THE FIRST CAST-IRON PLOW.



MICHIGAN DOUBLE PLOW.

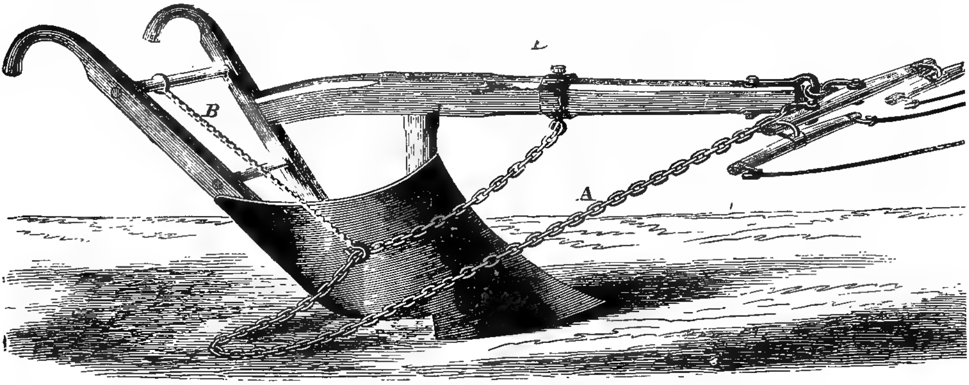


DEEP TILLER, WOODEN BEAM.

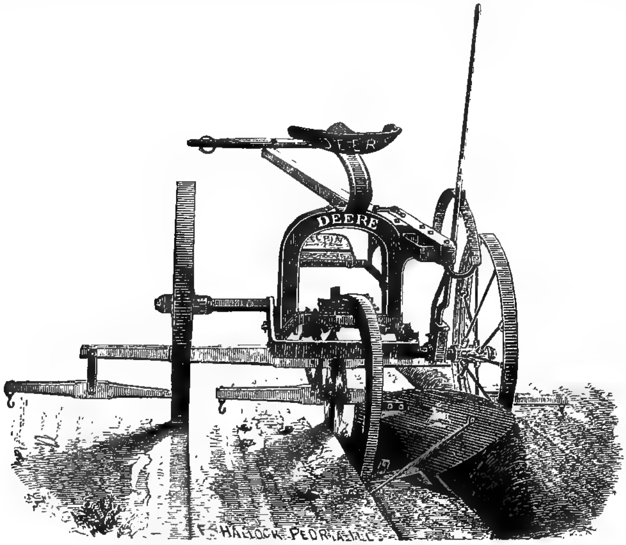


PRAIRIE BREAKER, KNIFE COULTER.

off the peculiar and sticky muck of many Western prairie soils. Mr. John Deere, the elder, of Moline, experimented with steel saw plates and realized a fair measure of success, which later resulted in the building of plows entirely of fine or what is now known as plow steel, at least so far as the surfaces which come in contact with the earth is concerned. Now these highly polished steel plows are made for every variety of soil, and for every variety of work, leaving only one thing more to be desired, an implement that shall perform the labor, at a less expenditure of draft, and pulverize the soil in a better manner than the plow. This has been successfully accomplished, by means of rotary implements, when simply the stirring of the soil is necessary. What the future has in store in this direction remains for future inventors to solve.



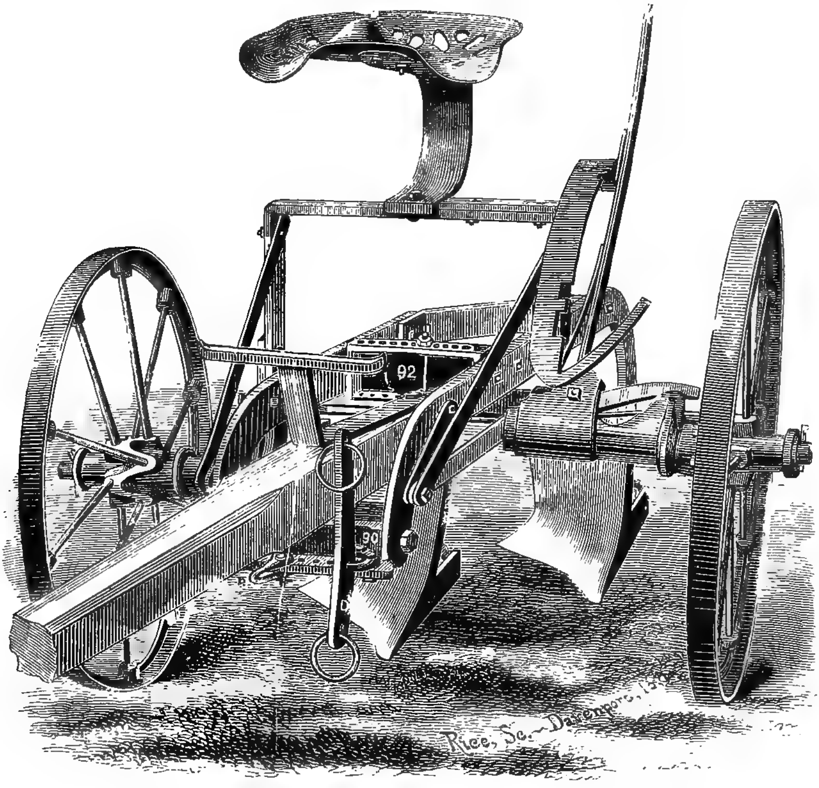
CHAIN FOR COVERING UNDER WEEDS.



RIDING PLOW.

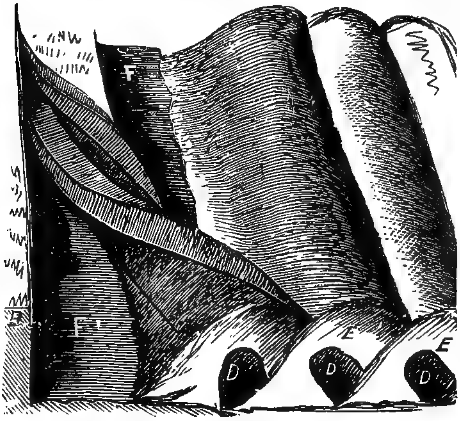
As illustrating the various forms of plows we have interspersed a series of cuts of plows as designed for various tillage, and which will sufficiently explain themselves. Within the last few years an important modification of the handling of plows has been inaugurated, which while not materially lightening the draft, enables the cut of the plow to be widened, as it certainly does cut a more equable furrow, than the swing plow, or in lieu of this, allows two plows to be ganged together, either plowing two furrows along side the other, or throwing one furrow directly on the other. The idea will readily be caught from the engraving of a three-horse plow turning a sixteen inch furrow. This class of plows are increasing in popularity year by year, the only objection to them being the increased cost over that of the ordinary swing plow. In the article Plowing will be given much additional matter in reference to plows and plowing, with cuts illustrating, both horse and steam plowing. (See also articles Cultivators and Stirring the Soil.)

PLOWING. In plowing, the object sought is to turn the soil in such manner as may adapt it to be most easily brought to that state best required for a crop, under the various conditions of prairie sod, second sod, green sward, grubby timber land, weedy fields, stubble; or, land, fallow or otherwise, but which may be covered with a green crop more or less heavy, and which is required to be turned under in such a way as to completely cover the trash, thus causing it to be freely brought into a state of decomposition. These states may now be all fully and perfectly accomplished by some one of the many plows made East and West, and specifically adapted to the end in view. Eastern made plows doing fully as well in Eastern soils as do Western made plows in the peculiar soils of our prairie States. Some years since the State Agricultural Society of New York offered handsome premiums for plows doing the best work in a variety of soils, and combinations, including turf, stubble, deep, trench, subsoil and other plowing. The Hon. J. Stanton Gould was chairman of the committee on plows and plowing, which committee included others of the most eminent practical men in the State. The most able, exhaustive, and elaborate report of this committee covers the whole ground of plows and plowing, and from the interest and importance of the subject, we extract portions pertinent to this article, which will be well worth the study of all, not excepting that large class who call themselves good plowmen; for it must be confessed that very few who consider themselves entitled to the best farm wages going, not only have never studied the rationale of plowing, but have really given but little attention as to whether the plow was only doing medium or strictly good work. Another class, never keep their furrows straight, and in fact can not drive a somewhat wild team straight across a forty-acre field, and of course can not make their furrows come out equal at the close of the land. In the extracts we give we shall exclude everything pertaining to the scientific elucidation of the subject. for, at this day plows are made for every variety of work so that all that the individual has to do is to state to the plow-making firm just what is expected to be performed and, the proper plow will be selected and sent out of the variety of materials in store. That is it should be stated whether flat or lap furrows are to be laid in sod, or whether the plow is intended for stirring the soil, turning under trash, for shallow plowing or deep tillage, and also, whether for skim and trench plowing, one plow following another. To illustrate: The plow for prairie sod, when the slice turned is to be as thin as possible is of an entirely different form from that where a deep furrow is to be turned; deep furrows being lapped one on another, as in plowing clover, and other meadow sward. Again, the curve of the mold-board must be different, when one strip of sod is to fit in closely along another, furrow for furrow. So again in trench plowing with the Michigan double plow, the thin skim furrow is often rolled up forming a scroll, or spiral of sod under the soil thrown on top. (See article Plow for illustrations of plows.) In plowing under trash various devices are used, called weed hooks, coulter cleaners, etc. The most common plan is to hitch a chain to the plow the loop to drag in the furrow as shown on page 744. Difficulty is sometimes experienced in getting the chain to work properly, this, however, can readily be arranged to suit the particular circumstances. Neither the chain nor weed hook, however, will work unless the crop to be turned under is of considerable length so the implement can guide the tops in the proper direction to be covered under. In trench plowing especially where it is deep, the lower slice, which covers the skim furrow, must always be more or less crowded or pushed up, so the work will be as shown in the cut on next page; D, showing the position of the under slice, E, the covering furrow slice and F, F, the furrows; the curve of the furrow slices are shown between E, E, and D, D, D. The Michigan double plow is now but little used, since riding plows have come into use. The two plows are now attached to one beam as shown in the cut, double or trench plow.



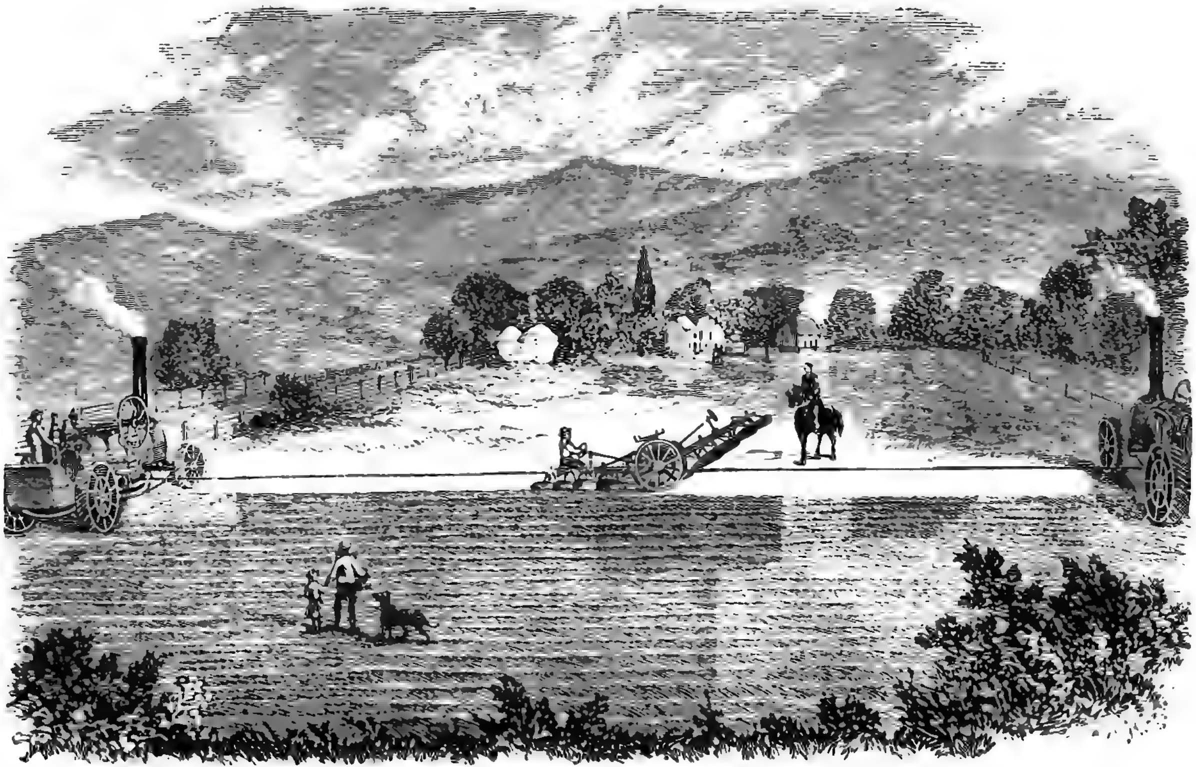
DOUBLE OR TRENCH PLOW.

These are now made of a draft so light that four horses work them easily. With the Michigan double plow the draft is very much more severe. Plowing by steam has never been economically accomplished in the United States. It is not by any means that the plowing is not superior of its kind, especially when extra deep plowing is required, as has been attested in the sugar fields of Louisiana, and in various trials in the West, by the various traction engines that have been invented. The difficulty with all traction engines has been, that on soft soil, they would mire themselves, or else the sticky nature of the soil would at times clog them. Another difficulty is the trouble in obtaining skilled engineers in the country, and the expense of hauling fuel and water to feed the engines. Again if they get out of repair, ordinary country blacksmiths can not repair them.

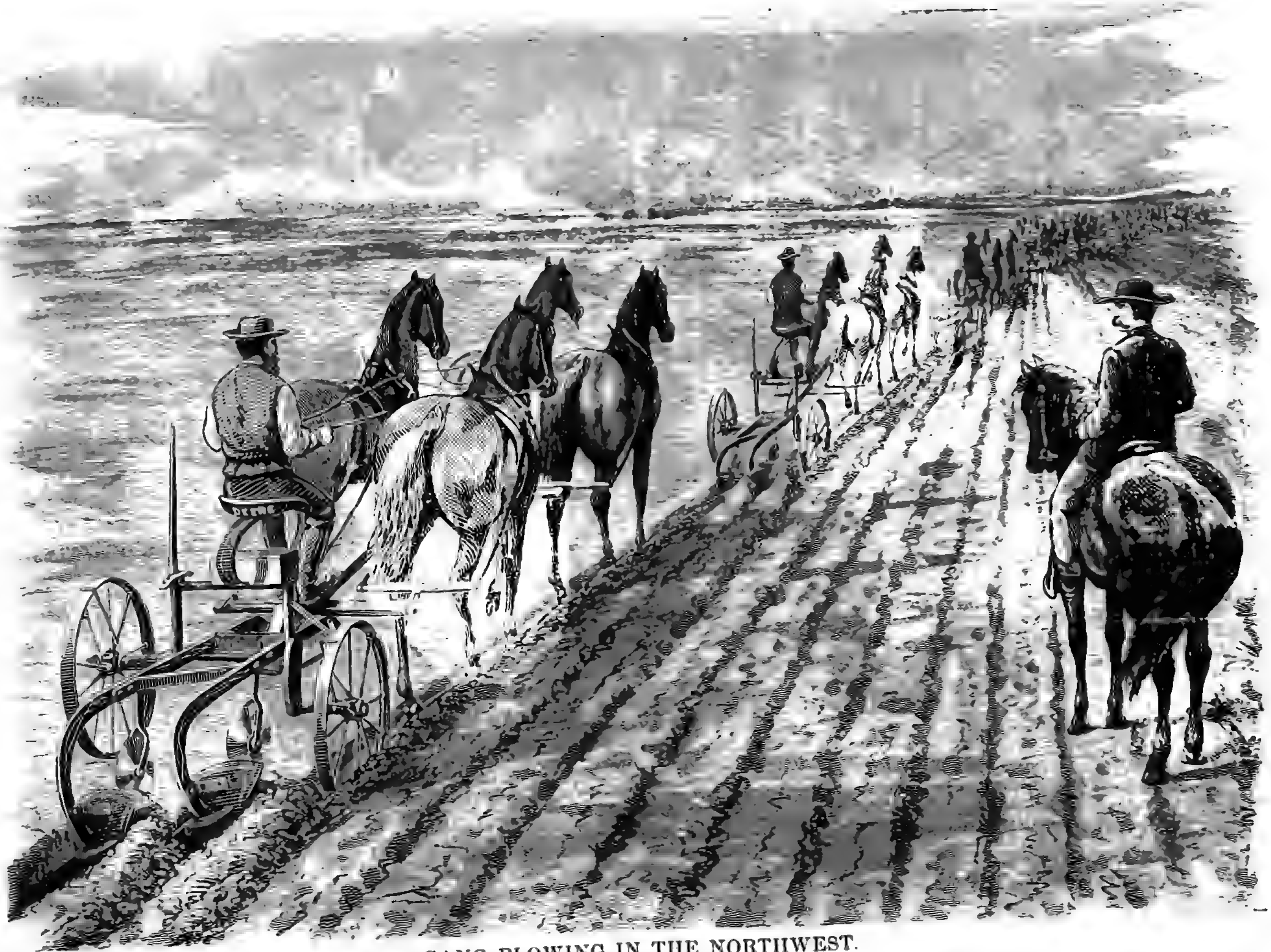


TRENCH PLOWING.

On the other hand our two-furrow gang plows do operate successfully and evenly, and are much employed on large farms and upon the great wheat fields of the far Northwest. As illustrating steam gang-plowing as against horse gang-plowing, we give two illustrations, showing the English system of steam plowing, and the American system of horse plowing. The reader will readily see why, in ordinary plowing, the American system is the cheapest. The writer has superintended the working of twenty single swing plows, turning twenty furrows, with twenty men and sixty horses, or three horses to each plow, the plows cutting fourteen inches each. The daily average work of the gang, on lands running across a section, of 640 acres, was one-third of an acre per hour, or three acres per team per day, or an aggregate of sixty acres a day. Few plowmen understand the necessity of a nice adjustment of the plow to the work in hand; bolts are lost, nuts get loose, and the plow is still driven, they being content with such work as it will do. If it be a plow in which a coulter is used, feeble attempts are made to remedy the evil by giving the coulter a twist out of line, or altering the set of the clevis, when the real fault lies in a proper adjustment of the beam. A plow, when properly adjusted, in a soil free from roots and stones, will swim along almost without the aid of the plowman. The same plow not properly adjusted, can scarcely be made to work at all. Again, the good plowman will feel at once the slightest deviation in a plow from the true course, and a slight change keeps the plow in its proper course. So we see that lightness and delicacy of touch is by no means a useless accomplishment in the plowman. It is of as much consequence as that he have a correct eye, that the furrow slices be straight, and of uniform width and thickness, and turned so the plowed surface shall be disintegrated and level, or left rough as occasion may require. Yet, how many plowmen really pay attention to these details? How many, in fact, know really good plowing from indifferent plowing. It is to be regretted that competitive trials by expert plowmen should have gone out of fashion. They were of great value as object lessons to the masses who attended. At least the master of the farm might here compare results and get many valuable lessons to be communicated to the farm hands, and knowing just what good work consisted in, it might be insisted that the work should be so done. For the object in all matches of this kind should be to award the premium to the plowman leaving the best surface finish, with proper pulverization, according to the width and depth of furrow. As an aid in estimating the work to be done by a plow we give an elaborate and highly valuable table on page 749, showing the distance traveled by the team in plowing an acre, in connection with the width of furrow slice in inches and the extent plowed per day, the team traveling respectively eighteen and sixteen miles, working nine hours per day. The rationale of plowing may be stated as follows: A soil in a finely pulverized state holds more moisture—hydroscopic water—than when in a solid state. A single experiment will show this. A field plowed in the fall will retain a larger amount of moisture in the spring than if it were left unplowed. Finely pulverized soil when in a dry state takes up moisture equally from the air, and with it large quantities of nitrogen compounds. Thus porous soils, because cool, are constantly condensing water during droughts, and hold the constituents it contains to be taken up by the rootlets, and assimilated by plants. Soils thoroughly underdrained, when allowed to rest, become honey-combed by insects to the water line occupied by the drains, and hence these serve as channels to quickly conduct the rain which falls immediately away. This, however, is not what is wanted, for thus the fertilizing properties in rain water do not come intimately in contact with the soil, and are lost; thus the error into which certain superficial experimenters have been led, in supposing that drained lands would not stand drought. If the surface soil were pulverized to a depth of from six to ten inches or more, the case would be very different. It would then act as a filter, passing the water off more slowly, but still fast enough, and in addition, the elements of fertility would be retained and the whole area of the soil uniformly moistened. Again, underdrained soils liable to become water soaked, become hard and impacted. Insects do not penetrate to any considerable depth, and the soil holds water like a dish, to be slowly evaporated by the sun, rendering it, by this very process, cold, sour, and unfertile. So also tilth and drainage prevents the washing away of fertilizing properties during continued rains;



ENGLISH STEAM PLOWING.



GANG PLOWING IN THE NORTHWEST.

the moisture is absorbed, and passed down through the soil instead of running along the surface, and thence into the nearest stream.

Breadth of furrow-slice or cultivator.	Space traveled in turning an acre.	Extent plowed per day, at the rate of	
Inches.	Miles.	18 miles. Acres.	16 miles. Acres.
7	14⅛	1¼	1⅛
8	12¼	1½	1¼
9	11	1 3-5	1½
10	9 9-10	1 4-5	1 3-5
11	9	2	1¾
12	8¼	2 1-5	1 9-10
13	7½	2⅓	2 1-10
14	7	2½	2¼
15	6½	2¾	2 2-5
16	6 1-6	2 9-10	2 3-5
17	5¾	3 1-10	2¾
18	5½	3¼	2 9-10
19	5¼	3½	3 1-10
20	4 9-10	3 3-5	3¼
21	4 7-10	3 4-5	3⅓
22	4½	4	3½
23	4¼	4 1-5	3 7-10
24	4	4⅓	3 9-10
25	4	4½	4
26	3 4-5	4¾	4 1-5
27	3 3-5	4 9-10	4⅓
28	3½	5⅛	4½
29	3½	5¼	4 3-5
30	3⅓	5¾	4 4-5
31	3 1-5	5	5
32	3 1-10	5 4-5	5¼
33	3	6	5⅓
34	2 9-10	6 1-5	5½
35	2 4-5	6⅓	5 3-5
36	2¾	6½	5 4-5
37	2⅔	6¼	6
38	2 3-5	6 9-10	6⅛
39	2½	7⅛	6⅓
40	2½	7⅓	6½
41	2 2-5	7¾	6¾
42	2⅓	7	6⅔
43	2 3-10	7 4-5	7
44	2	8	7 1-10
45	2 1-5	8 1-6	7¼
46	2 1-6	8⅓	7 2-5
47	2 1-10	8	7 3-5
48	2 1-12	8¾	7¾
49	2	8 9-10	7 9-10
50	2	8 9-10	8 1-10
51	1 9-10	9 1-5	8¼
52	1 9-10	9½	8 2-5
53	1 9-10	9¼	8½
54	1 4-5	9 4-5	8 9-10
55	1 4-5	10	[illegible]
56	1¾	10¼	9
57	1¾	10 2-5	9 1-5
58	1 7-10	10 3-5	9⅓
59	1 7- 0	10¾	9½
60	1 3-5	10 9-10	9 7-10
61	1 3-5	11 1-5	9 4-5
62	1 3-5	11⅓	10
63	1 3-5	11½	10 1-5
64	1½	11 7-10	10⅓
65	1½	11 4-5	10½
66	1½	12	10 3-5
67	1½	12¼	10 4-5
68	1½	12 2-5	11
69	1 2-5	12 3-5	11⅛
70	1 2-5	12¾	11⅓
71	1 2-5	12 9-10	11½
72	1 2-5	13⅛	11 3-5
73	1⅓	13⅓	11 4-5
74	1½	13½	12
75	1⅓	13 3-5	12⅛
76	1 3-10	13 4-5	12¼
77	1 3-10	14	12½
78	1¼	14¼	12 3-5
79	1¼	14 2 5	12¾
80	1¼	14 3-5	12 9-10
81	1 1-5	14¾	13 1-10
82	1 1-5	15	13¼
83	1 1-5	15⅛	13 2-5
84	1 1-6	15⅓	13 3-5

PLOWING THREE ABREAST. The using of four horses in heavy plowing, by attaching one pair before the other, is going out of general use, for the reason that it has been found in practice that three horses or mules working abreast or beside each other, accomplish about as much work, and do it more easily for the team and driver, than can be done by the old-fashioned way of hitching them before each other. Very many farmers, however, do not receive this modern innovation with favor, because they have not learned the proper manner of making the whiffletrees, and adjusting the driving-lines, and the draft of the plow. In plowing with four horses, two abreast, the forward horses, drawing in a nearly horizontal line, exert a large portion of their strength at a disadvantage not only to themselves, but also to the team immediately behind them. The disadvantage in plowing three abreast is that the middle horse is apt to be sweated unduly in hot weather by contact with the outside horses, but the evil is more than counterbalanced by the gain in power. The most simple attachment and the one in most common use is a draw-bar, having its clevis or draft-clip one-third of the way from the end to which the double-trees are to be attached. To the other end a single-tree is attached by a chain long enough to bring it in line with the single-trees attached to the double trees at the other end. The whole should be of such a length as will bring the middle horse immediately in front of the plow-beam. Various patented three-horse trees are before the public, all more or less complicated, but the one here described is simple and within the reach of all. Mules work admirably three abreast, and in their case the draw-bars and the whiffle-trees may be very much shortened, since they will work much closer than horses without danger of overheating. The most simple way of driving them is by means of a single line attached to the outside bits of the near and off horse, tying their heads together at suitable intervals by the bits. This will do if the team and driver are both steady and reliable. But perhaps a better plan is to hitch the team drawing upon the double tree, as is commonly done for two horses. Then pass a check-line from the outside bit of the third horse through the hame-ring, and attach it to the main or driving line of the middle horse. It should be about eight inches longer than the ordinary check or cross rein. Another method is to attach two single lines to the middle horse, having shorter reins from the near and the off horse passing to the same bit, so that each shall bear alike. The near check-lines of the outside horses should then be attached to the near main line of the center horse, and the off or right-hand check of the outside horses should be fastened to the off-side main line of the center horse. Of course, in plowing with three horses or mules abreast, the plow must be so adjusted that the line of draft will be immediately behind the middle horse.

PLUM. The plum delights in a rather compact, well drained, rich, loamy soil. It is one of the most hardy of trees, quite as much so as the apple, and would be generally cultivated were it not for the ravages of the curculio. There has never yet been found any successful means of preventing the ravages of this pest, except jarring the trees, from the time the fruit is the size of a small hazel nut, until it is fully grown, catching the insects on a sheet and killing them. Unfortunately this takes so much time at a very busy season that none but special orchardists will take the trouble. The varieties as recommended by the American Pomological Society, include many. The following do well generally: Coe's Golden Drop; Damson; Lombard Imperial Gage; Jefferson; Smith's Orleans and Washington. Besides those mentioned the following are considerably planted in the Eastern States: Bavay's Green Gage, also known as Reine Claude de Bavay; Duane's Purple; Lawrence's Favorite; McLaughlin; Prince's Yellow Gage; Washington and Yellow Egg, or White Magnum Bonum. In the Western States the Wild Goose is almost universally planted, in every collection. The history of the plum gained from a variety of sources is as follows: The most generally distributed, and longest known species of plum, is the common plum (*Prunus domestica*), coming originally from the Caucasus, and the mountains of Talysch. It is cultivated extensively in Syria, where it has passed into numerous varieties. It reached Italy about the time of Cato, and Pliny speaks of *ingens turba prunorum*, by which he designated the numerous varieties. At the present day the different varieties may be referred to the following kinds: 1. The little cherry-plum, (*Prunus cerasina*). 2. The genuine plum (*Prunus prunaria*), of a little larger size; here belong the damsons. 3. The spilling or egg-plum (*Prunus Armeniaca*), which includes the mirabellas and reine claude, or green-gage plums. 4. The almond plum, (*Prunus amygdalina*). And, finally, 5. the *Prunus Persicaria*. Although the plum has been distributed over the whole of Europe, and extended far to the north, it is little known in eastern Asia, and it is doubtful whether it occurs in northern China. The bullace plum (*Prunus insititia*), which is closely allied to the common plum, is of slight importance. It is found wild on the Caucasus. It is difficult to decide whether it occurs wild, or only run wild in Greece and Southern Europe. This tree has certainly not been derived from the sloe bush. Here also belongs the Bear plum (*Prunus ursina,*) a thorny tree-like shrub, which grows wild everywhere about Mt. Lebanon, the sweet, pleasant fruit of which, the size of our damson, is eaten not only by the bears, but serves as food to the inhabitants of the mountain regions. Among the plums, in the most extended sense, may be mentioned the cultivated cherry (*Prunus cerasus*), and the wild black cherry (*Prunus avium*). The former, growing wild in the mountain forests of Southern Caucasus, was brought to Italy from Cerasunt, in Pontus, succeeding the conquest of Mithridates, seventy-four years before Christ. Another fruit, the size and shape of our plum, the ibametara, or Spanish plum, is obtained from a tree, (*Spondias myrobalanus,*) which grows wild in the forests of Jamaica, and is cultivated in the northern regions of the tropical parts of Brazil. The natives eat the sweetish acid flesh, prepare a sauce, and manufacture drink from it. Another species of the same genus, (*Spondias dulcis,*) is found on the Friendly Islands. The tree is fifty feet high, with a straight trunk, the thickness of a man, and bears clusters of large, oval, golden yellow, stone fruit, like pomegranates, the fleshy putamen of which is sweet and palatable, and reminds one of the pineapple. The *Spondias tuberosa* and *Spondias lutea* in the West Indies, also furnish edible fruit. The Icaco plum (*Chrysobalanus icaco*, L.) is also worthy of mention. This tree-like shrub, with its fruit similar to the damson, grows wild as well as cultivated in the forests along the shores of South America, and on the wet coasts of Carolina. It has been introduced from Africa, where it occurs from Senegal to Congo. The fruit is made into preserves and brought to Europe.

PLUMBAGO. Native carburet of iron; black lead.

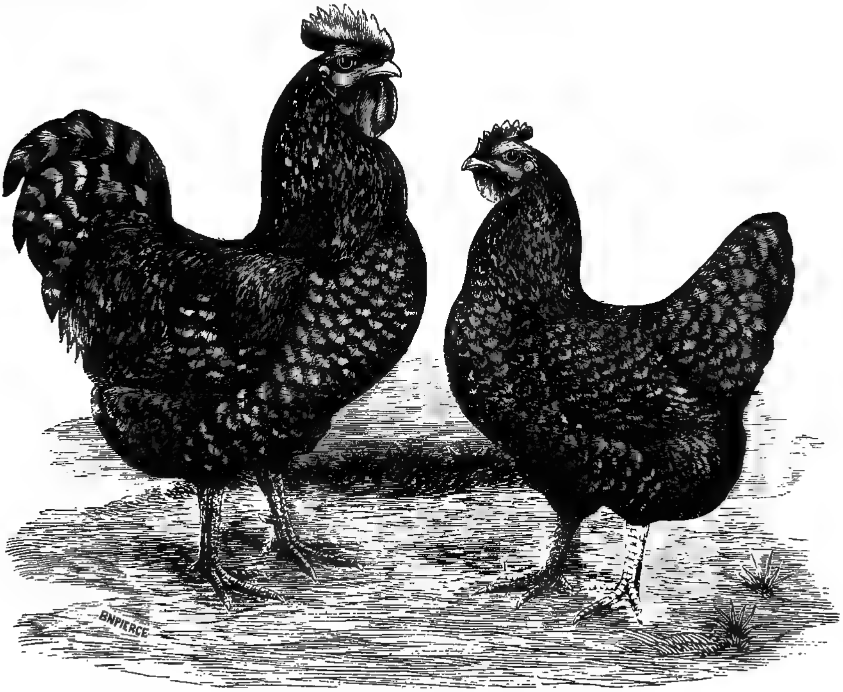
PLUMULA. The leaf-like portion of the embryo.

PLUS. More: marked by the sign +.

PLUTONIC ROCKS. Unstratified crystalline rocks, like granite, porphyry, basalt.

PLUVIAMETER. The rain gauge.

PLYMOUTH ROCK FOWLS. Of late years this breed has come distinctively into notice, and has had many admirers. The original fowls are claimed to have been bred by Dr. J. C. Bennett from a cross of a Cochin-China cockerel with a hen, a cross between a fawn-colored Dorking, the great Malay and the wild Indian fowl, and were first exhibited in Boston in 1849. As might have been expected, as the breeds multiplied, they varied much in form and color, from the blood of the various fowls with which they were imbued, and it was found difficult to fix a uniform character, nevertheless they were large fine birds, the cocks weighing eight to ten pounds, and the pullets six to seven pounds at a year old, and the plumage rich and variegated. At length as the breed became more constant in their characteristics, and ten years ago they were described by Lewis in his Poultry Book as follows: The cocks are usually of a beautiful red or speckled color, and the hens of a darkish brown. Some of the colors thrown by this breed, are not dissimilar to the Dominique fowl. They have very fine flesh, and are fit for the table at an early age. The legs are quite large, and usually blue or green, but occasionally yellow or even white, and frequently have five toes upon each foot. Some of the varieties have the legs occasionally slightly feathered. They have large single rose-colored or red combs and wattles; cheeks are rather large; tails stout and short, and very small wings in proportion to their bodies. The chicks are quite hardy and have the same uniformity in size and appearance as those of the pure bloods of primary races. The hens make good mothers and close setters. Accompanying this we give a cut of a pair of Plymouth Rock fowls, cock and hen. Mr. F. H. Corbin who has written a pamphlet on the Improved Plymouth Rocks, upon mating and breeding these fowls from a fancier's standpoint, has some good suggestions, and which will apply to all parti-colored fowls where the penciling and markings are of importance, and also as applicable to breeding generally. We extract as follows: It is a fixed natural law that the best and fittest survive. It makes no difference, in the application of this law, whether you are treating of an analytical truth or the propagation of life; it still remains the central point around and toward which all researches must be directed. It is in direct proportion to the observance of this law by fanciers that they are enabled to perpetuate and improve all classes of fowls. The first requisite in mating fowls for any purpose, is to secure birds possessing strength, vigor, and stamina. Select stock famed for these requirements, and you will be very sure of obtaining strong, hardy chicks. Let the parent stock consist of birds standing head and shoulders above ordinary stock, and you will be little troubled with roup and its kindred diseases. Breeders disagree as to the age of breeding-birds; but we have found that cockerels nearly or quite a year old, mated to two-year-old hens, usually give the best results. A cock two years of age, mated to early pullets, will also be found satisfactory. The best authorities agree that the ages of the males and females should vary, and for this reason cockerels and pullets should seldom be mated together, unless it is particularly desirable to secure or render permanent some peculiar characteristic or point in that way, and then they should be at least a year old. If the cocks and hens have been entirely separated during the several months preceding the mating, so much the better, as the added amount of vigor is very beneficial. Most breeders find it advantageous to pursue this plan. In the breeding of no other choice stock is it considered beneficial, or allowable, even, to permit the male to roam at will with the females during the entire year, and choice fowls will be found to be no exception to the rule. In breeding for fancy points, one should understand exactly the object sought, and have a clear idea of the means to be employed in obtaining that object. The different elements, about to be brought together and harmonized, must be carefully studied, and if there is necessarily a defect in either cock or hen, it should be counterbalanced by perfection on this point in the other. For instance, if the cock's comb be defective in any way, as lop combed, the hen's comb should stand perfectly erect, and be fine in other respects, in order to breed out the defect arising from the comb of the cock. Of course, no defective bird should be bred from unless it is absolutely necessary, and under no circumstances should a male and female both having the same defect be bred from. No over-fattened birds should be used in the breeding-pen, as nonfertile eggs will abound if they are. In a perfect mating, the sire should possess beautiful plumage, perfectly marked, fine symmetry, and as large size as is compatible with full vigor. The constitutional requirements, which apply with equal force to the hen, have already been spoken of, and need not be repeated here. The dam should excel in productiveness and size, while the shape and plumage must not be lost sight of. This union is the most desirable one for any purpose. Symmetry is especially important in breeding for points, as, in the show-pen, it is marked higher than any other single qualification, and by many judges is again marked in estimating breast and body. The standard of excellence requires that the breast of a Plymouth Rock be broad, deep, and full, and the body large, square, and compact. This necessitates birds for breeding that are both of large size and the improved shape; as no other is or can be square in shape. In breeding Plymouth Rocks to feather, it should be remembered that they are parti-colored, and, therefore, more difficult to breed exactly true to a particular shade than the solid-colored breeds. Moreover, being a somewhat recent cross, the tendency to revert in color is stronger and the result more perceptible. That there has been no



PLYMOUTH ROCK FOWLS.

well-settled rule in regard to mating with a view to breeding true to feather is well known, and each breeder, be he experienced or a beginner, has been left to his own devices. The result has been a whole or partial failure in a majority of yards. Five different matings have been advocated and practiced as follows: A male light in color mated to dark females; a male dark in color mated to light females; a male dark in color mated to dark females; birds matching in the show-pen; a female medium in color mated with a male about two points or shades lighter in color.

PNEUMATICS. The science which treats of the mechanical characters of gases and vapors.

PNEUMATIC TROUGH. A chemical utensil used for the collection of gases over water or fluids. It consists of a vessel of tin or wood containing water, in which is placed one or more ledges, within two inches of the surface. On the ledges the jars which are to receive the gases rest, and they are at first filled with the fluid of the trough, but the gas passing up into them from conductors, the fluid is displaced.

PNEUMONIA. This is lung fever in horses, or an inflammation of the substance of the lungs, followed by secretion and effusion of lymph, which solidifies the lungs, at length causing death by suffocation, or recovering by the gradual absorption of the matter. It is brought about by various causes, as standing in drafts when heated, bad ventilation in the stables, or from anything causing inflammation, or which may run into it. There will be a chill, cold ears and legs, a dry dull cough, sometimes a semi-bloody mucus will issue from the nose, the pulse will be rapid, and the heat of the body often 103° or 104°, or even more. If, in addition, upon striking with the knuckles over the lungs, at the chest, there is a dull sound, (when in the well animal it is resonant), the disease is positive. If the animal is young and full of blood, it may not be amiss to bleed at the very outset, but blistering and purging must be avoided, and bleeding except as stated. A counter-irritant may be had by means of mustard poultices to the chest. For the fever, give every two hours until the fever is abated, one ounce sweet spirits of nitre, and six ounces solution of acetate of ammonia, in six ounces of water. To reduce the pulse, give alternately with the above, once in two hours, twenty or thirty drops of tincture of aconite, in a little water. This will also relieve the pressure on the lungs, but these doses must be watched; and upon the first appearance of depression of the system, as failing pulse, sweating or trembling, the doses must bt intermitted or discontinued. The animal must be well clothed, comfortably sheltered, and the bowels loosened, if necessary, by injections of warm water. If there is much weakness, give two drachms each of carbonate of ammonia and camphor, twice a day, and in the form of a ball, and in case of great exhaustion, a gill of whisky occasionally. Good nursing, and simple, cooling, laxative and nutritious food, will accomplish more than any heroic treatment, and the animal must be watched until fully recovered, giving gentle exercise, but not real work, and plenty of grass if possible.

PNEUMO-ENTERITIS. (See Cholera, Hog.)

PNEUMO-THORAX. A collection of air in the cavity of the pleura.

POA. An extensive genus of valuable natural grasses, to which the meadow grass, blue grass, and many important species belong. The botanical characters of this genus are, *panicle* loose; *spikelets* three or more flowered, or even two-flowered, with the pedicels of a greater number of florets; florets articulated with the rachis; *paleæ* two, nearly equal, awnless, *scales* oval, acute, gibbous at the base. (See Grasses.)

POACHING. The treading of cattle in wet meadows, in which they leave their hoof marks.

POA COMPRESSA. (See Blue Grass.)

POA TRIVIALIS. (See Blue Grass.)

POD. Those of the pea and bean are called *legumes;* those of the radish, mustard, and cruciferæ are *siliques.*

PODENTIA. The stalk which supports the fructification of some lichens, as the reindeer moss.

PODICEPS. A genus of palmipedine birds, in which the web of the foot is not perfect.

POIKILITIC. Variegated. In geology, the new red sandstone formation.

POISON OAK. *Rhus radicans* and *R. toxicodendron*, the former being also called poison vine: it is a climber, the stem throwing out an abundance of black roots. The milky juice is poisonous, and, to some persons, the volatile particles thrown off from the plant. They produce inflammation and swelling, resembling erysipelas. Light diet, laxatives, and a lotion of sugar of lead and water to the part are best.

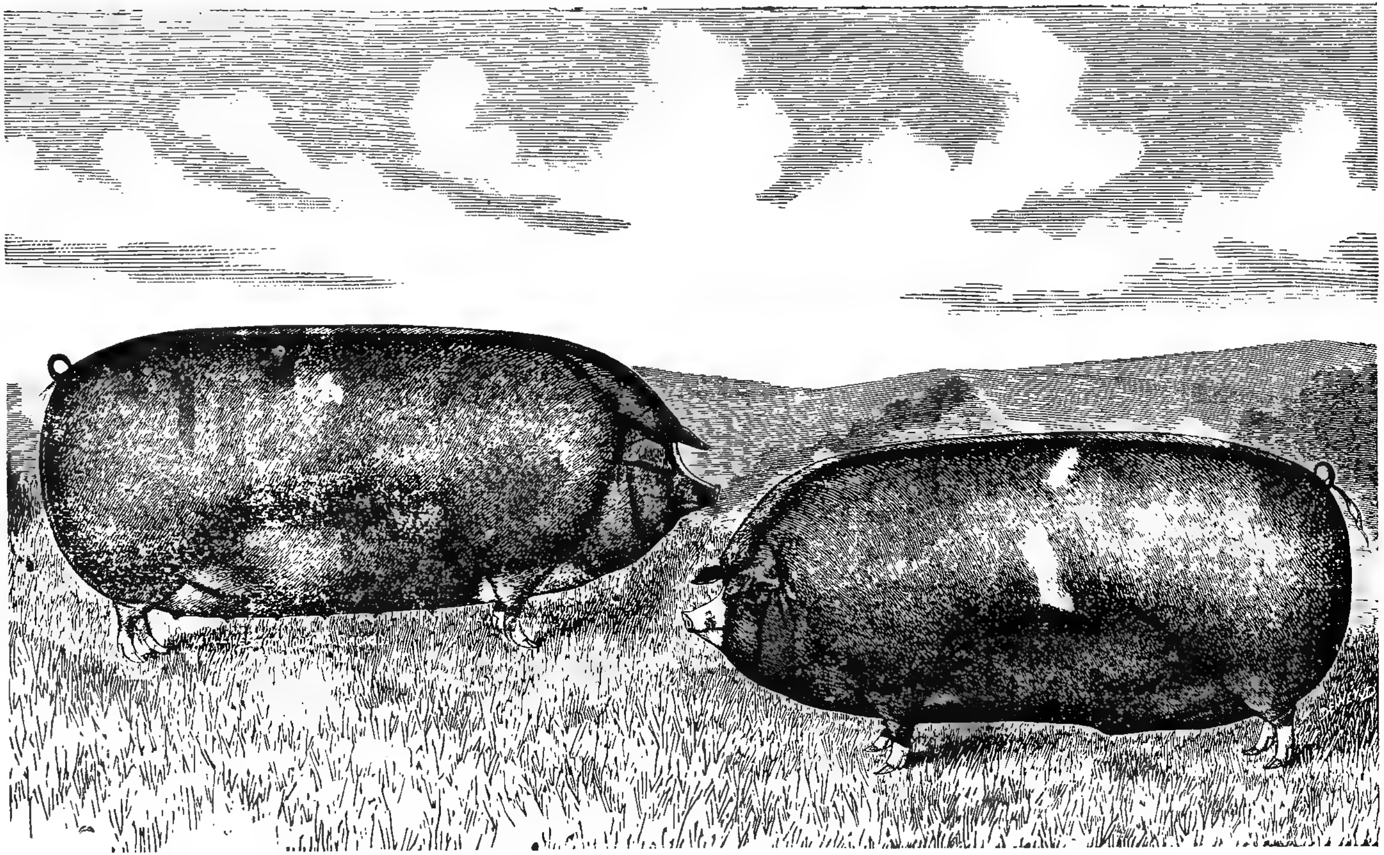
POISONS. Bodies which disturb or destroy the natural functions of the body. They are narcotic, acrid, or septic. Many are to be met by antidotes; but with animals the stomach pump is to be looked to as the chief means of relief.

POISONS AND ANTIDOTES. As a rule the lower animals are seldom poisoned, if left to themsleves. Poisoning is oftener the result of carelessness or the stupidity of stablemen, giving quack nostrums to improve the coat or courage of the horse. If the cause is not known, give at once, a quart of linseed oil, to be followed by an injection of twenty to thirty drops of croton oil, three or four ounces of spirits of turpentine, and one pint of linseed oil, to be thrown into the bowels with considerable force; supplement this with injections of lukewarm milk and water, or simply warm water. If there is considerable exhaustion and drowsiness, administer whisky freely. If, however, a stomach pump is at hand, use this first in preference to all other means. For special cases of poisoning, the following are antidotes: Aloes; give as an antidote, two ounces of laudanum in a quart of linseed tea, repeat in two hours if necessary. Inject also the same dose into the bowels. The same antidote will also apply to poisoning by castor seeds and croton seeds. For fungus poisoning, as smut, toad stools, bad fodder, etc., give full doses of purgatives, both by the mouth and by injection, and afterward support the strength with stimulants and nourishing food. Indian poke, or white hellebore poisoning is relieved by means of whisky in full doses or a tumbler full at a time. In poisoning by laurel, give purgatives and injections, and also stimulate with whisky. Stramonium poisoning is to be met by quart doses of linseed oil, to which two ounces of laudanum is added; injections, and stimulants, as whisky, to keep up the strength. So far as mineral poisons are concerned, they must not be allowed about, and especially must arsenic be kept out of the hands of stablemen. As a medicine, in intelligent hands, it is valuable; as a condiment, to give fictitious fire and spirit, it is vicious.

POISONS AFFECTING PLANTS. These are few in number, and principally mineral. Of gases, the common illuminating gas is the only one to be feared, acting fatally, when from leakage of the underground pipes, it is taken up by the roots. Plants quickly suffer if kept in rooms lighted with gas, and hence the reason why florists refuse to leave rare plants long on exhibition at public places lighted with gas. It has been generally credited that Paris Green acts injuriously to plants when used for destroying insects, and many think that it may be taken up to such a degree as to become poisonous to persons eating the fruit. This, however, is groundless, except when the poison may have been applied, and lodging on the fruit or vegetable to be eaten, and taken into the stomach. Hence poisonous compounds should never be used on plants, the fruit of which is designed for eating after the season of inflorescence. This will not apply to underground tubers, like potatoes; upon cabbage, cauliflower and other plants which may retain the poison, it should not be used at all. Among the mineral poisons fatal to vegetable life, the compounds of boracic acid have been found to be a veritable plant poison. M. Peligot has discovered that the free acid, and its compounds, when present in the soil in moderate quantities may cause the death of plants in a short time. A remarkable exception to the rule for the influence of aluminium salts is said to have been observed by Bergstrand, in a locality near Westerbotten, in Sweden, *Rubus articus* was found in a flourishing condidition upon a sandy soil containing as high as three per cent. of alum. The dry plants yield 4.68 per cent, of ash, containing 12.60 per cent. sulphuric acid and five per cent. alumina; but these figures are very much reduced when the percentage of alum in the soil is sufficiently low to admit of the growth of grass and grain. In such case the sulphuric acid of the ash amounts to only five per cent. In relation to the influence of arsenical compounds, when present in the soil, the chemist of the Department of Agriculture, in a late report, gives the results of interesting and conclusive experiments of much value, showing that there is but little to fear. The investigation was made to determine: 1 If applied to the soil, can arsenic or arsenious acid be absorbed and assimilated in the economy of plant-growth? 2. If absorbed and assimilated, can it be taken up in sufficient quantity to become prejudicial or injurious to the health of consumers? 3. If not taken up by the plant during growth, does it by its presence in the soil exert a poisonous influence upon the plant itself? 4. If it exerts a poisonous influence upon the plant, to what extent may it exist in the soil before it becomes injurious? The experiments were conducted as follows: Fifteen common flower-pots, of as nearly uniform size as possible, were selected, and each one filled with a measured quantity of good garden-soil. With the soil of each pot were then thoroughly intermixed quantities of Paris Green, ranging from 100 milligrams to one gram. Thus one pot contained 100 milligrams; that next to it contained 200 milligrams; the next 300; and this quantity was increased until it finally reached one gram. In the other pots, the increase was made more rapid, and the other pots contained two, three, four, and five grams respectively. After the soil had thus been carefully prepared, a given number of peas, all of which were carefully selected, so as to secure as nearly as possible those of the same size and appearance, were planted in each pot. At this time, the question arose, What would be the effect of arsenic in combination, as arsenite of potassa and arseniate of potassa? For the purpose of determining this, two other series of pots were prepared in the same manner as before, placed alongside the former. In these experiments, for the sake of comparison, one pot of soil was prepared without addition of any poisonous compound. It is evident from results that the arsenical compounds in the soil did produce an injurious effect, and in some instances, in fact in the majority of them, it was decidedly marked. In case of the Paris Green, it is not noticed until the quantity present in the soil reaches 500 milligrams, and that in the other pots the size of the plants decreases regularly as the quantity of arsenical compound present increases. In case of the arsenite of potassa, the effect seems to be more immediate. This may be due either to the greater solubility of the compound or to a possibly larger quantity of arsenious acid. The potash compound seemed nearly pure, being crystallized, and the purity of the copper compound was not estimated. Yet in this case the effect does not seem decidedly marked until the quantity present reached 300 milligrams. To the influence of arseniate of potassa the plants seemed to be more sensitive still; for those in the pot containing but 100 milligrams seem to be affected. Yet even when 200 milligrams are present, the plants seem to thrive tolerably well. What, then, are the quantities of these compounds which may be applied to the soil for the various purposes in practical agriculture before effecting any injurious results? The amount of soil in each of the pots employed in these experiments was 91.5 cubic inches. In case of the Paris Green, the limit is 500 milligrams for this quantity of soil, which is equivalent to 145.6 grams per cubic foot, or 906.4 pounds per acre, calculating for a depth of one foot. The limit for arsenite of potassa, being 300 milligrams per 91.5 cubic inches, is about 540 pounds per acre. Though the plants seem to be affected by even a small quantity of arseniate of potash in the soil, the chemist was nevertheless inclined to the opinion that this compound may be applied at the rate of 150 pounds per acre without any great injury to the crop. For practical purposes, however, it is never necessary to apply in any case so large an amount. These results are confirmed by the water-culture experiments of Prof Freytag in his investigations upon the influence of the sulphurous and metallic fumes of the Freiberg Metallurgical Works upon the vegetation of the surrounding fields. He found that plants were killed when placed in solutions containing one-eightieth per cent. arsenious acid, one-fiftieth per cent. sulphate of zinc, one-fortieth per cent. sulphate of copper, one-twentyfifth per cent. sulphate of cobalt, one-fifteenth per cent. sulphate of nickel, and one-fifth per cent. sulphate of iron. Mons. E. Heckel states that twenty-five milligrams of arsenious acid, or the soluble arseniates in ninety grams of water, prevents germination and destroys the embryos of seeds. It is difficult, however, to agree with Prof. Freytag in the statement that the arsenious acid and the oxides of zinc and lead can not be injurious to vegetation on account of their property of forming insoluble compounds in the soil, since in some of my preliminary experiments presence of such insoluble compounds as the arseniates of barium, strontium, and magnesium was sufficient to prevent germination. Again, in reports upon the composition of certain mineral waters of Germany, we notice statements of the presence of such insoluble compounds as arsenite of iron in solution. These facts argue against the possibility of accumulation of sufficient arsenic in the soil by regular applications of Paris Green in the quantities recommended for the destruction of the Colorado potato beetle. When rotation of crops is observed, and application of the poison can not therefore take place upon the same plot more than once in three or four years, it is probable that each application, being acted upon by the natural solvents in the soil, will be removed by drainage before another is made. And yet, even when annual applications have been made, so much time must elapse before the limit could be attained that no injury need be feared from this cause. Now, can arsenic be absorbed and assimilated by the plant in the economy of growth? Investigations, the chemist says, give a negative reply. All of the plants grown, from the largest to the smallest, were examined by careful application of Marsh's test; yet he failed in any case to detect the presence of arsenic. Before making the test, the organic matter of the plant was destroyed by boiling it in hydrochloric acid with addition of potassic chlorate, and the solution filtered. He also carefully examined potatoes which had been subjected to applications of Paris Green, and which were furnished from Delaware and Sandusky, O., and Chambersburgh, Pa., and failed in any case to detect the presence of arsenic. With these facts before us, and without considering what might be the result of a series of experiments continued through a number of years, we must conclude that plants have not the power to absorb and assimilate from the soil compounds of arsenic, and that though arsenical compounds exert an injurious influence upon vegetation, yet this is without effect until the quantity present reaches: for Paris Green, about 900 pounds per acre; for arsenite of potassa, about 400 pounds per acre; for arseniate of potassa, about 150 pounds per acre. The influence of illuminating gas upon the aerial portions of plants, is shown to be as follows: The subject of the influence of illuminating gas upon vegetation has, until within a short time, been neglected. In 1873, observations made in Berlin determined the fact that gas escaping from the pipes exerted an injurious influence upon the surrounding vegetation, with the roots of which it came in contact, and careful experiment showed that this effect could be observed when so small a quantity as twenty-five cubic feet per diem was distributed through 144 square feet of soil to a depth of four feet. In fact, the plants whose roots permeated this quantity of soil, 576 cubic feet, were by such treatment killed in a short time, and it appeared that less time was required to produce this effect when the surface of the ground was closed and more compact During the same year, J. Boehm made experiments by passing coal-gas through the soil of pots containing fuchsia and salvia; of the ten plants experimented upon seven died in four months. Further experiments convinced him of the fact that the plants were killed, not by the direct action of the gas upon the roots, but by poisoning the soil. It seems, therefore, pretty well established that when coal-gas permeates through the soil it has an injurious action upon the vegetation with which it may come in contact. My attention has, however, been attracted to a somewhat different action of the gas, which seems equally as destructive as that just described. Boehm found, in the course of his investigation, when cuttings of willow were placed in bottles containing a small quantity of water, and otherwise filled with illuminating-gas, as the buds developed and the leaves began to appear the latter rapidly withered and died before reaching complete development. Now, this is the direction taken in my investigation. In Boehm's paper, he does not state the percentage of gas in the atmosphere necessary to produce the effect described, and my object was therefore, if possible, to estimate the approximate quantity of gas required to bring about such results. The question arose out of a dispute concerning the destruction of an extensive stock of camellias in Philadelphia, in which it was alleged that the loss was due to the escape of gas from the street-mains. It was shown that the main was broken; that during the winter, the ground being frozen, there was no means of escape of the gas other than to work its way through the subsoil,. and into the atmosphere through the ground of the interior of the greenhouse. The distance between the main and the greenhouse is not stated, but it appears that trees growing between the former and the latter were completely killed. It was to determine whether the result in dispute could be effected by the action of the gas. The plants were growing in pots placed upon stands and it was therefore impossible that they should be injured through the medium of their roots. It was then to determine what might be the influence of the gas in question upon the aërial portions of plants that the investigation about to be described was instituted. In order to secure such conditions that the plants might be confined in an atmosphere containing a given quantity of gas, and yet be provided with the requisite degree of light, heat, and moisture, the plants were placed in closed boxes, provided with glass sides, the joints of which were cemented with white lead. When all was secured, a tube of glass was introduced through the side of the box and connected with the stop-cock of a gasometer. The stop-cock of the gasometer was then opened, and the gas allowed to flow into the box, until the entire contents of the former were transferred to the latter. The whole was then allowed to stand until the following day, when the gasometer was again filled with gas taken from the pipes supplying the laboratory, and one-half the contents transferred to the box. On the next day, press of other duties called my attention away from this work entirely, and the box therefore received no gas. On the fourth day, however, one-half the contents of the gasometer were introduced, and another day allowed to intervene before another application. Gas was then introduced into the box on four occasions, so that the amounts transferred, allowing ten gallons for the capacity of the gasometer, were: February 24, about ten gallons; 25th, about five gallons; 27th, about five gallons; March 1, about five gallons. During this time, an occasional leaf, as well as one of the buds, fell from the plant, and on March 2, on opening the box to apply water to the plant, a slight jar caused a number of the leaves to fall. The plant was then carefully removed from the box, when a sharp shock caused nearly all the leaves to fall. The leaves which had fallen were then gathered about the base of the plant, and the whole placed in a convenient position, together with the other plant, which had been submitted to the same conditions excepting the treatment with gas, and which remained perfectly sound and healthy. Now, what was the relative amount employed? The dimensions of the box were: horizontal cross-section, two feet square; height, four feet. Calculating from the data at hand, we find that the amount first introduced was equivalent to about 7.7 per cent. of the entire volume of the box, and that the quantity subsequently introduced, being one-half this amount, was but 3 35 per cent. Without making any allowances for escape of the gas by diffusion, which probably took place, reasoning from the fact that when the box was opened no odor of gas was perceptible within the box, we find that after the first day the amount of gas did not exceed four per cent. of the volume of the box. It is, however, probable that the average quantity was much less than three per cent., and I am inclined to the opinion that if camellias or other plants be confined in an atmosphere containing continually one to two per cent. of illuminating-gas, they must suffer and ultimately be killed.

POLAND-CHINA SWINE. This breed is famous all over the West, and also is locally known in Ohio as the Magie hog, from the name of one of its successful breeders there. It is described by the committee on Poland-Chinas at a convention of the National Swine Breeders' Association. In a number of articles on swine we have freely used these reports as they have appeared at this convention, since the peculiarities of the various breeds were then pretty fully discussed. There were two reports, a majority report and a minority report; the latter being finally adopted. It is as follows: In the early history of swine-breeding in the Miami Valley, in Ohio, it is clear, from the best written authorities available, and from oral testimony, that there were two breeds which, to a great extent, had been profitably crossed with the common bristled breed of the country. These were the Russia and Byfield breeds. The Bedford breed is also named in connection with the other two. To what extent it was used can not now be readily determined. In 1816, we have positive proof from an unquestioned source that the Shakers of Union Village, situate in Warren county, O., and being four miles from Monroe, in Butler county, purchased at Philadelphia one boar and three sows, of what was, at the time, believed to be pure China. They were represented to be either imported or the immediate descendants of imported stock. They were called Big China hogs. These animals were the first China hogs ever brought into southwestern Ohio. Subsequently other China hogs were introduced and extensively used. The shakers and other judicious breeders in Warren and Butler counties continued to use the breeds at command, and produced, by repeated crosses, a hog of exceedingly fine qualities for that period, which was generally known as the Warren County hog. These hogs, continually increasing in good qualities, were bred in both counties, and the very best specimens were carefully and interchangably used, so as to make the best crosses. Such was the progress that had been made in forming the ground-work of a good specimen of a hog. This condition of the breed remained measurably constant until about the year 1835 or 1836, when Mr. Munson Beach, of Warren county, first introduced the Berkshires, which were obtained from C. M Bement, of the State of New York . Other lots of Berkshires continued to flow into the Miami Valley, until about 1841. The Berkshire blood was liberally infused into the stock existing not only in southwestern Ohio, but in Kentucky also. Crossing with the Berkshires was almost exclusively done until about 1838 or 1839, when Mr. William Neff, of Cincinnati, imported some choice specimens of the Irish Grazier. This breed soon grew into high favor, and, as a consequence, was liberally used in making crosses with the best specimens of the crosses previously made. This intermingling of blood—this crossing of breeds—continued for some time. In a few years, however, the use of the pure-blooded Berkshire was entirely discontinued, and there were no further importations made of the Irish Grazier. The breeders of swine in the Miami Valley settled down to the conviction that the basis of a good breed of hogs had been established, and that in the future, judicious and discriminating breeders could use, and, if necessary, modify the material furnished so as to meet the highest demands of the public. For more than thirty years no new blood has been introduced into our breed, and no effort made to obtain a new supply of the blood of either breed previously used. While this is true, our breeders have not been indifferent to the further improvement of our breed. Stimulated by their success, they have perseveringly aimed to improve what they had been so successful in forming. The best points or qualities have been preserved, and, when practicable, have been made even more excellent. All defective points or undesirable qualities have been corrected or improved by the care, skill and judgment of our experienced breeders. Thus we have a breed thoroughly established—of fixed characteristics, of fine style, and of unquestioned good qualities, which can be relied upon for the production of a progeny of like qualities and character. The following is presented as the characteristics of the foregoing breed: The best specimens have good length, short legs, broad, straight backs, deep sides, flanking well down the legs, very broad, full, square hams and shoulders, drooping ears, short heads, wide between the eyes, of spotted or dark color; are hardy, vigorous, and prolific, and when fat are perfect models all over, pre-eminently combining the excellencies of both large and small breeds.

POLARITY. The quality in the particles of bodies adjusting themselves in given directions, as north and south, in the magnet.



POLAND-CHINA SWINE.

POLE. A rod. Sixteen and one-half feet.

POLLARD. A tree cut or lopped to form a low brushy top.

POLLED. Hornless.

POLLED CATTLE. Of the polled breeds of cattle there are several in England. Among the polled breeds that have acquired reputation are the Angus Polled, the Suffolk, and the Galloway. The latter have been, of late years, brought to the United States, bred and exhibited at our fairs. Those specimens we have seen have proved to be most admirable cattle, thick meated, deep flanked short legged, fine boned animals. That they were considered most valuable cattle, and worthy of being brought here in the early settlement of the country, is evidenced from the fact that forty years ago these hornless, (or Muley) cattle as they were termed, were not extremely rare often breeding back by reversion, entirely hornless or with but the rudiments of horns, and were classed as gentle and good milking cattle. Gentleness is a characteristic of the pure Galloway. Even the bulls are noted for their docility and quiet tempers. For the reason that this breed of cattle have of late years been growing in favor in the West, as grazing and milking cattle, (see article Galloway cattle), and, for the further reason that it is thought that crossing the Galloway on the half wild Texan will be most valuable, it has been advocated that they be carefully experimented with. While it is undoubtedly true of all pure or thorough-bred stock that, they will improve permanently the character of any native stock upon which they may be crossed, it seems especially so of the Galloways to-day. It has been held by some that pure breeds can not improve the mixed stock of a country. This is a fallacy. They must and do as the magnificent Short Horn Hereford and Devon grades amply testify in all our great markets. That the Galloways have many valuable points can not be denied. One of these is their absence of horns, another is their extreme docility. If by crossing Galloway bulls with Texan cows their horns could be toned down, their wildness tamed, their frames thickened with superior flesh, their milking qualities improved, and the whole animal ameliorated, it would seem as possible with the Galloway as by any other means we know. It is certainly well worthy of trial.

POLLEN. The pollen of plants is the fecundating dust or minute grains of organized fertilizing matter which, falling upon the pistil of the flower, throws out hair-like tubes, which penetrate through the whole extent of the vascular tissue of the pistil, and reaching the ovules, fertilize them, thus rendering them capable of perfecting the seed, and reproducing plants of their own kind. The pollen, therefore, represents the male element in plant life. The male and female organs (stamens and pistils) are sometimes in the same flower, as in the apple. These are called perfect flowers. When the stamens and pistils are on different flowers and on the same plant, as in the white oak, they are called *monœcious.* When in different flowers and on different plants, as on hemp, they are called *diœcious.* How the fertilization in different plants is accomplished, Mr. Horace Piper, of Maine, relates as follows, taking perfect flowering plants, *monœcious* and *diœcious* plants, to illustrate the three classes: In the first class the pollen is conveyed from the anthers to the pistils in some cases by actual contact of the two organs, as in the potato (*Solanum tuberosum*); in others, by the elasticity or spring of the stamens at the time the anthers emit the pollen, by which action it is scattered on the pistils, as in the mountain laurel (*Kalmia latifolia*); and still in others by the position or length of the stamens, being above or hanging over the pistils, and, therefore, requiring no accidental means to fertilize the plant. In the second class the staminate flowers are generally situated above the pistillate, and over them on the same stalk, so that the pollen falls upon the pistils by the mere force of gravity, as in Indian corn, in which the part commonly called the spindle contains the staminate flowers, and the ears the pistillate. In the third class the staminate flowers are on one plant, and the pistillate on another; therefore, the pollen must be conveyed by some artificial means from the stamens to the pistils. This is readily accomplished by the wind or insects. The grains being light and very numerous, are easily wafted by the breezes and severe winds in sufficient numbers, and to the necessary distances, to accomplish the desired object. But, lest this mode of conveyance should prove inadequate, nature has provided another security just referred to, namely, the transmission by insects when in search of honey for their food. Passing from the flowers of one plant to those of another, often to great distances, they carry the pollen which has adhered to their legs and bodies, and deposit it on the pistils of the flower of another plant, which is thus rendered fertile, and is as certain of producing fruit as if the pollen actually fell upon the pistils from the anthers of the same flower. In this way we may account for the fact that some trees of this class though thrifty and producing an abundance of flowers, do not bear any fruit. It is simply because there is no staminate plant sufficiently near from which pollen may be conveyed by any of the means above to the insulated plant. And, again, the plant may be so far distant as not to admit the pollen to reach it at all, or only on some extraordinary occasion, and, therefore, it would produce fruit only when such accident should happen to occur, which might never be. We have a very curious instance of the manner in which fertilization is sometimes effected in this class of plants in the case of the *Vallisneria spiralis*, in which the flower of the staminate plant detaches itself from its stalk and swims to its mate, attaches itself to it, and remains until it becomes fertilized, when both flowers wither and sink beneath the surface of the water in which they grew, the one to perish, and the other to mature seeds, and sow them on the muddy bottom below. As illustrating the action of pollen, Broigniart and others think that when the hair-like tube of the pollen-grain passes through the orifice in the coatings of the ovule, and reaches the nucleus, or embryo sac, it emits a spermatic or plantlet germ, which passes through the wall of the embryo sac and enters the germinal vesicle contained in it. The vesicle corresponds to the germinal spot, or vesicle, in the egg of birds, and the ovum of mammiferous animals. The germ remains in the vesicle, and finally becomes the embryo fully developed into a plantlet, as may be seen in the bean and other seeds. These tubes sometimes grow to great length, and are many days in penetrating the whole length of the pistil. Indian corn will furnish a good illustration. The pistils of this plant, which are commonly called the silk, grow to the length of ten or twelve inches, and yet these slender pollen-tubes penetrate the whole distance from the point where they come in contact with the pistils to the nucleus of each rudimentary seed.

POLL EVIL. (See Fistula.)

POLY. A prefix of many words, as polygon, polypetalous.

POLYGASTRIC INFUSORIALS. The class of animalcules with many stomachs inhabiting infusions.

POLYGONACEÆ. Herbaceous, apetalous exogens, with triangular, scaly fruit, and an ochrea. The rhubarbs, sorrels, docks, and buckwheat belong to this family.

POLYPES, POLYPI. The name of an extensive group of radiate animals in the system of Cuvier, associated together by the common character of a fleshy body, of a conical or cylindrical form, commonly fixed by one extremity, and with the mouth situated at the opposite end, and surrounded by more or less numerous arms or tentacles.

POLYPODY. *Polypodium.* Having numerous root-like feet. This is an extensive genus of ornamental ferns. The hardy kinds are well adapted for ornamenting rock-work, or they may be grown in pots, in light loamy soil. All the species may be readily increased by dividing the roots, or by seeds.

POLYPUS. A fleshy tumor of the nostrils or womb. It is only removed by the knife in the hands of a competent surgeon.

POMACE, POMAGE. Refuse of fruits, after pressing for cider.

POMACEÆ. Rosaceous plants, with an inferior ovary, as the apple, pear, etc.

POMEGRANATE. A tropical fruit. A beautiful, hardy, deciduous shrub, growing twelve or more feet high. *Punica granatum,* and its varieties, produce their splendid flowers and fruit very plentifully from July to September. They all grow well in a light, rich loam, and strike root freely from cuttings or layers; the rarer varieties are sometimes increased by grafting on the common kinds. The pulp of the fruit is of an agreeable acid, and the rind is highly astringent.

POMMEL. The front prominence of the saddle.

POMOLOGY. (See Horticulture.)

PONE, PONES OF BREAD. Small loaves, usually applied to a particular form of corn-meal bread.

PONIES. Of ponies, the Shetland, the Canadian, the Indian pony, and the Mustang are the principal breeds worthy of notice. The Shetland ponies are the smallest of all the breeds of ponies, though there are ponies having some of the characteristics of the Shetlands in northern Sweden, Iceland, Wales, and also on the southwest coast of England; in fact wherever civilization has extended, in Alpine regions and in high northern latitudes, there will be found ponies, rough and often shaggy in their coats, dwarfed, and hardy little horses, undoubtedly the descendants of more powerful ancestors, that being taken to those inhospitable regions have, in the course of many generations of exposure and hardship, been dwarfed to their present size, until the more diminutive of them are scarcely larger than some of the improved breeds of mutton and long-wooled sheep. (See Canadian, Indian, Mustang, Narragansett pacer, and Shetland ponies.)

PONS VAROLII. An eminence of the medulla oblongata, at the top of the spinal marrow.

PONTIA. The genus of insects to which the cabbage butterfly belongs.

POPLAR. *Populus.* The genera contains the aspens, the downy-leaved poplar, the cottonwoods, and the balsam poplars. Also, as introduced trees in the United States, the Lombardy poplar, and the Abela or Silver-leaved poplar. Both of these latter are undesirable trees, from the fact that the Lombardy poplar, *populus dilatata* dies young, and the abele, *P. Alba,* spreads by suckers so as to become a nuisance. The aspens are, the American aspen, *P. tremuloides,* or quaking aspen, a small tree, with smooth greenish bark; the larged-toothed aspen, *P. grandidentata,* larger than the preceding, with smoothish gray bark. The downy-leaved poplar, *P. heterophylla,* found in swamps from New England to Illinois, and southward; the cottonwood poplars, *P. Monilifera,* or necklace poplar; and *P. Angulata,* or angled cottonwood The balsam poplars, *P. balsamifera,* or tacamahac, and the variety *candidans,* or balm of Gilead poplar, and the black poplar, *P. nigra,* found sparingly East, and supposed to be an introduced form of the European black poplar. The poplars belong to the *Salicaceæ,* or willow family. The cottonwoods are extensively planted in the West by early settlers, on account of their quick growth, and fair quality for firewood and other uses, but to give place to better trees when they can be grown.

POPLITEAL. Relating to the space behind the knee joint.

POPPY. *Papaver.* The common poppy, *P. somnifera,* furnishes the opium of commerce, obtained by the exudation of the milky sap, upon being cut. *P. dubium,* is the smooth fruited corn poppy. Argemany, or prickly poppy, *A. Mexicana; Stylopharum,* or celandine poppy, *S. diphyllum,* is found in the Mississippi valley, east of the Mississippi, from the lakes to Kentucky. Chelidonium, or celandine, *C. majus,* is a perennial weed growing in waste places. Glancium, or horn poppy, *G. luteum,* is an introduced plant from Europe, runs wild in Maryland and Virginia. Sanguinaria, or blood root, *S. Canadensis,* belongs to the poppy family, as also does *Eschscholitzia Californica,* and *Douglasii.* These are handsome flowering plants, the juice colorless, and curious, from the fact that they have the odor of muriatic acid.

POPULIN. A crystalline substance obtained from the bark of the aspen.

PORCATE. In entomology, divided into ridges; a surface on which there are several elevated and parallel grooves.

PORCELAIN CAPSULES. Evaporating basins of porcelain; this material resists a great heat, and is not readily acted on except by potash or soda.

PORCH. An arched or flat-ceiled vestibule to a door or building.

PORES. Small spaces existing between the atoms of bodies; also distinct apertures through leaves or membranes, from which perspiration and vapors pass.

PORK. The flesh of swine, after being cut for use, is called pork. In cutting it should be done with reference to the use for which it is intended. In the great pork packing establishments the cutting and curing has special reference to the particular markets to which it is to be sent, and even including the particular form of the hams, shoulders, bacon, and pickled pork. Thus in hams, sometimes the hip bone is removed at the socket, or left entire. The shank is left long, to the hock joint, or cut well up to the ham. So with the shoulder, it may be cut square, back of the shoulder blade, and the neck, or trimmed rounding. The bacon pieces may embrace the entire side from ham to shoulder, or the flank piece may be separated from the back piece. Sometimes the tips of the ribs are left in, but generally the whole of the ribs are taken out and the backbone always. In making pickled pork, whole hog pork contains two hams, two shoulders, the side meat, chops and feet. Mess pork is the side meat containing the bone, clear pork is the side meat containing no bone. Another grade of clear pork is made by taking the flank, or lower half of the side for bacon, and the upper half or back for barreling, after being divested of the bone. In putting up pork for home consumption, the chops, shoulders, hams and flank pieces of the side meat should be used for smoking, and the back pieces of the side meat barreled. The shoulders and hams should be trimmed close, and the hip bone removed from the ham at the socket joint. All the bone should be removed from the bacon and pickling pieces, since these, as well as the scrap pieces from the hams and shoulders, are more economically used fresh than otherwise; the lean and fat scraps, may be used for sausage, and the bones with the meat adhering, in whatever way may suit the taste. With the backbone the large loin muscle should be removed, since this lean strip is not good salted, from the excess of salt it takes up. Fat pork will not become over salt. From forty to fifty pounds of salt will cure a barrel, but if double this quantity is used no harm will ensue, but the undissolved salt will remain good in the barrel. The layers should be placed in regularly, the skin side next the barrel, the whole packed as firm as possible, with plenty of the best coarse salt between each layer. Then fill the barrel with pure water, soft water preferably, the meat to be kept entirely covered with the brine, kept cool and there is no danger of spoiling. The bony and other pieces that remain for eating fresh may be kept for a long time by packing in a barrel with snow, or even by hanging on the north side of a building, where they may be kept frozen. Hams, shoulders and bacon must be so cured that they will be only seasoned enough for use, without freshening, (a part of the preservative process being smoking). This may be done by making a pickle of salt, saltpetre and sugar or molasses, and immersing the meat therein for two or three weeks, the pieces having been previously rubbed with salt and allowed to drain for two or three days. The proper proportion for a pickle of beef and hams should be as follows: Make a brine that will bear up an egg so it will show a section the size of a ten cent piece. Then to each 100 pounds of hams or shoulders to be cured, add six ounces saltpetre, and two pounds of sugar. In this immerse the meat after it has been rubbed with salt and laid to drain two days. The hams will be fit for smoking in from two to three weeks, according to size, though they may lie a month without injury. Before smoking, drain dry, and rub the whole thoroughly with black pepper. Hams intended for boiling, may be prepared by this recipe. For broiling the following recipe is one of the best we have ever used, since by this process the fat as well as the lean will be found superior: The hams are to be laid regularly on a platform and rubbed with salt, and allowed to drain for two days, being careful not to place one on another. Each fifteen or sixteen pounds of ham will require one pound of New Orleans brown sugar, two ounces of pulverized saltpetre, and half a pound of coarse salt pulverized. Rub the flesh and end of shank with one-third of the saltpetre and cover with sugar about one-quarter of an inch thick. In five days rub the skin briskly with sugar, and the flesh side with another third of the saltpetre mixed with three parts of sugar and one of salt, on the seventh day repeat the process. In three days more rub again with half sugar and half salt and repeat in seven days. Let the ham lie for five or six days, clean the flesh side and rub with New Orleans molasses as long as the meat will absorb it, the idea being to saturate the ham with sugar and molasses, using only salt enough to flavor it; when cured through, rub with black pepper. Hang the hams in the smoke house and dry with gentle heat for a week, and then smoke with a green hickory fire smothered with sawdust of the same, or of bur oak; clean corn cobs also make an excellent smoke. If the smoke house is so constructed that the smoke can be admitted at the top so much the better. The temperature of the house should never be above eighty or eighty-five degrees, and the meat should not freeze either before or after smoking. The smoking, or drying (for the meat should be dried rather than smoked), may continue until the skin assumes a light chestnut hue, and when fully cured and dried, put them in muslin bags well sewed and whitewashed to guard against flies. Beef may be cured in the same manner, and mutton hams as well, but in this case little or no smoke should be used, but simply a heat of about eighty degrees. It may be objected that this is an expensive method. Very true, but the pleasure of eating the delicious broiled slices will fully warrant the cost. A common plan of dry salting is to use salt and saltpetre in the proportion of one pound of the former to one ounce of the latter. Rub with salt and drain for three days, then warm the mixture just so it can be borne by the hand, and rub every three days until the meat is cured to the bone, packing in a hogshead, box, or other convenient place, each time the rubbing is performed, placing the under pieces on top. When cured, clean and rub with ground black pepper, and dry, smoke, and preserve as before directed. If wanted very nice, add half a pound of sugar to each pound of salt, rubbing in the sugar at the second handling before using the salt. In dry salting it is quite essential that the salt used be rubbed on hot.

PORK, CLEAR. Side pork for barreling, free from lean.

POROSITY. The property of bodies, whereby they transmit fluids or gases, and which depends on their pores.

PORPHYRY. A hard red or gray stone of the nature of granite, and consisting of feldspar, with quartz or hornblende. It occurs in the oldest dikes.

PORRECT. Extending. When a part extends horizontally.

PORRIGO. Scald head, ring-worm, tetter. Tar ointment, or dilute carbolic acid is a remedy. Cleanliness and attention to the general health, are essential.

PORTAL. The lesser of two gates.

PORTAL CIRCULATION. The circulation of the venous blood from the abdominal viscera through the liver to the right auricle of the heart.

PORTER. A beer colored with dark malt or molasses.

PORTICO. A projection from a building, supported by arches or pillars.

POSITIVE ELECTRICITY. A surplus of electricity. (See Electricity.)

POST ABDOMEN. The five posterior segments of the abdomen of insects, or the tails of some crustaceans.

POTASH. *Alkali. Protoxide of potassium* The substance popularly known under the name of potash is a combination of oxygen and of a metal called potassium. This metal was first separated from the alkali in 1807, by Sir Humphrey Davy, and is interesting on account of its properties, and as having been the first of its class obtained by means of the galvanic pile. It is of a bluish color, is soft, and may be worked by the fingers as wax. Its luster is eminently metallic, and can not be retained in contact with the air. This metal must be kept under oil of naphtha, (which contains no oxygen,) because, if left in contact with the atmosphere, it will absorb oxygen, and again become potash, or oxide of potassium. It is lighter than water, its specific gravity being 0.865. At the temperature of freezing water it is brittle; as the temperature rises it first becomes soft, and then liquifies long before the thermometer reaches the boiling point; and, finally, is volatilized at a red heat, giving out vapors of a beautiful green color. When a piece of potassium is thrown upon water its affinity for oxygen is so great that the water is decomposed, the oxygen of the water uniting with the metal with such rapidity that the hydrogen is ignited, and continues to burn until the metal is completely oxydized. If the remaining water be then examined it will be found alkaline, and capable of turning reddened litmus blue. Potash, as known in commerce, is an impure compound of all the soluble salts extracted from wood ashes by lixiviation and evaporation to dryness. Pearl-ash contains fewer impurities, being prepared by a more perfect calcination in contact with the air, promoted by constant stirring, by which means the carbonaceous matter, as well as the sulphur, is dissipated. Resolution and evaporation, toward the close of the process, produce a white granular appearance. Pure potash, (vegetable alkali, caustic potash, etc.,) is solid, white, and fusible, and does not undergo decomposition at any degree of heat to which it may be subjected; but it is deliquescent, and, when exposed to the air, absorbs the carbonic acid of the atmosphere, and will consequently effervesce by the application of any of the stronger acids, such as sulphuric, nitric, or chlorohydric. It is one of the most powerful bases, and so caustic as to alter all organic substances with which it comes in contact, and it is hence used as an escharotic in surgery. Not only does it dissolve many animal substances, but also changes the nature of vegetable products, particularly when its action is aided by heat. Potash is never found pure in nature, being always combined with acids, such as carbonic, sulphuric, chlorohydric, nitric, tartaric, oxalic, etc. That which is extracted from the ashes of vegetables is mixed with divers other salts, varying according to the vegetables from which the ashes have been procured, the nature of the soil, and the kinds of manure used in their production. In preparing caustic potash, regard must be had to the substance used for the carbonate. That produced by reducing to ashes the tartrate of potash is the most pure. By successive crystallizations any degree of purity may be gradually attained. The carbonate of potash is decarbonized by the application of caustic lime to a solution of the carbonate in boiling water, the boiling being continued for a time. The carbonate of lime, formed by the absorption of the carbonic acid from potash, precipitates, and may hence be easily separated by decantation or by filtration. To ascertain when all the carbonic acid has been removed, it is only necessary to add a few drops of acid to an equal quantity of the clear solution, when any effervescence will indicate the incompleteness of the operation. The decomposition being effected, the solution is allowed to settle, the clear liquid is decanted, and the residuum is thrown upon a filter, which may be of straw, clean sand, cloth, or paper. The evaporation should be rapid until the water is dissipated, when the product may be run into moulds, as may be desired, or allowed to cool on the sides of the evaporating pan. It should then be broken into fragments and secured in glass vases with emery stoppers. Potash thus obtained is known in commerce as potash prepared with lime. It is not absolutely pure, but contains salts, such as chlorides, sulphates, silicates, and aluminates of potash. By dissolving this potash in alcohol, and evaporating first in a still, to economize the alcohol, and finally in a silver vase, a product is obtained known as potash á l'alcohol, which is used in analyses, and may be considered the purest found in commerce. Potash, if not the strongest, is at least one of the strongest of the bases, and forms salts that are very permanent—all of which are soluble in water; such as are but slightly so being rare exceptions. In agriculture it is never used alone, but in combination with substances produced in the arts or found in certain localities, as geological formations, such as green sand, occurring along our eastern littoral, (sea shore between high and low water), varieties of feldspar, lavas, etc. Potash is widely diffused throughout nature. It enters into the composition of animals and plants, and of all the soils which support vegetation; and it forms one of the constituents of the predominant rocks of which the earth is composed, such as granites, mica-schists, the sienites, lavas, basalts, etc. Where the soil is formed from a rock in which there is no potash, it would be useless to seek it, or to anticipate fertility without supplying this element. (See Manures.)

POTASSIUM. The metallic basis of potash; it is white and brilliant, but soft as wax, lighter than water, specific gravity 86, and spontaneously inflammable on water. Its compound with one equivalent oxygen, potash, is one of the most important chemical agents; a powerful base and an alkali.

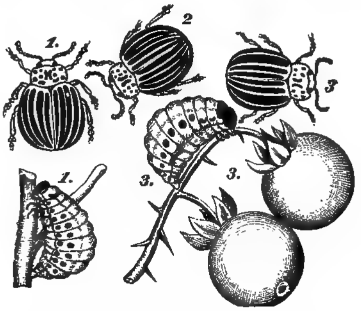
POTATO. *Solanum tuberosum.* The potato is one of the most important of field crops, as food for man, ranking next to wheat, its limits of cultivation being carried further north than that of spring wheat and extending south to the equator. One of the singular circumstances in connection with the common name of the potato is that it should be called Irish. This was undoubtedly caused from the fact that early in this century it became the principal sustenance of the Irish peasantry. According to the younger Hooker, the wild species has passed into several varieties. The cultivated species are innumerable, and each year adds a host of new varieties as candidates for popular favor. In its wild state, the tubers never exceed two inches in length, and the flavor is insipid but not bitter. In Chili and Peru, it is peculiar to hilly or rocky soils, and found near the coast. The cultivated potato is a native of America, but tuberous solanums are found in the East and West Indies, having the ends of the stolons thickened into tubers, as *S. commersonii*, *S. Maglia*, and *S. immite.* In Mexico, there are also tuberous solanums, as *S. demissum*, *S. cardiophyllum*, and *S. verrucosum.* This latter variety produces small, but well flavored tubers. In the Argentine Republic, in some of the mountain regions, a species of solanum grows wild, and is also cultivated for its tubers. The natural history of the potato leaves us in some doubt as to its original nativity. It was carried to England, in 1565, by Sir John Wamkins, from Santa Fe de Bogota, where it was found growing wild, at an elevation of from 8,000 to 13,000 feet above the ocean, in elevated valleys surrounded by high mountains, and above the range of Indian corn. The climate is dry and cool, and, being near the equator, is not subject to great extremes of heat and cold. An attention to this fact will be of advantage to cultivators of this crop in climates not so well suited to it. It is said to have been known, at that early day, in various parts of North America; and after its introduction into England, from Virginia, by Sir Walter Raleigh, in 1586, it began to attract more and more notice, until, at this day, the potato, as one of the root crops, and maize among cereals, have been among the most valuable food-producing plants ever bestowed upon man. From a history of the potato, by Bonjean, published in 1836, we find that it came originally from the intertropical parts of the American continent; that it grows spontaneously from Carolina to Valparaiso, in Chili. The celebrated Joseph Pavon, one of the authors of the Peruvian Flora, found it growing wild in the vicinity of Lima, Peru, where the Indians cultivated it abundantly for their subsistence. Lopez de Tomera, a Spanish priest, in his general history of the Indies, published in 1553, mentions the *Papas*, the name by which it was known to the Indians. Joseph Acosta says that the Peruvians employed it in lieu of bread roots, which they called *Chunno*, or they ate them fresh and boiled. Before its introduction into England it had already been very extensively diffused throughout the south of Europe. The botanist, Charles L'Ecluses (Clusius), about the year 1588, is said to have been the first European writer who mentions the potato. In 1631 he published a description of the root, and says that it was then so common in some parts of Italy that it was eaten by men and fed to hogs. He doubts whether it was known to ancients; thinks that it may have been the *Arachidna* of Theophrastus. Cortusus, another botanist, supposes that it was the *Pycnocoma* of Dioscorides. In 1590 Gaspard Bonhin received frem Scholtz a colored drawing of the potato, and recognized it as a solanum. Mathiola afterwards described it in his commentaries upon Dioscorides. It was in Italy that potatoes were first cultivated to any extent, and from thence it began to be spread over Europe, about the year 1550. The Italians called them Tartoffoli, or ground truffles, and from this is said to have come the German name, Kartoffle. Parmentier, in 1783, succeeded in introducing the potato into general cultivation in France, and spent much time and research in demonstrating, by chemical experiments, that the potato was both a healthful and nutritious food. The following is a summing up of an analysis of the potato, by the author first quoted, Bonjean: Starch, peculiar animal matter, bitter aromatic resin, Parenchyma (fibrous matter), Solanin, Asparagine, colored Albumen, a sugar principle, a gum principle, citrate of lime, citrate of potash, phosphate of potash, phosphate of lime, free citric acid, Silica, Alumine, Magnesia, Manganese, oxide of iron, Iode, Brome and water of vegetation. An analysis of the Mercer potato, by Charles T. Jackson, M. D., of Boston, Mass., gives in 100 parts by weight:

Constituents.	Per cent.
Water	75.80
Starch	12.54
Cellulose	3.62
Other matters, not separated	8.04
	100.00

In an analysis of the ash of the potato, according to Prof. Norton, it contains:

Chemical Elements.	Per cent.
Carbonic acid	10.04
Sulphuric acid	7.01
Phosphoric acid	10.03
Chlorine	2.07
Lime	1.08
Magnesia	5.04
Potash	56.55
Soda	trace.
Silica	8.06
Iron	0.05
Charcoal in ash, and loss	10.07
	100.00

After its introduction into England, by Sir Walter Raleigh, it was cultivated in Ireland in 1610, in Alsace in 1720, in Scotland in 1728, in Switzerland in 1730. Since this time its cultivation has been extended to every civilized country, and many barbarous ones, from the equator to the 64th parallel of north latitude, has added millions to the population of the earth, and has rendered almost unknown those famines which so often desolated the civilized world. Indeed, it has been said that if the sanguinary wars of the French Revolution had occurred before the introduction of the potato, that Europe would have been decimated by famine. Very many theories have been, from time to time, promulgated relating to the deterioration of the potato, principal among which are degeneration, or a wearing out of its vital forces, which nature herself has disproved by recuperating, in a measure, this valuable esculent. Another theory is that the disease is produced by excessive cultivation and high manuring, thereby inducing an extremely succulent and watery growth, and consequently a greater liability to be affected by atmospheric and other changes which are constantly taking place. That it is due to this cause, measurably, is more than probable, from the fact that the potato, when given its true, or normal condition, i.e. a cool and equable temperature, allowing it to make its growth without subjecting it to violent atmospheric changes, it uniformly produces fair crops, as, for instance, if we plant early varieties early in the spring in the Northern States, upon new or fibrous soil, however well manured, we may confidently expect to harvest a good crop about the first of August; and also, if we plant in June, we may expect to gather a crop in September or October, if the season is proper, that is, not wet and hot; these are conditions that are not suitable to a healthful growth of the potato. In fact, a season that produces good wheat is apt to produce good potatoes, but a season that is subjected to violent extremes of heat and cold, especially upon highly manured soils, is sure to deteriorate and reduce the potato crop. The effect of high cultivation, and strong and especially green manures, is such as to induce an extremely succulent growth of vines, and while in this condition, if such weather occurs as would cause rust in the wheat plant or rot in fruit, the cells, being gorged with sap, are ruptured, and decomposition taking place, it is immediately seized upon by microscopic fungi, and unless seasonable weather succeed the poisonous matter is communicated to every part of the plant, and a total destruction of the plant ensues. That it is due to atmospheric causes, in a great measure, there is no doubt, and it is also as true that a hot murky atmosphere is the superinducing cause. Indeed, the disease has not been confined exclusively to the potato, for about the same time, we have accounts of similarly affected bulbs and roots, as tulips, hyacinths, the sweet potato, various vegetables and fruits, as tomatoes, the yam, the cocoa, apples, peaches, pears and other fruits. That it is due to engorgement, or something analogous, is probable—the rupture of the plant cells presenting a proper nidus for microscopic insects and fungi, the vitality of the plant is more and more impaired, until finally, as in the case of annuals, they are completely destroyed; but perennials may linger from year to year, until they finally succumb, or, during more favorable seasons, eventually recover. This is a principal reason that we find certain plants growing within certain isothermal lines, or where the temperature is natural to them, and it is not strange that the potato, requiring as it does such peculiar conditions for its normal development, being transplanted to such a variety of climates, should become diseased, and the seeds of that disease be carried, perhaps, to every country where it is cultivated. The potato requires a cool, equable climate. Michigan and Wisconsin are celebrated for their fine crops of potatoes, so are Maine and Nova Scotia. Now it is known that the climate of Michigan, nearly surrounded as it is by extremely deep water, and protected besides by dense forests, has a comparatively equal climate; it is warmer in winter and cooler in summer, not subject to so violent alternations of heat and cold as are the more open countries in the same latitude lying west of lake Michigan. In fact the delicate Carter potato was, for many years after it ceased to be profitable elsewhere, successfully grown on the Eastern shore of lake Michigan, 200 miles north of Chicago, upon the clearings of the dense forests, for the reason that their summers, although short, are marked by a steady degree of heat and moisture, sufficient to mature the crop; so of Maine and Nova Scotia. Wisconsin is subject to greater atmospheric variations, lies nearer the great treeless prairies, but is at the same time sufficiently protected to be exempt from the more violent extremes. Indian corn requires a much greater average heat to mature its crop than the potato, but at the same time it will stand greater extremes of heat and cold. The least frost blackens the potato vine, but the corn simply turns yellow, subsequently recovers, and under favorable conditions as to moisture and heat matures its crop. The theory of degeneration as producing the potato rot, is essentially this, that reproduction, by extension as by layering, by cuttings and by eyes, tends so to impoverish the vital energy of the plant from generation to generation, that it continually becomes more and more weakened, until finally it dies. Now plants, as well as animals, may be called both viviparous and oviparous, not scientifically, but, as a condensed illustration; and some plants, as the potato, dahlia, artichoke, etc., are both oviparous and viviparous—oviparous as reproducing themselves from seeds or ovules, and viviparous, reproducing themselves by tubers, or offsets or buds. Now the seed, in order to reproduce the living organism, must first undergo certain changes, must be placed in its nest and be hatched; but in reproduction from the bud, it is fed by the sap itself until it has put forth its roots and leaves and is enabled to draw from the earth its proper nourishment. It seems to be a law of nature that the higher we breed either the animal or plant, the more susceptible it becomes to climatic and other changes; that the more we refine the more delicate becomes the tissue; that the higher we feed the more liable are we to engorge, and with engorgement comes rupture, disease and death. We have forced the potato, by high feeding and extreme culture, into excessive growth; under certain atmospheric or other conditions, engorgement ensues, the cellular tissue is ruptured, the vitiated sap decomposes, fungi attack it, and unless assisted by other conditions favorable to the normal condition of the plant, finally ends in its complete destruction, or partial disorganization, leaves it in so feeble a condition that it is not able to fully elaborate its starch, and instead of the dry, mealy potato, we have the soggy, waxy and watery one. It is no argument, for it is only a theory, against the theory that reproduction from seed does not bring it back to a healthful condition, for the seed being but a minute part of the whole plant, may necessarily be diseased from the parent, and might, perhaps, continue so for generations, until it wears out just as fever and ague wears out upon the human patient. But under fortuitous circumstances, it may at last regain its original health and vigor. The history of potato culture in the West shows plenty of failures, resulting from plantings in the month of May and early in June, for the reason before stated that the hot sun and dry atmosphere of July and August; or else the sudden alternations of wet and dry, hot and cold, are not conducive to the steady growth which the potato requires. But even under these circumstances, we may measurably succeed, by mulching, when the conditions are such that early planted ones do not perfect their growth before the heat of summer ensues. Upon clay or heavy loams, we advise planting as early in the spring as possible, upon deep fall plowing, by marking the land three feet apart, making a deep narrow furrow, which will of course be left filled with the fine earth. If you plant in hills, mark the other way, two feet apart, and put two strong single eyes in each hill. If in drills, plant the eyes about ten or twelve inches apart, stepping upon each piece in order to press it firmly into the earth, or if two rows are planted at once, this must of course be omitted, in which case a roller may be passed over the land before covering by the cultivator or hiller. Notwithstanding the assertion that it makes no difference whether the eye lies uppermost or not, it is bad practice to allow some eyes to lie up and some down, since they do not appear above ground at one time. Have them lie in the furrow as they are to grow, the eye up; cover about four inches deep. As the weeds start, or from rain, a crust forms, harrow thoroughly with a light drag, and continue to do so as often as necessary, until the rows can plainly be seen, then with any suitable implement, turn a light furrow away from the potatoes, and within four or five days turn it to them again, and continue to earth them from time to time, until at the time of blossoming the vines will be supported by a moderately broad and high hill. If the vines now grow so as to cover the ground and shade the ridges or hills, you may confidently expect to harvest a crop, unless the season is unfavorable, that is, wet and hot, or with alternations of heat and cold. We have gathered fine crops by filling between the hills with litter or fine manure, to obviate the effects of heat and drought. What the potato most craves is a moist, equable temperature of the earth, which can only be obtained, in variable seasons, by having the ground covered with the vines or mulch. If these conditions are secured you will not be much troubled by weeds, but if so you must get them out by hand or otherwise. Neither potatoes nor any other crop will thrive among weeds. In case blight attacks them severely cut the tops, but if slight leave them alone—they may recuperate; and in no case when attacked by disease should you dig them to save them, they are safer in the ground than out, unless the land is very wet, in which case, if they are dug, they should be spread thinly, and some absorbent, as lime, powdered charcoal, or dry muck, mixed with them. When thoroughly ripe they may be dug and placed in narrow piles to sweat and dry, after which they may be stored where they are to remain through the winter. More attention should be used in the storing of potatoes than is generally allowed. Those intended for eating should be kept as much as possible from the light and air, and all potatoes should be kept at such a temperature as to prevent germination; but potatoes intended for planting certainly sprout more kindly and more quickly if they are exposed to the air sufficiently in the fall to become even greened before storing, on the same principle, perhaps, that the roots of trees dug in the autumn and healed in, get calloused and ready for growth in the spring. The planting of small potatoes can not be too much deprecated, and why otherwise intelligent farmers will practice planting inferior and small potatoes, and at the same time be so careful in saving seed of corn and other cereals, is something wonderful. A crop may be reduced one-half in four years by the experiment. A single strong eye, with a liberal quantity of tuber attached, is as good as more. In planting whole potatoes none but the strongest eyes grow, while if all the apparent eyes are cut out there will still be latent eyes, which, under favorable circumstances will germinate. The small potatoes, however, in this day of high prices, may be utilized thus: Select a certain portion of the best potatoes, sufficient for the seed of the next year to be saved from, and if you continue this practice from year to year, you may plant the small potatoes for the market crop; but in no case must seed be saved from the produce of these small potatoes. It is not necessary that we send long distances for change of seed. We have proved, from our own experience, that plants will not degenerate if care is taken to save seed from the best specimens, but will, on the other hand, improve yearly. The potato is liable to the attacks of a number of insects. Those doing the most damage are cut worms eating the young shoots, the white grub which eats the roots to some extent, but whose principal mischief is in eating holes in the tubers. The most destructive insect, however, is the Colorado Potato Beetle. The cut above at 1, 1, shows the beetle and larva of Colorado potato beetle; 3, 3, *D. juncta*, of the South which feeds on the horse nettle: 2 shows an apparent cross between the two, in which the thick heavy line of the juncta is supplemented with a yellowish line running partly through it longitudinally.



POTATO FLY. *Cantharides.* There are many varieties.

POTATO STARCH. The farina of the potato.

POTTER'S CLAY. Plastic clay either of a white or red color.

POTTING. The placing of young plants in pots. The chief end attained by potting is the power, says Lindley, of moving plants about from place to place without injury; greenhouse plants from the open air to the house, and the reverse; hardy species, difficult to transplant, to their final stations in the open ground without disturbing their roots; annuals raised in heat to the open borders and so on; and when this power of moving plants is wanted, pots afford the only means of doing so. It also cramps the roots, diminishes the tendency to form leaves, and increases the disposition to flower. Another object is to effect a secure and constant drainage from roots of water; a third is, to expose the roots to the most favorable amount of bottom heat, which can not be readily accomplished when plants of large size are made to grow in the ground, even of a hot-house; and finally, it is a convenient process for the nourishment of delicate seedlings. Unless some one of these ends is to be answered, and can not be effected in a more natural manner, potting is better dispensed with.

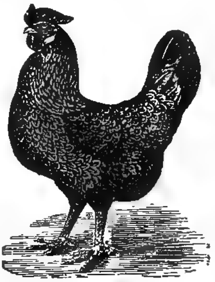
POTTING PLANTS. The successful florist knows that the best soil for plants is a normal one, or one in which it naturally grew, and naturally seeks to give it those conditions as near as he can. All this requires a pretty extensive knowledge, not only of the habits of the plants themselves, but of soils also. But the normal condition of a plant is not to have its roots cramped in a pot. So, the cultivation of plants in pots must be entirely artificial in practice. One natural supposition of the amateur is, therefore, the richer I can get the earth in my pot, the better, and to this end he makes it fat with strong manure, or the larger the pot the better for the plant. Yet both these natural propositions are wrong in practice. A soil exceedingly fat tends to disease in plants, in artificial culture. A large pot tends to increase growth at the expense of bloom. A six inch pot is amply large for ordinary house plants. The soil should be pure, what is known as a sandy loam, enriched with none but the most thoroughly digested compost—that is, manure and soil so thoroughly seasoned, tempered and worked that rankness no longer exists. Again, the florist depends largely upon liquid manure to stimulate the plant when it needs it. For this there is nothing better in the West than blood or offal manure. To use this dissolve from one-quarter to one-half pound in a gallon of water. Give this on the surface, once a week or ten days, as the plants seem to need it, and in quantities only sufficient to moisten the soil of the pot, allowing so much soft, clear, tepid water from time to time as the plants may need. When guano is substituted, from one to two ounces will be sufficient, beginning with the smallest quantities and noting the results. If the fertilizers named are not easily procured, prepare a tight barrel with sticks and straw at the bottom, to form a receptacle for the liquid at the bottom, as in setting up a leach tub, set it where it will not freeze. Mix a peck of hen or pigeon manure, with sufficient barnyard scrapings to fill the barrel, well packed down, pour on rain water until it stands in the hollow at the top, and draw from the bottom from a plug as wanted, adding more water from time to time as needed. As you draw from the bottom, dilute properly and apply as before directed. In shifting from one pot to another use only a size larger than the plant had before. An easy way to proceed is to select the pot, cover the bottom with bits of crock or broken flower pots, cover this with sharp sand and rich compost, half and half. Put into the larger pot, one a size less than the one containing the plant, filling about it good compost earth well packed down. Lift out the pot and fill with earth, so the ball of earth with the plant to be placed thereon will reach to within a half inch of the rim of the pot. Set in the plant, press in the earth about it, and fill up with more soil if necessary, jar slightly to settle all firmly together, water, and the whole is as well done as possible, and in far less time than we have written it. If the plant has no ball of earth, the pot must have drainage as before directed, and filled with earth pretty firmly packed, so the neck of the plant—when the roots are spread—will just reach within half an inch of the top of the pot. Sift fine earth about the roots, pressing the soil well about them, filling only so full that when well settled it will be even with the neck of the plant or that portion at the old surface of the earth. Water and shade for a day or two and the plant should do nicely. To remove a plant from the pot in which it has been growing, turn the pot upside down upon the hand so the stem of the plant will come between the first and second fingers, covering the earth with the thumb and fingers. Strike on the bottom with the other hand, or jar the rim gently on some hard substance, and the ball entire will, as a rule, slip easily and intact from the pot. If the plant have a mass of roots next the side of the pot, trim them with a sharp knife as desired, and the whole is ready for re-potting. One thing should be remembered; liquid manure should not be given after re-potting until the plant is growing well, and the roots have filled the pots or nearly so. Thus a little observation and practical experience will soon enable the novice in floriculture to become expert.

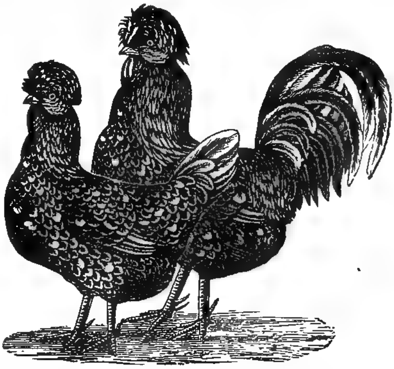
POUDRETTE. Poudrettes consist of blood, fish and animal matters, and night-soil, dried and combined with substances capable of deodorizing them and absorbing their ammonia, phosphuretted hydrogen, and other gases and moisture, and reduced to powder. A species of poudrette, fish manure, is prepared by steaming and pressing the fish, for the purpose primarily of obtaining their oil. The fish are steamed and subjected to strong pressure, by which the oil is forced out, and the residuum is left almost as dry as so much seasoned wood. It is then ground and packed in barrels for the market. All the poudrettes are packed in barrels or bags, and can be readily transported by land or water. When properly manufactured the poudrettes are very valuable manures. When applied to the roots of plants, in a soil well supplied with coarser manures, they give a vigorous start to young plants, and a larger development and a deeper tint to the petals of flowers. When applied in the hill they give to young plants a fine and early growth. They are rapidly decomposed in the soil, and should always be so deeply covered that their evolving gases may be retained by it. Poudrette should be used over a surface of ten or twelve inches square, rather than thrown in a mass around the seeds or roots of young plants. If the soil is cold, or the season backward, the good effect is soon manifest.

It is with poudrettes as with other commercial manures; without a well attested affidavit of the constituent parts, they should never be purchased. This should show the nitrogen and phosphorus contained, especially since these are the valuable elements. Poudrette prepared from night soil has especially given dissatisfaction in many cases, it not being found as valuable as good barnyard manure. If the poudrette is made from fish, flesh, blood, and the tank stuff of rendering establishments, and thoroughly condensed, from 300 to 400 pounds per acre will be sufficient in connection with barnyard manure.

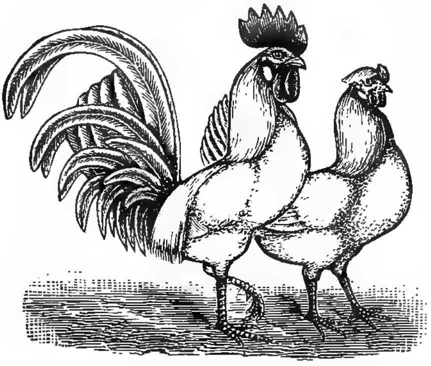
POULTICE. An external application employed for promoting the suppuration of tumors, or abating painful inflammation. The chief intention of the poultice is to retain the heat on the tumor for a sufficient length of time; consequently, corn meal and linseed meal are the best fitted for poultices. The fatty matter usually added is to give softness to the poultice, which is otherwise apt to harden as the moisture evaporates. Few farmers are aware of the value of these simple applications in abating inflammation, relieving pain, cleansing wounds, and disposing them to heal. The poultice may be rendered more soothing by opium, or in cases of foul ulcers powdered charcoal may be added. As an emollient poultice for grease and cracked heels, and especially if accompanied by much unpleasant smell, there is nothing preferable to a poultice of mashed carrots with charcoal. It is always best to enclose poultices in bags. Hot poultices are made with enough boiling water to bring them to a proper consistency. Hot poultices favor suppuration and should not be applied to fresh wounds. Cold poultices are made precisely as hot ones are, but allowed to get cold before using. A cold poultice of ripe cranberries is almost a specific in the earlier stages of erysipelas.

POULTRY. The term poultry is, strictly speaking, applied to the gallinaceous tribe. The French *poule* signifies a hen, and *poulet* a chicken. The Italian *polla* a chicken, and *pollame* poultry. In Latin *pullus* is a chicken, or other allied young animal. In its broad sense it is now used to designate all barnyard fowls, including ducks, geese, Guinea fowls, turkeys and peafowls. Since the days of improved breeds of poultry the industry has been vastly augmented, and various schemes have been devised for keeping them on a large scale, few of which have proved to be paying investments, and principally from the fact that the gallinaceous tribe, especially, require a wide range and plenty of exercise and pure air to keep them in health. Another class, who buy up young birds and fatten them for market, have succeeded better, and this would seem to be the true policy, since more than from 100 to 300 birds can not be profitably kept on the same range unless so divided up that they do not come in contact with each other. Even then they must be allowed to range partly at will, in which event they will be found to be great exterminators of insects, especially the young chicks. Particular care, however, must be taken with the young birds. They must be fully fed and the weaker ones protected from the stronger, else no after amount of stuffing will increase their frames. In relation to profits and increase two committees of the Massachusetts Agricultural Society, some years since, reported as follows: The Middlesex South committee give the following statements: Fifteen hens, mostly Leghorns and Black Hamburgs, laid in ten months 191 dozen eggs. Profits on eggs sold, chickens raised and sold, etc., $89.81; expenses, twenty bushels of corn, $24; net profit, $65.81. Fowls were allowed to run at large, and were fed well three times a day, Another lot of fifteen hens and one cock, mixture of Leghorn and native breed, laid 181 dozen eggs, which, with sixteen chickens, brought $66.78; expenses nine bushels of corn and six bushels of barley, $18.75; net profit, $58.03. Fowls run at large, fed twice a day in winter and once in summer. A flock of 113 Brahmas, in September, 1866, increased to 163 in one year, besides supplying eggs to the amount of $232.80; fowls sold, $75.28, making, with the fifty increase in flock, $408.08; expenses, $145.03; net profit $263.05, taking no account of the droppings of the chickens. The Bristol Central Committee recommend the Brahmas and Dorkings for the table; the Leghorns and Hamburgs for eggs; the Games and Dorkings, where all qualities are required of a high degree of excellence; and if pure breeds are not wanted, at least a game cock to improve the stock of every yard. When large numbers of fowls are to be kept, at least an acre must be allowed to each 100 hens, and if this is covered partially with brush so much the better. Constant care and vigilance are required, when keeping poultry in large numbers is followed. Tegetmeier, upon the subject of keeping poultry says: Fowls are either kept for the table or for eggs In the former case, the object is to prepare the young birds so as to be fit for market at the earliest possible period. It is evident that they are not only better in quality, but that they realize a larger sum, if they are well fed; and as young birds have consumed a smaller amount of food, on account of their shorter lives, they must of necessity return a larger profit than older ones. Eggs, again, can only be produced by the hens out of the materials furnished by their food. A scanty supply of the former is therefore the inev-

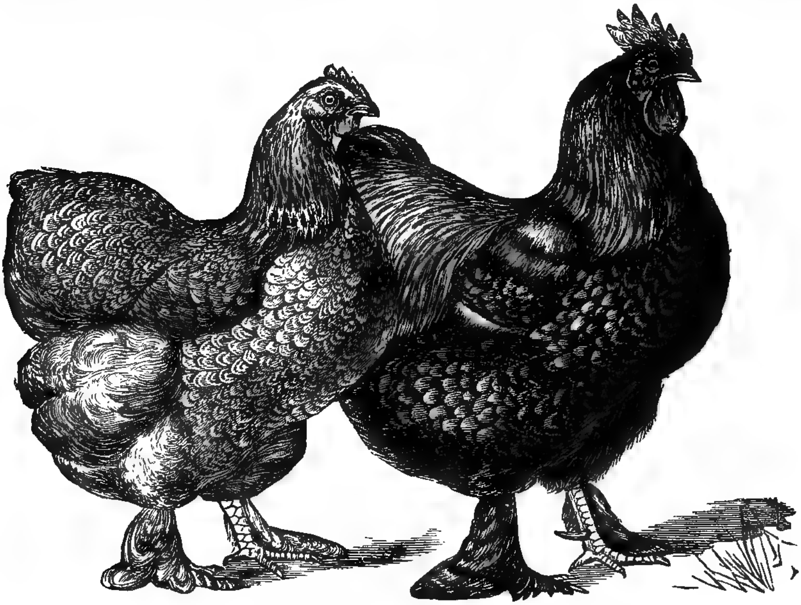

BROWN LEGHORN HEN.


HOUDANS.

itable result of a short supply of the latter. In winter, when eggs are most valuable, this is particularly shown; for as there is then no insect or other food to be obtained by scratching, the production of eggs diminishes remarkably, unless the fowls are very well fed. As regards the number of times the stock fowls should be fed, we believe the most economical mode, when fowls have a free range, is to feed twice a day. The fowls should be let out early in the morning; in fact, if there is no fear of foxes or other thieves, the hen-house had better be left open, so that the birds can come out at will. This they will do at daybreak, and, by wandering over the fields, secure a large amount of worms and insect food. They should receive their morning meal at a fixed hour: immediately after breakfast is usually a convenient time. It may be asked, how much corn should be given per head? We believe it to be quite impossible to give to that question an answer that would be of any practical value, so much depends on the size of the birds; it is obvious that a Dorking of ten pounds weight, and a Game fowl of five pounds, would require very different quantities of food. Again, the quantity must vary with the season of the year, much more being required to keep up the due amount of animal heat in winter than in summer. The work going on in the farm-yard, and the number of birds that are laying, will also influence the amount required to be given; for when a hen is producing eggs, she will eat nearly twice the amount of food that she requires at another time. The best rule, both as to quantity and time, is to give the fowls a full meal in the morning, and a second shortly before going to roost. Many persons feed their fowls only once a day, usually in the morning; the consequence is that they go to roost with empty crops, and as the nutriment they have collected during the day is required to keep up the animal warmth, particularly during the long cold nights of winter, it can not be employed in the production of eggs; thus feeding hens once a day is not favorable to their fertility. It is necessary, therefore, to feed liberally twice a day, if any large amount of profit be desired from fowls. There is one great advantage dependent on having fixed hours of feeding, namely, that the birds soon become accustomed to them, and do not hang about the house door all day long, as they do if irregularly and frequently fed. They consequently obtain a greater amount of food for themselves, and are less troublesome than they otherwise would be. If fowls have not a free range where they can obtain green vegetable food, a supply is indispensable to health, and it is as well to vary it if possible. In winter, a swede turnip may be cut across, and thrown down for them to peck at. In summer, cabbages should be supplied daily; or, what is still better, lettuces, especially those running to seed. The avidity with which these



WHITE LEGHORN.



PARTRIDGE COCHINS.

are devoured by fowls and turkeys is remarkable. Vegetable food may be advantageously cooked and mixed with meal, as a change. Small waste potatoes, boiled or steamed till soft, form a cheap and useful occasional food; but the fowls soon become tired of them, and they should only be used at intervals. In addition to wholesome and abundant food, a supply of clean water is indispensable. Some kind of fountain is often more convenient than an open vessel, in which the water is apt to become dirtied by the fowls. A very cheap and convenient contrivance of this kind may be made out of an earthenware jar and an ordinary glazed flower-pot saucer, by boring a small hole in the jar an inch and a half from the edge. When required for use, the jar is to be filled with water, and the saucer placed bottom upwards on the top. Both together are then to be turned quickly over, when the water will be found to flow into the saucer to the same height as the hole in the side of the jar. Some of the most successful rearers of chickens and pheasants are in the habit of administering to the young birds a chalybeate tonic in the water given them to drink; and they speak very highly of its good effects in those cases where broods are weakly, or where the young fowls are inclined to outgrow their strength. For this purpose an ounce of sulphate of iron (green vitriol) may be dissolved in a quart bottle of water, and two or three spoonfuls of this solution added to the water in the drinking-fountain, sufficient being supplied to give it a slight inky taste. The effect of this chalybeate on the health and vigor of the birds is very marked; their combs brighten in color, their appetite increases, and their general stamina is much improved. This mixture is practically identical with many of the poultry nostrums extensively advertised. Water fowl, ducks geese, etc., do not require large bodies of water as has generally been supposed. A small pond that may be kept clean in which they may bathe is all that is required, and even when there is no water save for drinking they do fairly well, when only a few are kept. Turkeys require and must have a considerable range, and they must also be allowed full liberty with their young after they begin to feather, else they will surely not be kept in good health. The same may be said of pea, and Guinea fowl. (For respective breeds, see articles under the respective names.)

POUND, LB. The avoirdupois contains sixteen ounces, and 7,000 troy grains. The troy pound twelve ounces and 5,760 grains. Also, an enclosure for cattle. In England a penal enclosure for trespassing cattle.

POUPART'S LIGAMENT. A tendinous expansion, running from the top, or *crista*, of the ilium to the os pubis, under which hernias protrude.

POVERTY GRASS. *Aristida dichotoma.* A grass growing on sterile places.

POWER. In mechanics, denoting a force which, being applied to a machine, tends to produce motion. A mechanical power denotes one of the six simple machines, viz: the lever, the inclined plane, the screw, the wheel and axle, the wedge, and the pulley. The mechanical horse power is estimated as being a force sufficient to raise 33,000 pounds to a height of one foot in a minute. This is the unit or standard by which steam engines and other prime motive force is measured, and is now in universal use for such measurements of applied force as relate to machinery.

POZZUOLANA. Volcanic ashes, used in making hydraulic cements.

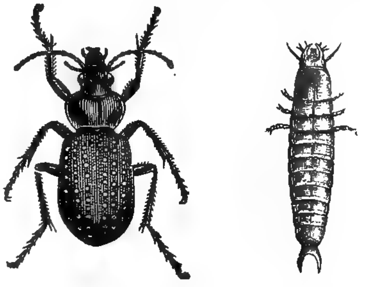
PRÆCORDIA. The fore part of the chest.

PRÆMORSE, BITTEN. Short thick roots which appear to have been bitten.

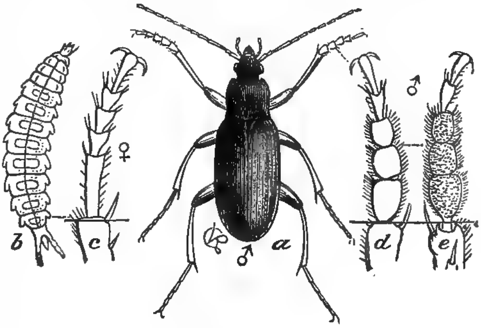
PRAIRIE. This name is given to the immense tracts of grass land occurring throughout the West. They are usually gently rolling or undulating lands, the grass of which is thickly matted, and from a few inches to three or four feet high, being most luxuriant in wet, swampy places. The prairie is often adorned with beautiful flowers in spring, and throughout summer and fall. The grass is of various kinds, some being of great value; the whole is, however, nutritious, and sustains cattle, horses, and sheep remarkably well.

PRECIPITATE. A solid matter thrown down in a clear fluid by chemical action.

PREDACEOUS BEETLE. The predaceous beetles are among the most beneficial in agriculture, since they prey exclusively upon insects, and principally on noxious ones. There are two principal classes of these, the predaceous ground beetles, the most useful, and the soft-winged predaceous beetles. In the first class we have the *Cicinelidæ* or Tiger beetles, and the *Carabidæ* or Ground beetles; the latter divided into a number of subfamilies. *Calosoma calidum*, (see cut), is one of the most useful of these, the beetle and larva of which is given above. The beetle is an inch in length, with three rows of golden dots on each wing cover, and is predaceous both in the larval and perfect state. This division of the subfamily Carabides embraces the genera *Carabus*, *Calosoma*, and

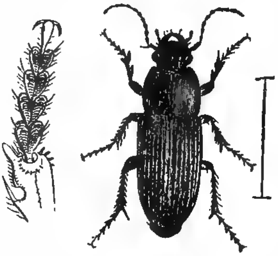


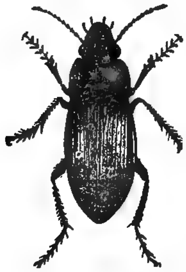
GROUND BEETLE AND LARVA.

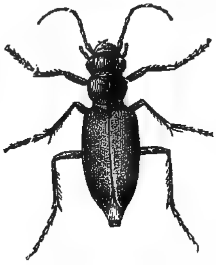


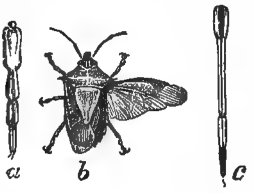
CHALÆNIUS.

Cychrus. The preceding cut shows *Chalænius Pennsylvanicus*, of the subfamily Chalænides; *a*, male beetle; *b*, larva; *c*, *d*, *e*. front tarsus of male and of female magnified. Harpalus Pennsylvanicus is a nearly related species, as also is *H. caliginosus*. The family Harpalides embrace a very extensive group of beetles little inferior to all the other subfamilies noticed. They are black or dark metallic in color as a rule, and their size is limited in its range from a quarter of an inch to a little more than an inch in length. Their distinctive characters are difficult to determine except by an entomologist, and are omitted. In *Harpalus Pennsylvanicus*, however, we have shown the under side of the anterior tarsus of the male magnified, showing the two rows of scale-like papillæ, and near the end is the notch so characteristic of the anterior tibia of the tibiæ spurs at its upper angle as delineated by Dr. Riley. The Virginia Tiger Beetle (*Tetracha Virginica*) also belongs to the predaceous ground beetles, and the name well expresses their fierce voracity in their attacks on other insects. It is one of the insects attacking the Colorado Potato Beetle, and the larva also feeds upon insects, and indeed the larva of its own kind, if it find them. Another insect often mistaken for the Squash Bug, and thus destroyed, is the Spined Soldier Beetle, one of the most persistent in its attacks on the Colorado Potato Beetle, but feeding on various insects. The Plant Bug is squarer than the Soldier Beetle, and its beak is sharper and larger. The cut at *a*, shows the beak of the Soldier Beetle, *b*, the beetle, *c*, the beak of the Dotted-legged Plant Bug (*Euschistus punctipes*). The Plant Bugs should be destroyed and the Soldier Beetles protected wherever found for their services as exterminators of noxious insects.


HARPALUS PENNSYLVANICUS.


HARPALUS CALIGINOSUS.


VIRGINIA TIGER BEETLE.



SPINED SOLDIER BEETLE.

PREDISPOSING AFFINITY. Chemical affinity arising in the presence of three bodies, whereby a union is accomplished between two, which, without coming in contact with a third, would not readily unite.

PREGNANCY. (See Gestation.)

PRESERVING MEAT. (See Curing Meat.)

PRICKING OUT. Setting small plants in drills, etc.

PRICKLE. A sharp thorn, produced by a thickening of the bark or skin of the plant.

PRIMÆ VIÆ. The passage through the bowels.

PRIMARY ROCKS. The unstratified, crystalline rocks, as granites. Sometimes the transition slates and stratified rocks are included in this term.

PRIMINE. The outermost covering of the ovule; afterward it becomes the skin, or testa, of the seed.

PRIMROSE. Flowering perennials of the genus *Primula*.

PRISM. A solid contained by planes, of which two that are opposite are equal, similar, and parallel, and all the rest parallelograms. Prisms take particular names from the figures of their ends, or opposite, equal, and parallel sides When the ends are triangles, they are called triangular prisms; when the ends are square, square prisms; when the ends are pentagonal, pentagonal prisms; and so on. A right prism has its sides perpendicular to its ends; an oblique prism is that of which the sides are oblique to the ends. The solid contents of a prism is found by multiplying the area of the base into the perpendicular altitude; hence all prisms are to one another in the ratio compounded of their bases and altitudes. The optical prism is of three similar sides.

PRISMATIC COLORS. Light passing through a prism is divided into seven colors, called the prismatic spectrum; these colors are, in their order, red, orange, yellow, green, blue, indigo, and violet. They have each peculiar properties.

PRESERVING WINTER FRUIT. The result of long and diversified experience in keeping fruit may be summed up in a single sentence: keep them dry, cool, and as nearly as possible from contact with external air. How to do this under ordinary circumstances, and with the facilities at command, is the question. For winter keeping they should be allowed to hang on the tree as long as possible, or, until there is really danger of their freezing, leaving those least affected by early frosts and most tenacious in their habit of hanging late, to the last. When the fruit is perfectly dry and free from dew, and, on a cool day if possible, pick them by hand, placing them, a basketful at a time, into clean, sweet, dry, tight barrels, using the greatest care that they be not bruised; or, better, use a pouch or sack for picking in. Invert this in the barrel and turn them carefully out. Thus there is no possible chance of bruising the fruit. In this condition if they are entirely dry, cool, and sound, they may be immediately headed up, pressing in the head so there is no possibility of the fruit being shaken about—and wheeled to a cool, airy place in the barn, a shed or outhouse, where they may remain until hard weather. Above all things, avoid placing them where the sun will shine on the barrels, or where they may be subjected to considerable changes of temperature. When cold weather comes, they may be removed to a dry cellar, or, better, a fruit room, if such be had. Here the temperature should be kept as low and uniform as possible. Leave the cellar windows or ventilators open in winter, unless the temperature is such as to freeze the fruit; then, if warm spells intervene, close the ventilator at such times to keep out the heat. In spring close the windows during the day, and leave them open at night. In other words, when the weather is warmer out side than in the fruit room, keep the whole close, and *vice versa*. Fruit when confined in tight barrels, retains the carbonic acid given off by the fruit in the spaces between themselves. If the barrels are open, and especially if there be an excessive draft of air, the carbonic acid is forced out and the spaces supplied with air. This is what causes the apples to rot. The principal thing therefore to be avoided is, contact with air, undue heat and consequent sweating in the barrel. This last is not likely to occur if care has been taken in picking the fruit when cool and dry, and in packing and keeping the packages cool thereafter. We have seen it stated that if apples are packed in entirely dry barrels in which salt has been packed, they will be found sounder in the spring than in ordinary barrels. However this may be, salt barrels are not available except in isolated cases. Salt in a state of perfect dryness will take up a large amount of water, and hence such barrels may be of advantage when excessive sweating ensues. So, absolutely dry barrels will be indicated. The advantage of tight barrels, as previously stated, is that they retain the carbonic acid and exclude the air.

PRESERVING SMOKED MEATS. We do not consider the smoke house, as ordinarily built, to be the best place to preserve cured meats. Our July and August suns are generally so hot as to cause the fat parts to melt more or less, and this destroys the integrity of the whole. The very best way we know is to wrap the meat in thick brown paper, and enclose each piece separately in sacks made to fit. Sew tight; dip them in a preparation of slacked lime, of the consistency of ordinary paint. Then the pieces may be packed in barrels, with plenty of ashes, or better, pounded charcoal, and kept in a cool, well ventilated cellar, or in the coolest place in the barn. Another plan is to wrap in paper as before directed, then in an outer layer, and pack in barrels with some good absorbent. Still another plan is, after wrapping in thick brown paper, to pack in barrels with plenty of dry cut straw, examining them occasionaly to see they do not mold, if the weather is damp for any considerable length of time. By this plan, however, it is difficult to keep the meat from contracting mold if entirely excluded from light and air, and where light and air may enter insects and mold are pretty sure to follow. A smoke house built so as to prevent the admission of light, and at the same time insure ventilation and a degree of coolness so that the meat will not mold, may be had by placing it under the shade of a spreading tree. It should be built of brick, with an ample flue on top protected with blinds at the sides, and a wire gauze at the bottom to prevent the admission of insects, the gauze to be removed when smoking the meat. Another flue at the bottom protected with gauze allows the admission of air. Thus the house may be kept cool and well ventilated, and by throwing it entirely open occasionally at night, when dry, meat may be kept perfectly for a long time. This smoke house may be used for a variety of purposes, as for the keeping of ashes in districts where wood is used for fuel.

PRIVET. *Ligustrum vulgare.* A plant introduced from Europe, for the purpose of hedging, but now only used for ornamental hedges. It is hardy in the latitude of Chicago and is completely naturalized in the Eastern and Middle States and South. In the North, its leaves are killed after hard freezing weather sets in, but they remain attached to the branches sometimes nearly all winter. For ornamental hedging it is one of the prettiest of plants, its small glossy leaves producing a most pleasing effect. It stands the shears well, is of dwarf habit, and should be planted more than it is, in dry situations.

PROBANG. (See Choke.)

PROBE. A wire of silver, with a blunt or sharp point, used to ascertain the depth of wounds, sinuses, etc.

PROBOSCIS. A trunk, or nasal projection.

PROCESS. In descriptions, a tumor or eminence on a bone or part. A projection.

PROCUMBENT. Laying on the ground.

PROGNOSIS. A conclusion respecting the termination of a disease.

PROLAPSUS. A falling out or protrusion of any part of the body; as of the intestines, womb, etc.

PROLEGS. The imperfect legs of caterpillars; a wart-like tubercle.

PROMUSCIS. The suctional organ of the hemiptera.

PROPAGATING HOUSE OR PIT. (See Conservatory.)

PROPAGATION. Seeds are the most general means of propagation, but they do not perpetuate improved varieties, especially of fruits; buds do, however. Buds are propagated by budding, grafting, setting slips, cuttings, layers, offshoots, suckers, and in some plants, as the strawberry, by natural runners. The bulb is a peculiar bud, which propagates by offsets or buds. Tubers, or rhizomes, are underground stems, as in the potato, dahlia, flag, and they propagate the varieties also. Cuttings are portions of shoots, either of ligneous or herbaceous plants; and they are made of the young shoots with the leaves on, or of the ripened wood either with or without its leaves; and after they have, either in an herbaceous state with the leaves on, or with the wood mature, and with or without leaves, been properly prepared and planted, they form roots at their lower extremity, each cutting becoming a perfect plant. In general, cuttings should be taken from those shoots of a plant which are nearest the soil; because, from the moisture and shade there, such shoots are more predisposed to emit roots than those on the upper part of the plant. The young, or last-formed shoots, are to be taken in preference to such as are older, as containing more perfect buds in an undeveloped state, and a bark more easily permeable by roots; and the cutting is to be prepared by cutting its lower extremity across at a joint, the lenticels, or root-buds, being there most abundant. When the cutting is planted, the principal part of the art consists in packing the earth firm at the lower extremity, so as completely to exclude the air from the wounded section. Cuttings emit roots at this section, either in consequence of the action of the accumulated sap in the cutting, as in the case of the ripened wood in deciduous trees and shrubs; or in consequence of the joint action of the accumulated sap and of the leaves, as in the case of cuttings of soft wood with the leaves on, and in a living state. A few plants are propagated by cuttings of the leaves, the petiole of the leaf being slipped off from the parent plant, and probably containing the latent embryos of buds. Grafting and budding are processes which have been already explained. Inarching may be described as a species of grafting, in which the scion is not separated from the parent plant till it has become united with the stock. (See Grafting, Budding, etc.)

PROPEDS. The same as prolegs.

PROPHYLACTIC. Preventing disease.

PROPORTIONS, CHEMICAL. (See Equivalents and Atom.)

PROSENCHYMA. Elongated cellular tissue, as that of woody structures.

PROTEIN. The pure basis of the animal principles; it is separated from albumen, or fibrin, by dissolving them in caustic potash, and precipitating by acetic acid. It is gelatinous; gray; when dry, semi-transparent, and insoluble. It is a body of great interest, since in its combinations with sulphur, phosphorus, ammonia, etc., most animal tissues are formed.

PROTOTHORAX. The first segment of the thorax in insects.

PROTO-SALTS. Oxides; compounds, the bases of which are combined with but one equivalent of oxygen.

PROTOZOA. The lowest animalcules.

PROTUSILE. Capable of being protruded and withdrawn.

PROVENDER. Dry food. (See Fodder.)

PROXIMATE ANALYSIS. The separation of a compound organic body into its several complex parts, as the flour of wheat into starch, sugar, gum, fibrin, gluten, albumen. These are also called proximate principles. This kind of analysis is made by means of solvents, as alcohol, ether, water, potash, and acids; it is coarse and unsatisfactory.

PSEUDO. A common prefix, meaning false.

PTYALISM. Increased salivation.

PUBESCENT, PUBESCENCE. Covered with soft hairs.

PUCCOON. American alkanet. *Lithosphurmum canescens.* A perennial-rooted plant of the borage tribe, the root of which yields a red pigment, with which the Indians color themselves.

PUDDINGSTONE. A conglomerate.

PUDDLING. Ramming clay with sand and water until it is converted into an impervious mortar.

PUERPERAL. Relating to parturition.

PUFF-BALL. The genus *Lycoperdon* yields numerous puff-balls. The dust was at one time used to stop bleeding from wounds, as a styptic.

PUGGING. The stuff laid between floors to deaden sound.

PUGIL. A pinch of any stuff.

PULMONARIES. A kind of spider.

PULMONARY. Relating to the lungs.

PULQUE. The fermented juice of the Mexican aloe, (*Agave Americana*).

PULSE. Leguminous crops.

PULSE IN ANIMALS. The pulse of animals may be felt wherever a considerable artery passes over a bone. In cattle the pulse is soft and rolling, and in the horse full and rather tense, and when the pulse differs from this condition we may expect disease, or, if it be much slower or faster. If the pulse is rapid, full and hard, it denotes high fever, or acute inflammation; if it be rapid, but small and feeble, there is low fever, or loss of blood, or weakness. In brain diseases it is very slow, and in disease of the heart it is irregular, or at one time fast and again slow. In swine the pulse is felt by placing the hand at the left side next the heart: in sheep the same, or else when the femoral artery passes obliquely over the bone, about the middle of the inside of the thigh. In cattle it may be felt over the middle of the first rib, or beneath the tail. In the horse, it may be felt on the bony ridge extending upward from the eye, or on the lower jaw, just forward of the curved portion, and inside the elbow. The rapidity of the pulse of the adult healthy sheep is seventy or eighty beats a minute, or about that of man; in the ox from fifty to sixty, and in the horse about forty beats per minute, a state of rest being always implied. Hot, close stables, forced feeding, and when with young, always increases the pulse, and that of calves and colts will be about twice the rapidity of the adult animal, and the same is true of animals well advanced in old age. So, in determining the pulse, all these circumstances must be taken into consideration.

PULVILLI. The hairs, or a membrane, which covers the feet of some insects, enabling them to walk on the ceiling of rooms against gravity.

PUMICE. Porous lava. It consists of silica, 77.5; alumina, 17.5; potash and soda, 3.0; oxide of iron, 1.75.

PUMICED FOOT. In farriery, a wide-spread hoof, the sole of which is flat with the ground.

PUMPKIN *Cucurbita pepo.* Formerly the pumpkin was extensively cultivated for culinary use. Since the improvement in squashes they have been supplanted, and are now planted almost solely as food for farm stock, and usually among corn, often giving two or three good loads per acre in addition to the corn. The usual manner of planting is to drop a seed at every third or fourth hill, and every third or fourth row, at the first hoeing of the corn. Sometimes, however, the plants grow so vigorously as seriously to interfere with the late cultivation of the corn, and for this reason they are seldom cultivated in the West, except in localities where the corn is hoed by hand. The varieties usually planted are the Cheese Pumpkin, a variety strong and vigorous in its growth; the fruit much flattened, deeply and regularly ribbed, broadly dished about the stem; large, thick meated, and of good quality. The Connecticut Field Pumpkin is prolific, large, round, earlier than the Cheese Pumpkin, and is an excellent stock pumpkin. The Sugar Pumpkin is round, bright orange yellow, small, with a hard rind, prolific, and superior for pies, and always matures its crop, even in untoward seasons. The Canada Pumpkin is a sub-variety of the common field pumpkin. It is a hardy sort, adapts itself to a variety of soils, and ripens with surety.

PUNCHEON. A measure of eighty-four gallons.

PUPA. A nymph, grub, or chrysalis.

PUPIPARES, PUPIPARA. Those insects are said to be pupiparous which produce their young in the condition of a pupa or nymph, as the forest fly (*Hippobosca equina*).

PUPIVORES, PUPIVORA. The name of a tribe of hymenopterous insects, comprehending those of which the larvæ live parasitically in the interior or the larvæ and pupæ of other insects.

PURGATIVES. In farriery, such medicines as tend to evacuate the bowels by stool, and which are sometimes called cathartics. The purgatives most frequently employed for horses and cows are sulphur, jalap, aloes, gamboge, *Rhamnus catharticus*, and calomel. Saline purgatives are not often required; but when they are, Epsom salts (the sulphate of magnesia), is adequate for every purpose. Purgatives are less used now than formerly. Aloes is the best form of physic; but Epsom salts, linseed and olive oil, are sometimes used on certain occasions as laxatives with great propriety and benefit, and in gross, full horses, in some disorders of the stomach, liver, etc., but it should always be directed with caution. Violent purging or scouring, attended with inflammation, will sometimes arise when a horse is worked hard upon green food. The remedy is change of diet or less labor. Astringents should be used with much caution. It is probable an effort of nature to get rid of something that offends. A few doses of gruel will assist in effecting this purpose, and the purging will cease, without astringent medicine.

PURIFORM. Like pus.

PURLINE. In building, a piece of timber lying on the principal rafters to support them in the middle.

PURPURIC ACID. A red compound produced by the action of nitric acid on uric acid.

PURSIVENESS, PURSINESS. Shortness of breath.

PURSLANE. Pursley, pusley. *Portulacca oleracea.* A well known creeping plant said to be indigenous in the West, and universal as a weed, especially on warm, dry, sandy soils. It does not make its appearance until warm weather sets in, and is killed by the first general frost, springing readily the next season from seed. Once it gets a lodgment it usually retains it, since its growth is made chiefly after the cultivation of crops is over. It is much relished by swine, but should be exterminated so far as possible wherever found. Some of the cultivated varieties have beautiful flowers, white, pink, yellow and striped, both single and double, and once introduced spring annually from seed.

PUS, MATTER. A yellow, cream-like fluid formed in abscesses and from wounds. It contains globules, and is blood modified by inflammatory action. Healthy matter is that formed when a wound is healing kindly; unhealthy, is when the wound assumes a malignant form.

PUTAMEN. The shell of a fruit. The endocarp.

PUT LOGS. Short timbers used in scaffolding.

PUTREFACTION. The spontaneous decomposition of animal and vegetable substances, attended by the evolution of fetid gases. The putrefactive fermentation of animal substances is usually attended by more fetid and noxious exhalations than those arising from vegetable products. This appears principally referable to the more abundant presence of nitrogen in the former; and hence, those vegetables which abound in nitrous principles, such as most (if not all) of the cruciform plants, exhale peculiarly nauseous effluvia; hence, also, such animal products as are destitute of nitrogen, are either unsusceptible of what is commonly called putrefaction, or suffer it slowly and imperfectly. The formation of ammonia or of ammoniacal compounds is a characteristic of most cases of animal putrefaction; while other combinations of hydrogen are also formed, especially carburetted hydrogen, and sulphuretted hydrogen, together with complicated and often highly infectious vapors or gases, in which sulphur and phosphorus are frequently discerned. These putrefactive effluvia are, for the most part, easily decomposed, and resolved into new and comparatively innocuous compounds by the agency of chlorine; hence the importance of that body as a powerful and rapidly acting disinfectant. The rapidity of putrefaction and the nature of its products are, to a great extent, influenced by temperature, moisture, and access of air; they do not ensue below the freezing point, nor in dry substances, nor under the entire exclusion of oxygen; and hence, various means suggest themselves of retarding or preventing putrefaction, as well as of modifying its results. A temperature between 60° and 80°, a due degree of humidity, and free access of air, are the circumstances under which it proceeds most rapidly. The most effective antiputrefactives, or antiseptics, are substances which either absorb or remove a portion of the water or moisture, and enter into new combinations with the organic matter. The astringent or tannic principle of vegetables is also a powerful preserver of most organic tissues; it enters into chemical combination with the albuminous and gelatinous membranes and fibers; and the resulting compound, of which leather furnishes a characteristic example, is comparatively little prone to change, although the tanning material itself, as well as the animal principles with which it unites, are separately liable to decay. Among saline substances, the antiputrefactive powers of salt are commonly known: when a piece of flesh is salted, brine runs from it, in consequence of the energy with which the salt abstracts the component water of the muscular fiber: the flesh becomes indurated, and its susceptibility to putrefactive changes is greatly diminished; but it becomes at the same time less easy of digestion as an article of food.

PUTTY. In building, a fine cement of lime only. In glazing, a compound of linseed oil, and whiting.

PYLORUS. The passage or valve of the stomach into the intestines.

PYRITES. Native sulphurets of iron or copper.

PYRO. A common chemical prefix, indicating compounds modified by the action of heat, as pyrophosphoric, pyrotartaric acids.

PYROACETIC SPIRIT. A volatile, inflammable, and limpid fluid, formed by the distillation of acetate of lead. It is also called acetone.

PYROLIGNEOUS ACID. Acetic acid, procured by distilling wood. It contains creosote and other tarry compounds, but is extensively used to form solution of iron or red liquor for dyers. Its compounds are called pyrolignites.

PYROLIGNEOUS SPIRIT, PYROXYLIC SPIRIT. Hydrate of methylene, wood naphtha, a very volatile, inflammable fluid, from distilled wood. It is one of the most powerful antiseptics, but of unpleasant odor.

PYROMETER. An instrument for measuring degrees of heat above 600° Fahr.

PYROSIS. Acidity of the stomach, with a discharge of hot fluid into the throat and mouth.

PYROXENE. Augite.

PYXIDIUM. A fruit which splits into an upper and lower half, as that of the pimpernel. Pimpernel means two-winged.

Q

QUADRICORNES. A family of wingless insects, with four antennæ.

QUADRIFID. Four-cleft.

QUADRILATERAL. Four-sided.

QUADRIPENNATES. A tribe of insects provided with four membranous wings.

QUAGGA. A quadruped allied to the zebra.

QUAGMIRE. A muddy, soft bog or marsh.

QUAIL. (See Partridge.)

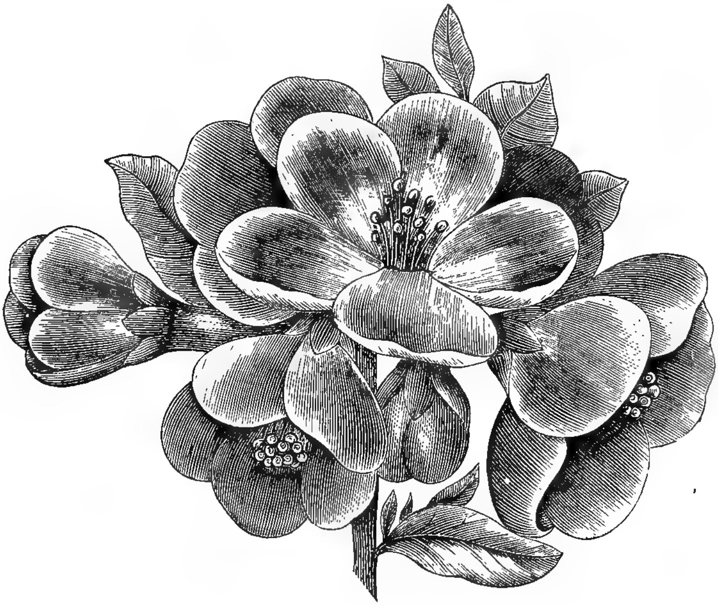
QUAKING GRASS. The genus *Briza.*

QUART. The fourth of a gallon.

QUARTAN. An intermittent fever, appearing every fourth day.

QUARTER. Eight bushels, a fourth part.

QUARTER AIL. (See Murrain.)



FLOWERS OF JAPAN QUINCE.

QUARRY. Any rock formation excavated, or from which the material is taken by blasting or otherwise.

QUARTZ. Silicic acid crystallized, rock crystal.

QUASSIA. A bitter wood (*Q. excelsa*), of South America. A strong decoction, sweetened with sugar, is a safe poison for flies.

QUEEN POST. In building, an upright post in a roof for suspending the beam when the principal rafters do not meet in the ridge.

QUERCITRON BARK. The inner bark of the Black oak.

QUICKLIME. Caustic, fresh-burned lime.

QUICKSILVER. Mercury.

QUICKS. Young white thorns.

QUICKSET HEDGE. A hedge of white thorn.

QUIDDING IN HORSES. The throwing out of the mouth of half chewed food is termed quidding. It is occasioned by some disease of the mouth, as sore gums, decayed teeth, swelling caused by obstructions of the ducts of the salivary glands, or by chronic enlargement of the glands of the lower jaw. The remedy is evident. In sore gums the remains of foul food should be cleaned from between the teeth, and the gums washed with a solution of chloride of lime, an ounce to a pint of water, and rubbing with tincture of myrrh until well. Swelling of the ducts should be met by cutting with a knife, or be touched every day with a pencil of nitrate of silver, and soft food be given until cured. If the trouble is in the glands of the lower jaw, they may be painted with tincture of iodine, or ointment of biniodide of mercury, one drachm to an ounce of lard, well rubbed together. If decayed teeth are the cause they should be removed.

QUINCE. *Cydonia vulgaris.* This fruit is a native of Asia, probably Northern India; was carried to Greece by way of Ispahan and Syria, and has been known in Greece from the earliest period, its fruit was there dedicated to the Goddess of Love. It found its way into Italy from Kydron, a city in the island of Crete. Both the pear-shaped and apple-shaped varieties were known to the Greeks. The trees must have been larger than are now generally found in the United States, since it is related in Grecian mythology how Melus, a priest of Aphrodite, hung himself, from grief at the death of Adonis, to a quince tree, into which he was then transformed. There are but few varieties of the quince, those principally cultivated being the Apple or Orange quince, the Angers and the Portugal. There is also the Chinese and Japan quince, the latter an elegant flowering sort and a fair hedging plant. The cut shows the flower of the Japan quince natural size. They are deep crimson, and appear before or at the time of the first leaves. The quince delights in a cool, moist but well drained soil, and rather humid atmosphere; hence it is but little cultivated in the prairie regions of the West, or in other dry intercontinental climates. There are, however, special localities near the great lakes, congenial to it, and in these situations the crop is very profitable, since the scarcity of the fruit causes it to sell at high prices. The quince is largely used as a stock upon which to bud the pear to dwarf it for cultivation in gardens and other small places. But when this is done, they should be worked so low that they may be planted below the junction of the bud or graft, else they are short lived.

QUINCE CURCULIO. *Conotrachelus cratægi.* The insect resembles the plum curculio, and belongs to the same genus, but differs remarkably in its habits from either the apple or plum curculio. It makes a direct puncture as a nidus for the egg and the larva, feeds near the surface of the fruit, and does not approach the core. It passes the winter in the larva state, and does not change to a pupa until a few days before it issues as a beetle. As with the plum curculio jarring the insects upon a sheet is the remedy, say from the first of June until the middle of August in the North.

QUINCUNX. In the following order $\begin{smallmatrix}\circ & & \circ\\ & \circ & \\ \circ & & \circ\end{smallmatrix}$, with one at each corner, and a fifth in the center of the square. (See Orcharding.)

QUININE. The active principle of Peruvian bark, a white crystalline alkaloid.

QUINSY. Inflammation of the tonsils. This is common inflammatory sore throat; it is not infectious. It begins with pain on one side of the throat and swelling of the tonsils, attended by febrile symptoms, which sometimes run high, especially as the tumefaction advances; there is great restlessness and anxiety, and often the utmost difficulty of swallowing even liquids and of breathing. The disease has proved fatal by producing suffocation, but it generally terminates in resolution or suppuration; in the latter case the abscess breaks, and a great deal of pus is discharged, and the patient is at once relieved of all urgent symptoms; but it occasionally happens that the other side of the throat becomes affected and goes through the same stages. Quinsy in hogs is prevalent and often fatal; when attacked, injections of four ounces of sulphate of magnesia and two drachms of oil of turpentine in half a pint of soap-suds, should be given to relieve the bowels. Cast and tie the hog firmly, and with a sharp knife scarify the skin over the swelling, to draw blood freely, and assist the bleeding with cloths rung out of hot water. Give also internally in gruel two ounce doses of turpentine, if the hog will eat, if not, swab the throat with a feather dipped in equal parts of turpentine and oil.

QUITCH GRASS. Couch grass. (See Grasses.)

QUITTOR. This is a fistula of the coronet, caused by calking, a bruise, suppurating corns, irritation between the sole and wall caused by any foreign substance. The horse may go lame for a long time; finally a tender swelling will make its appearance at the coronet, above the hoof, which, when it bursts discharges a whitish watery matter, difficult to heal. Often the fibrous network covering the bone and elastic tissue of the foot will be completely involved, canals leading thence to the main issue. If there is inflammation reduce this by poulticing. The probe will show somewhat the extent of the disease. Give the treatment into the hands of a veterinary surgeon, if one is to be had. The inflammation being partly reduced, inject three or four times in a day, of the following: Five grains of bichloride mercury, twenty drops of muriatic acid, one ounce of alcohol. The next day inject the mixture twice, and thereafter once a day until the fistula becomes superficial, when it may be kept covered with wet tow or lint. Severe cases may require the knife. If so, a competent surgeon should be called. Everything about the stall should be kept sweet and clean, and the animal's bowels kept in a natural state by grass, bran mashes or a gentle laxative.

QUOIN. The corner of a building. Oblong blocks of wood used to lock printers' form.

R

RABBET. A moulding.

RABBIT. The common gray rabbit, really a hare, *Lepus Americanus,* is one of the most noxious animals of the farm, and should be exterminated wherever found. This may easily be done, or at least they may be kept well under by means of a common box trap with a floor. The trap may be made of boards seven inches wide for the sides, with a door in the top for introducing the hand, the box to be placed on a bottom of tight boards. The box should be about eighteen inches across each way, and set with a common figure four, and weighted, so the rabbit can not move off its foundation. The bait used may be a piece of sweet apple. (See Hare.) The varieties of domestic rabbits, *Lepus cunniculus*, are numerous, and of many colors; white, black, blue, gray, and parti-colored. The lop-eared varieties are among the most curious. A rabbit warren is built by excavating the soil and using six inches of pounded glass or tin waste to prevent burrowing out, and covered over with about six inches of earth, boarded up and the top covered with slats. A suitable box should be provided for breeding, and the males must be kept separate from the females except during the rutting season. Rabbits breed at the age of six or seven months. The doe goes with young thirty to thirty-one days, producing from four to seven or eight young at a litter. The rabbit, like the female hare, has a double matrix, and therefore can carry in the womb two separate litters. In the hare super-fœtation is common, but in the rabbit much less so.

RABBIT FOOT. One of the names of Welsh or stone clover. *Trifolium arvense.* It is a worthless plant and should be eradicated wherever found. It is a native of Europe, a one-seeded legume, flowering and bearing seed twice in a season. Being an annual plant, its eradication is not difficult to a farmer who gives clean cultivation. (See article Clover.)

RACEME. In botany, a form of inflorescence, in which the flowers are stalked along a common unbranched axis, as in the hyacinth.

RACEMIC ACID. An old name for a tartaric acid; the paratartaric acid.

RACHIS. A branch which proceeds in nearly a straight line from the base to the apex of the inflorescence of a plant. It is also applied to the petioles of the leaves of ferns.

RACK. A railed place formed above the manger in a stable for holding hay. It should be constructed with openings at the bottom for the seed or dust to pass through.

RACKING. Decanting; separating the clear portions from the dregs. The barrel into which the fluid is racked should be perfectly clean and fumigated with sulphur.

RADIANT. A luminous spot or body.

RADIATION. (See Meteorology.)

RADICAL. A base in chemistry. Compound radical is a compound base in organic bodies.

RADICLE. In botany, that portion of an embryo which eventually becomes the descending axis or root. It is the lowest of the two opposite cones of which an embryo plant consists.

RADISH. *Raphanus sativus.* A hardy annual plant, originally from China, perfecting its seed the first season. It is broken now into many varieties, generally round, ovoid, or fusiform, some varieties being exceedingly long and slender. The varieties generally in cultivation require to be sown in rich, warm land, early in spring so the growth may be early in the season, to have them tender and succulent. The seed may be sown in shallow drills, one foot apart, and rather thickly in the rows; thinning out as necessary, and gathering for use as soon as they get to be the size of the little finger. For a very early crop the seed may be sown in a gentle hot-bed the latter part of February, using a turnip rooted variety. So at the time of sowing in the open ground, sow turnip rooted, either early white or scarlet, and at the same time sow long scarlet and French breakfast radish. For autumn and winter use sow Black Spanish, and Rose-colored Chinese, from July 25 to August 10 in the West, and later South. To keep over winter pack the roots in barrels tops down, and pour air-dried sand about them. An ounce contains about 3,500 seeds retaining vitality five or six years. Seed one or two years old do not make such strong tops as fresh seed.

RADISH, WILD. The charlock, a weed.

RADIUS. The length of a straight line drawn from the center to the circumference of a circle.

RADIUS BONE. One of the bones of the forearm.

RAFTER. A timber of the roof.

RAFTERING LAND. Plowing only half the land, and turning the grass side of each furrow-slice upon an unplowed bed.

RAG. Woolen rags are very useful as a manure. They are chopped fine, and used at the rate of half a ton to the acre. They last four or five years, and advance vegetation, especially the hop. The rags, by decay, become converted into carbonate of ammonia, in the same way as hair and horns, with which manures they are identical.

RAGGED ROBIN. *Centaurea cyanus.* Blue bonnets of the Scotch, a pretty flower, an annual introduced from Europe, and naturalized, in many places as a weed. In England and the Continent, it is regarded as a troublesome weed in grain, and care should be taken that it does not spread from gardens.

RAGWEED. *Ambrosia trifida,* great ragweed, and, *A. artemisiæ,* bitter weed or ragweed. The first a coarse, ugly, native weed common in uncultivated places. The second well known as springing up in stubble fields, especially after wheat. The land being in grass, it gives no trouble, but on good wheat soil it springs again when the land is plowed for crops.

RAIL. Great Red-breasted Rail. *Rallus elegans.* A fresh-water bird living and breeding in the inland Southern States, and rarely appearing in the North, but is at home in the Gulf States. They scarcely wander far, but are in the habit of returning to the same nests year after year. The length of the bird is nineteen inches and the expanse of wings twenty-five inches. Their flesh is good, and the eggs excellent. *R. crepitans,* sometimes confounded with the former, inhabits salt marshes from New Jersey south, along the coast. The Sora Rail and the Virginia Rail are both found in the West. They are plainly colored, dark brown, very swift, and at the approach of cold weather emigrate south. The food of all the species is insects and aquatic seeds.

RAIN. It has been said that drought scares the farmer, but that too much water absolutely destroys his hopes. This has especially been found to be a truism in the West, and hence the impetus given to surface and tile draining within the last few years, especially the latter, since it not only quickly rids the soil of superfluous moisture, but in times of drought, through intercirculation and condensation of vapor in the pores of earth, causes the accumulation of moisture within the soil. In relation to the rainfall of the country it has been determined that throughout the Northern States the fall of rain during the summer varies from nine to fourteen inches. The region including all the great lakes from the mountains of northern New York and valley of Lake Champlain to the western extremity of Lake Superior, extending along the southern border of Lake Ontario and the east end of Lake Erie, then passing southeast to include almost all of Pennsylvania west of the Susquehanna, the high region of Virginia to the border of North Carolina, eastern Kentucky, northeastern Ohio, all of Michigan, a small portion of Indiana, and the borders of Lakes Michigan and Superior, in Wisconsin, appear to be favored with a smaller fall of rain during the summer than any other parts of the vine-growing districts of the United States east of the Mississippi. Over this region, which may also properly include the coast of New England, there occurs in summer the average of about ten inches of rain. There is a district over which nine inches only are deposited, but it is quite limited, and extends from Rochester west to the end of Lake Ontario, and not much further south than Buffalo. A similar contracted district of eight inches summer rainfall occurs in the mountains of Virginia. As regards the fitness of the latter for vine-growing we have no information. The region over which the fall of nine to ten inches of summer rain extends includes all the localities where the cultivation of the vine has, in the northern section of our country, been attended with the largest share of success. At Cincinnati and St. Louis the fall of rain for the summer months is about fourteen inches, and this deposit of moisture occurs over most of southeastern Virginia, the Carolinas, where it reaches fifteen inches; most of Kentucky, middle Tennessee; but equaling that of the Carolinas in the western part of the two last-named States, the southwestern corner of Ohio, the southern border of Indiana, all the south, southwestern and western parts of Illinois, including one-half of the State; southeastern Iowa, and all the eastern half of Missouri to the Ozark mountains. Between the northern border of the rain district of fourteen inches thus appropriately designated, and which can only be properly defined upon a map, and the district of ten inches fall before noted, there is interpolated a very irregularly shaped region, over which there is deposited in the average of summers about twelve inches of rain. This extends over almost all of New Hampshire, all of Vermont except the northwest corner and valley of Lake Champlain, all of New York except the northeast mountain region, the valley of the St. Lawrence and lake borders before noted, as having nine and ten inches fall, and the lower valley of the Hudson, where eleven inches are deposited. It also includes all of eastern Pennsylvania and southern New Jersey, the northern part resembling the valley of the Hudson, and passing southwestwardly between the two districts before named, extends in a narrow belt through Maryland and Virginia, crosses the mountains in western North Carolina, ranges along the west boundary of Virginia, extends over southern, middle, and western Ohio, nearly all northern and middle Indiana, all northeastern Illinois and Wisconsin, except the lake borders, and over most of Iowa and Missouri not before excepted. The table page 776 will be interesting not only to those living in the regions directly named, but generally, since it shows that the opinions usually current, in regard to the rainfall of the great plains have been erroneous. This table as given also affords unexpectedly favorable results, particularly in regard to the critical seasons of spring and summer. Of more than twenty stations near or on the plains, but two or three show marked deficiency of rain, even in summer; and in spring, April and May at the South, and May and June at the North, are always marked by a fair amount of rain. A report to the United States government a few years since says: There is, it is true, need of observation at a much greater number of places, and conducted for longer periods. A few years more of the present fullness of observation will warrant more decisive judgments as to the quantities anywhere at hand to be utilized in some way more than is done at present. If, at the localities of Fort Atkinson, Fort Kearney, and Fort Sully, on this side of the plains, a summer aggregate of ten inches or more is to be relied upon, and at Fort Lyon, Golden City, Laramie, and Cheyenne, five to seven inches can be relied upon for the same season, the assurance is certain that forest growth may be anywhere maintained after the first efforts and dangers of planting are past. Comparing these quantities with the records of rainfall in Europe, the facts appear in a still more striking light; the whole interior, and indeed much of the west of Europe, having a small quantity of rain. The following are condensed results by seasons, and generally derived from long periods of observation.

Locality.	Spring.	Summer.	Autumn.	Winter.	Year.
	Inch.	Inch.	Inch.	Inch.	Inch.
London, England........	4.09	6 00	6.15	4.45	20.69
Marseilles, France.......	4 67	2.17	8.00	5.23	20.16
Berlin....................	5.66	7.21	5.45	5.24	23.56
St. Petersburg..	2.89	6.73	5.11	2.93	17.65
Simferopol, Crimea......	3.22	6.01	3.40	2.20	14.83
Lougan, South Russia...	3.57	4.99	3.02	2.28	13.87

The whole central area of Europe exhibits like small quantities of rain, and the simple measurements of quantity on the plains of the United States by no means sustain the idea that such aridity exists as to require irrigation. Yet the small number of rainy or cloudy days, and the sudden outflow of the water in streams, as well as its rapid evaporation in the somewhat caustic atmosphere that sweeps over the plains, reduce the practical value of the rain falling to little more than half the quantity when deposited elsewhere. At Niagara and Rochester, N.Y., the quantity of rain in spring is less than seven inches, and that of summer eight and a half to nine inches only. At Council Grove, Fort Riley, and Fort Atkinson, positions reaching westward from the settled border of Kansas, the quantity is fully equal to or exceeds that at Rochester. Even at Golden City, Fort Lyon, and Denver, great altitudes, it is nearly euqal in spring, though deficient in summer. The actual proportion of the rain falling on any district, thrown off in the ordinary surface-drainage, has been calculated with care in many cases as a basis for the construction of works for the supply of water to cities. The results are variously stated at from fifty to seventy-five per cent. of the annual fall, in average districts of the Atlantic States. Ellet calculated the discharge of a stream called Anthony's Creek a tributary of the Greenbrier river of Virginia, by daily measurements for one year, to be seventy per cent. of the quantity falling in that year, and sixty-five per cent. of the average fall for a period of years. In all these localities of the Eastern States a fair proportion of woodland, and also of loose soil and cultivated surface, would be included, thus affording conditions much more favorable to the retention of moisture, and its absorption into the soil, than those existing on the general surface of the plains. If the rainfall of Maryland, at forty-four inches, should average to throw off sixty per cent. as a basis of available drainage for water-supply to reservoirs, there would be twenty-six and a half inches of waste, or of ordinary flow into rivers, and seventeen and one half inches permanently diverted by absorption and evaporation. And of the quantity thus retained and re-supplied to the air some portion would inevitably be re-deposited in rain; and thus the primary rainfall, as it may be called, may at the season of showers receive considerable augmentation. And this increase

DEPTH OF WATER FALLING IN RAIN AND SNOW (IN INCHES AND HUNDREDTHS) AT VARIOUS STATIONS ON OR NEAR THE PLAINS.

STATIONS.	Latitude.	Longitude.	Altitude.	Years. *	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Spring.	Summer.	Autumn.	Winter.	Year.
	° ′	° ′	Feet.																		
Fort Towson, Arizona	34 0	95 33	300	14	3.19	2.99	4.38	5.33	5.84	5.78	4.62	3.96	3.41	4.59	4.23	2.84	15.55	14.36	12.23	8.94	51.08
Fort Arbuckle, Indian Ter.	34 27	97 09	1,000	9¾	0.89	2.98	1.12	2.39	4.46	3.16	3.13	4.12	3.38	2.08	2.97	1.57	7.97	10.83	8.43	5.44	32.69
Fort Belknap, Texas	33 08	98 48	1,600	5 5-6	0.47	2.29	1.32	0.88	4.21	3.98	2.49	2.97	2.77	2.92	2.65	1.10	6.41	9.44	8.34	3.86	28.05
Fort Scott, Kansas	37 45	94 35	1,000	10¼	1.92	1.18	1.79	3.70	7.08	8.13	4.55	3.69	2.30	2.66	3.46	1.69	12.57	16.37	8.42	4.79	42.15
Council Grove, "	38 40	96 30	1,200	6	1.17	2.31	1.81	3.16	5.14	5.33	5.19	6.39	4.59	3.11	1.75	1.14	10.11	16.91	9.45	4.62	41.09
Manhattan, "	39 15	96 40	1,100	9	0.52	1.63	1.36	3.10	2.37	4.86	4.90	3.52	3.35	1.69	1.52	1.06	8.50	13.08	6.56	3.21	29.69
Fort Riley, "	39 03	96 35	1,300	14	0.77	1.01	0.75	1.74	3.01	3.93	3.00	3.22	3.09	1.21	1.15	0.74	6.83	10.15	5.45	2.52	23.62
Fort Atkinson	37 47	100 14	2,330	1	0.04	0.49	0.96	3.38	9.34	4.35	3.00	2.80	3.85	6.81	1.39	1.60	13.68	10 15	12.05	2 13	38.01
Bellevue, Nebraska	41 20	95 57	1,250	8	0.89	1.57	0.79	1.92	3.76	3.58	3.91	3.82	3.18	1.76	1.36	2.10	6.47	11.31	6.30	4.56	28.64
Omaha Mission, Nebraska	42 05	96 10	1,500	6½	1.03	0.84	1.42	2.56	4.42	3.00	4.42	3.57	3.06	1.68	1.67	1.13	8.40	10.99	6.41	3.00	28.80
Fort Kearney, "	40 38	98 57	2,360	14¼	0.59	0.43	1.25	2.26	4.30	3.69	4.74	2.70	2.29	1.57	0.97	0.46	7.81	11.13	4.83	1.48	25.25
Fort Randall, Dakota	43 01	98 12	1,456	8 5-6	0.49	0.42	0.99	1.10	2.67	2.30	1.78	2.56	2.43	1.09	0.47	0.30	4.76	6.64	3.90	1.21	16.51
Fort Laramie, Wyoming	42 12	104 31	4,519	12½	0.61	0.46	0.84	1.06	3.74	1.90	1.63	1.37	1.17	0.97	0.84	0.57	5.64	4.90	2.98	1.64	15.16
Denver, Colorado	39 40	105 10	5,500	2	0.81	0.97	1.26	2.80	1.45	0.29	0.51	0.20	2.85	0.54	1.82	0 75	5.51	1.00	5.21	2.53	14.25
Fort Lyon, "	38 08	102 50	4,000	1	0.32	0.12	0.16	2.09	4.84	1 40	2.53	0.37	0.04	0.00	0.07	0.15	7.09	4.30	0.11	0.59	12.09
Golden City, "	39 45	105 20	5,240	1	......	1.00	1.40	2.80	5.40	2.10	2.37	0.45	2.20	......	......	......	9.60	4 92	......	......	....
Fort Massachusetts	37 32	105 23	8,365	5	0.34	0.86	0 61	1.15	1.19	0.71	2.01	2.84	1.80	0.87	3.61	1.07	2.95	5.56	6.28	2.27	17.06
Great Salt Lake City, Utah	40 46	112 06	4,320	5⅔	1.68	2.25	2.47	1.39	1.34	1.49	2.54	1.01	1.37	2.20	2.35	3.76	5.20	5.04	5.92	7.69	23.85
Camp Douglas, Utah	40 39	111 42	4,800	3¼	2.77	1.53	2.87	1.11	1.58	0.60	0.84	0.60	0.99	1.79	1.71	4.18	5 76	2 04	4.49	8.48	20.57
Fort Defiance, Arizona	35 43	109 10	6,500	8½	0.98	0.70	0.84	0.67	0.52	0.74	2.44	2.73	1.86	0.70	1.16	0.87	2.03	5.91	3.72	2.55	14.21
Fort Ruby, Nevada	40 01	115 35	5,922	1¾	2.24	0.23	1.63	1.57	2.04	0.59	0.59	1.82	0 53	3.33	0.94	1.76	5.24	3.00	4.80	4.23	17.27
Deer Lodge City, Montana	46 15	112 30	6,000	2¾	1.45	1.81	1.64	1.40	2.28	1.97	0.58	0.58	0.86	0.48	1.38	0.49	5.32	3.13	2.72	3.75	14.92
Helena, "	46 45	111 50	4,150	1⅓	2.12	0.43	1.15	1.80	4.30	3.50	0.07	0.20	1.80	2.61	0.50	1.00	7.25	3 77	4.91	3.55	19.48
Fort Benton, "	47 52	110 40	2,674	1½	1.01	0.37	1.11	1.81	2.86	1.14	4.62	0.61	1.82	......	......	1.30	5.78	6 37	5.00	2.68	19.83
Fort Sully, Dakota	44 39	100 40	1,491	½	......	......	......	......	2.98	2.34	6 48	1.53	0.21	......	....	......	......	10.35	......	......	20.00
Cheyenne, Wyoming	41 12	104 42	6,000	1	0.02	0.27	6.38	1.61	1.99	1.84	3.90	2.05	1.03	......	......	......	3.98	7.79	......	......	16.00
Corinne, Utah	41 30	112 18	5,000	1	0.70	2.42	0.55	1.43	2.66	0.47	0.11	1.04	0.14	0.35	3.22	4.04	4.64	1.62	3.71	7.16	17.13

* The rainfall is the average for the years mentioned in the column, and not for particular years, since these would give an excess in particular years, and a light rainfall in other years.

once established, it becomes permanent so long as the surface continues favorable, increasing the humidity of the local atmosphere and the cultivable capacity of the soil. Applying this analogy to the plains, a quantity of twenty inches now found falling on the dry surface, and of which seventy to ninety per cent. is immediately thrown off in the streams and rivers, may, by covering the surface with forests in part, and by breaking up the hardened turf in cultivation, diminish the waste from eighty to sixty, or even fifty per cent., retaining, say, six or eight inches of this quantity in some form, and at least preventing the immediate waste from which no secondary benefits can now be derived. The practical value of the primary water-deposit can not fail under such change of surface to be equivalent to an addition of ten per cent. to such original quantity; sufficient in many cases to secure important results, and to obviate deficiencies that are now decisively adverse to whole classes of crops. A further measure may be suggested here, in the construction of what may be called temporary reservoirs, in which the surplus of the profuse showers falling in spring and early summer may be retained to be distributed by channels of irrigation, or to secure general benefits by simple retention. The cost of such works need not be great, nor need they be more than such temporary obstruction of the smaller drainage-channels as is within the power of a few settlers at any locality to construct at any time. For these, as for all preliminary works of the kind, the agency and means of the railroad companies may be easily and effectively employed. Whatever may be found practicable in this respect, it is clear that eight to ten inches of rainfall in the three or four months of most rapid growth can be utilized to a much greater extent than to permit eighty per cent. of the quantity to run off at the moment it falls, affording no useful result, and only flooding the valleys of great rivers and their tributaries just at a time when no surplus is wanted in such valleys. It is a common mistake to suppose that the rainfall of England is greater than that of the United States. Recent observations in this country enable us to make the comparisons between the fall of rain in the two countries with considerable accuracy, not only as to the amount which descends annually, but, what is more important, as to the amount in each particular season of the year. The average rainfall of England is, in general, much less than that of the United States. In the eastern portion of England the annual fall of rain is estimated at twenty inches; in the middle portion, at twenty-two inches; in the southern and western, at thirty; in the extreme southwestern, at forty-five inches. In Wales it is estimated at fifty inches; in the eastern portion of Ireland, at twenty-five inches, and in the western at forty inches. The rainfall in the United States, as shown by Blodgett's rain chart, is in the basin of the great lakes, thirty inches; on Lake Erie and Lake Champlain, thirty-two inches; in the valley of the Hudson, on the headwaters of the Ohio, through the middle portions of Pennsylvania and Virginia, and western part of North Carolina, thirty-six inches; in the extreme eastern and the northern portions of Maine, northern portions of New Hampshire and Vermont, southeastern counties of Massachusetts, central New York, northeast portion of Pennsylvania, southeast portions of New Jersey and Delaware, also on a narrow belt running down from the western portion of Maryland, through Virginia and North Carolina to the northwestern portion of South Carolina, thence up through the western portion of Virginia, northeast portions of Ohio, northern Indiana and Illinois, to Prairie du Chien, forty inches; on the east coast of Maine, eastern Massachusetts, Rhode Island, and Connecticut, and middle portion of Maryland, thence on a narrow belt to South Carolina, thence up through eastern Tennessee, central Ohio, Indiana, and Illinois, to Iowa, forty-two inches, and the same down through western Missouri and Texas to the Gulf of Mexico; from Concord, N. H., through Worcester, Mass., western Connecticut and the city of New York, to the Susquehanna river, also at Richmond, Va., Raleigh, N. C., Augusta, Ga., Knoxville, Tenn., Indianapolis, Ind., Springfield, Ill., St. Louis, Mo., thence through western Arkansas, across Red river to the Gulf of Mobile, forty-five inches; from the belt just described, the rain fall increases inland and southward until at Mobile it is sixty-three inches; the same amount also falls in the extreme southern portion of Florida. The rainfall of New England, it is perceived, is about double that of the eastern and middle portions of England. Observations at London, by Dalton, for forty years gave an average fall of 20.69 inches, while observations for forty-three years at New Bedford, Mass., gave 41.03. The most striking difference as to the fall of rain in the two countries is found in the quantities which fall in single days. While we have vastly more rain in our country, we have far less rainy days. In the United States we have either decided rain, or bright, fair weather; while in England, though it seldoms rains hard, there is much of the time a fog, a mist or a drizzling rain. The records at all points of observation are unfortunately too brief to afford any proper means of determining whether the quantity of rain is greater now than it was ten years since; though great force attaches to the almost universal belief in such increase on the part of the more intelligent residents and observers in the interior. The range of non-periodic variation is very great in all parts of the temperate latitudes, and it is possible that our earliest practical experience on the plains was in a period characterized by a succession of dry seasons. In Utah it is quite clear that practically the warmer seasons have become far more profuse in rainfall than they were fifteen years ago; and at the eastern foot of the mountains, the settled localities, as Denver, and the districts both south and north of the original center of settlements, afford marked evidence of improvement. But there are no statistics of measurement which afford any positive evidence; the periods observed at the military posts being quite irregular, and not sufficiently extended to establish any law of increase. On no point of practical results are both writers and observers more thoroughly agreed than in affirming the value of forests, as agents of at least local amelioration of climate. An essential condition of the growth or improvement of a soil by chemical decomposition of its elements and by the deposit in or on it of vegetable mold, is the constant permeation of its strata by the water of rains and snows. These waters bear more or less ammonia always with them, which is the chief agent of rock decomposition, and in practical experience the forest-soils of the Central States are found deeply decomposed and fertilized. They are also free in absorbing water, holding it long, and yielding it slowly by subsequent evaporation and by drainage through the surface strata in permanent springs. The first result of too great and general clearings of the forests is to dry up the springs, and next to harden the surface-soil, forming a stiff mass which sheds the water of ordinary rains, and can only be permeated by water and by the roots of plants when thoroughly broken up and fertilized by artificial means. After long periods of exposure the surface becomes so hard and refractory as to bear little or no resemblance to the soft, moist, deep soil of the original woodland. The denudation of the hills and upland plains of any one of the Central States will show a marked decline in productive capacity, from that belonging to the original or first occupancy. At that time the wealth of the soil had not been wasted, nor had the general exposure of the surface deprived the crops of the shelter of adjacent woods, preventing the dry and caustic winds from exhausting the vitality of every plant exposed to them. The ordinary condition of the atmosphere, as it sweeps in general progress eastward, is that of an absorbent of moisture. When rain is not actually falling the air is taking up moisture, and if nothing is offered to it by ordinary evaporation from the surface the condition soon becomes arid, or deficient in the quantity necessary for favorable action on vegetable growths. Though a desert surface intensifies the aridity, yet an ordinary dry and denuded surface yielding no moisture by evaporation soon renders the surface atmosphere unduly dry and caustic. The summer winds may even approach a sirocco in quality, and those of winter are piercing and destructive. The water surface of any one of the great lakes is quite sufficient to neutralize either extreme for the countries lying on the line of atmospheric circulation across those lakes; and while the actual rainfall of Buffalo, Niagara, and Lockport is but small, the air is rarely or never biting in its aridity, as when it reaches the eastern and cultivated border of the plains after traversing hundreds of miles of surface destitute of water, forests, or other moisture-yielding conditions. The practical question is whether, with a general climate of constant rainfall, the smaller quantity of such rainfall can be diffused and distributed so as to sustain the constant vegetation of the Central and Eastern States. What may be accomplished by replacing that which we are accustomed to regard as the natural covering of the soil in the forests? And what further by cultivation, by special irrigation, and by shelter from the present unrestricted sweep of surface winds? In answer, it may at least be assumed that important ameliorations of the local and surface conditions are certainly within control. And the whole field of action is in a climate especially mild as compared with the north of Europe. The denuded uplands of Germany, the exposed mountain districts of Scotland, and other localities of the Eastern continent where cultivation struggles to reclaim every inch of surface that may be made to yield the smallest product for human support, present examples of deterioration. The entire area of the plains, and all the plateaux, mesas, and basins of the interior need nothing but water to make them productive in valuable staples. Everywhere within the United States it is warm enough, and the natural soil is rich enough. So great is this natural capacity that every observer and writer who has visited these districts believes that irrigation would be profitable in every case where it would be possible; the general presumption being that many of the valleys and river bottoms near the mountains will continue to be deficient in rain, and can only be cultivated by the aid of irrigation. The concentration of settlements in the basin districts of Utah and Idaho has fortunately tested this capacity for profitable cultivation by irrigation very thoroughly, and it is pronounced successful in all cases. The mountain streams are abundant and permanent, showing a profusion of summer as well as winter rains on their summits. The rain which would be sufficient, probably, if equally distributed over valleys as well as mountains, is condensed by attraction on the higher ranges, and therefore is not constant in the valleys. In short, it is not the general average supply that is so much at fault as the local distribution. But the districts on the eastern slope of the greater mountain-plateaux are probably the most difficult to deal with. The great ranges have exhausted most of the moisture of the aërial volumes from which the summer rains fall, and until their disturbing influence has been wholly exhausted the deficiency of rain continues. Probably a belt at Denver and near the eastern foot of the mountains has the quite insufficient quantity of fifteen inches of rain annually, and another, stretching two hundred to three hundred miles eastward, has but twenty to twenty-four inches. This is not of itself decidedly adverse, and cultivation might here succeed without irrigation, if adequate shelter and local amelioration could be introduced, at least for the cereal crops, and many others not requiring much moisture. Saussure the celebrated Swiss meteorologist states that, in ascending the sides of a mountain into the region of the clouds, he has seen globules of water as large as small peas floating in the air, which, from their levity, were evidently hollow spheres, similar to small soap bubbles. From this observation the idea became prevalent that the water of a cloud was in a vesicular condition, or, in other words, that cloud consists of minute hollow spheres of liquid water, filled with air, which is rendered more buoyant by the rarefaction due to the heat of the sun; and this opinion was strengthened by the fact that clouds do not give a decomposition of the rays of light sufficient to exhibit the phenomena of the rainbow. In what manner such a condition of water can be produced, and how it can be retained by any principle of science, has not, so far as we are informed, been explained. A soap bubble soon becomes too thin to retain its globular form, and is resolved into the condition of soap water. Ordinary water is still more unstable, and can not be retained for an instant in a hollow spherical form. We shall therefore be on the safe side if we adopt an hypothesis apparently more in accordance with known and established principles, and, if this does not furnish a logical account of all the phenomena, we must wait until further research, or light from collateral branches of science dispels the obscurity with which this point may be involved. The suspension of the clouds can be explained by taking into account the extreme minuteness of the particles of which they are composed. In the case of mists, which are sometimes formed at the surface of the earth, and afterwards become clouds in being elevated into the atmosphere by a wind blowing between them and the earth, the particles are of such extreme tenuity as to be invisible to the naked eye, and their presence is only rendered evident by looking through a stratum of considerable thickness. The simplest method of measuring the rain, which any one may practice for himself, is to catch the water in a cylindrical vessel, a straight-sided tin pail, and to measure the depth in inches and tenths of an inch after each shower. It is hardly necessary to remark that the vessel should be so placed that it may not be screened by trees, buildings, and other obstacles from the wind which bears along the falling drops. The object of the investigation is to ascertain the number of inches of water which fall from the clouds on a given space, in a given time—for example, a year or a season. In relation to signs foretelling rain, much has been said and written. The Signal Service of the United States now predicts storms with tolerable accuracy forty-eight hours in advance. It is probable that in the near future the science of meteorology will have been so far perfected that the peculiarity of seasons may be foretold with a considerable approximation to reality. Certain phenomena in the air and peculiarities of birds have long been known to indicate a change in the weather. Many years ago the learned Dr. Jenner embodied these in verse, in reply to an invitation from a friend with whom he had planned an excursion the following day. It embodies about all that is known to-day upon that branch of the subject, and we reproduce it as being reasonably correct:

The hollow winds begin to blow,
The clouds look black, the glass is low;
The soot falls down, the spaniels sleep,
And spiders from their cobwebs peep.
Last night the sun went pale to bed,
The moon in halos hid her head;
The boding shepherd heaves a sigh,
For, see, a rainbow spans the sky:
The walls are damp, the ditches smell,
Closed is the pink-eyed pimpernel.
Hark! how the chairs and tables crack,
Old Betty's joints are on the rack:
Loud quack the ducks, the peacocks cry:
The distant hills are looking nigh.
How restless are the snorting swine,
The busy flies disturb the kine;
Low o'er the grass the swallow wings;
The cricket, too, how sharp he sings;
Puss, on the hearth, with velvet paws,
Sits, wiping o'er her whisker'd jaws.
Through the clear stream the fishes rise,
And nimbly catch th' incautious flies;
The glow-worms, numerous and bright,
Illum'd the dewy dell last night.
At dusk the squalid toad was seen,
Hopping and crawling o'er the green;
The whirling wind the dust obeys,
And in the rapid eddy plays;
The frog has chang'd his yellow vest,
And in a russet coat is dressed.
Though June, the air is cold and still;
The black-bird's mellow voice is shrill.
My dog, so alter'd is his taste,
Quits mutton bones, on grass to feast;
And see, yon rooks, how odd their flight,
They imitate the gliding kite,
And seem precipitate to fall—
As if they felt the piercing ball.
'Twill surely rain, I see with sorrow,
Our jaunt must be put off to-morrow.

RAINBOW. A display of the prismatic colors in the air, produced by the action of particles of water on the sun's rays.

RAIN GAUGE. An instrument to measure the amount of rainfall. (See article Rain.)

RAISING PLATE. The timber to which the upper ends of the rafters are nailed.

RAISINS. Grapes allowed to dry on the vine. As soon as they are ripe, the leaves are pruned off, and none but sound fruit left. The stalk is also half cut through. When dry they are plucked, dipped in a solution of lye, and dried on frames.

RAKE. There are so many uses to which hand rakes may be put that, notwithstanding the almost universal use of horse rakes in gathering crops, the industry connected with the manufacture of wooden, iron and steel rakes is immense. Since the introduction of the lawn mower, the lawn rake with its sharp edged teeth has almost disappeared and has been superseded by one similar to the old time hay rake, but with teeth as close again. In gardening six and eight inch rakes, in connection with wheel hoes, have nearly in like manner displaced the common. In buying a garden rake many persons select goose-neck hoe and the Sutch or Scuffle hoe, cast iron implements on account of their cheapness. It is poor economy. It is far better to pay the difference and get the lighter and stronger steel implement. Two sizes are all that are required, one of eight inches and another of twelve inches in width. The latter to be used only in fining the soil. In buying a rake see that the handle is long, tough and flexible, since in working the soil fine, the backward movement is of more consequence than the forward movement. Thus with a tough flexible handle, the gardener may do double the work, and in a better manner than with a rigid one. So in buying a wooden rake, see that the handle, and especially the teeth, are of tough, second growth wood if possible. Then as fast as a tooth breaks out put in another, and when not in use, whatever the implement, see that it is put away clean, dry, and in a dry place.

RAM. The male of sheep, as distinguished from the ewe. Sometimes the word buck is used, and the word doe for the female. It is manifestly incorrect and should not be persisted in. (See article Sheep.)

RAMENTA. Thin, brown scales seen on ferns and young shoots.

RAMIE. This fiber plant has attracted much attention in the South within the last twenty years, and especially so within the last ten years, as also has the other coarser fiber plant of the East Indies, jute, which see. The chief difficulties in the way of the manufacture of both these articles has been in economically separating the fiber. So important has this matter long been felt that the British government has offered immense rewards in cash to the inventor of a properly and economically working machine. Until this is accomplished the cultivation of ramie can not be successfully engaged in, in the United States, on account of the high price of manual labor. In India and China, with their wonderfully cheap labor, the cost of separating the fiber is $150 per ton. Its value when prepared is about $375 per ton in England. In 1875, a machine was exhibited which it was claimed would separate the fiber at a cost of $30 per ton. Yet but little seemed to come of it, from the fact that like machine-manufactured flax, the quality of the article for fine dress goods was worthless. Later, however, by the combination of chemical means and improved machines, it seems that inventive talent is in a fair way to accomplish the object sought. When so, the cultivation both of ramie and jute will be immensely profitable in the Gulf States, and in California where the climate is adapted to the growth of these plants. In relation to the ramie plant and its preparation, the following article, prepared for the United States government, by an expert, Emile Lefranc, will be interesting. The writer is enthusiastic and sanguine, nevertheless, there are facts of interest aside from this to those in the South who wish to engage in this new industry. We quote from the writer as follows: Introduced into Louisiana toward the fall of 1867, the ramie has had ample time to prove its vitality and toughness as a perennial growth. With little or no care it has thriven alone since then, and whenever attention has been given to it, its propagation has been considerable. In some rich and elevated soils the plant has stood and propagated without the least cultivation for the last six years. The stems die in winter, and multitudes of others shoot forth every spring. Where the bushes are regularly cut three or four times a year, the more vigorous and luxuriant is the growth. All these facts sufficiently prove the perennial and hardy vitality of the plant, as also its adaptability to our soil, and the congeniality of our climate. Therefore the agricultural problems and the questions of acclimation are also solved and settled. If the ramie industry did not unfold sooner the advantage of the plant, it was solely on account of the unprofitable or inefficient methods of extracting the fiber. When first introduced on this continent, the treatment of the ramie-plant was erroneously assimilated to that of the nettle family. The universal opinion was that it should be treated like jute, flax, hemp, and other textiles of the cannabis variety, which are disintegrated lengthwise from the stems by the simple process of water fermentation. The error was soon discovered. Ramie fiber admits of no rotting action on the stalks. Steeped and fermented in water or exposed to the air, it is decomposed and reduced to a short and weak fiber, saturated with tannic acid and spotted with tan-bark. Moreover the process is tedious and anti-economical. It has been found that the envelope of the ramie-fiber contains some sulphuric and carbonic elements, which dissolve the joints of the cellulose when the stem is subjected to the acetic degree of fermentation or rotting. Then, some chemists resorted to the process of neutralizing those dissolving elements by means of an acidulated bath for the plants. But those different systems were of no avail, because they required the additional intervention of machinery to break and hackle the filament, which was otherwise more or less injured in its quality by the unnatural treatment to which it was subjected. In face of the despotic exigencies of economy in labor, and the absolute necessity of a large production, none of those methods were practicable. What is the process of the Chinese, who for centuries have monopolized the trade? Their process consists in stripping the ramie-plant and scraping the bark containing the filament. The contrivance that cleans ramie, and furnishes a product similar to that of China, is founded on that true principle, as follows: Revolving cleaners, provided with a peculiar sort of knives, receive gradually, by means of a circular carrier, bunches of stems, which are doubled down and hooked in the middle. The carrier withdraws them from the rotary action of the cleaners, and delivers them in the form of clear ribbons, of a light yellow color, as fine as the imported China-grass. English manufacturers have monopolized the ramie or China-grass trade in Europe and America, and kept somewhat secret the process of finishing and weaving the fiber. Almost all the dress-goods, mixed with brilliant materials and imitating silk fabrics, are made in part of ramie. Leeds and Bradford are the principal manufacturing centers that use that staple as a substitute for silk in many sorts of goods. It is a common error to consider ramie as a substitute for cotton. The observation of the following rules will be absolutely necessary for the cultivation of ramie, and for drawing from the rich plant all it can yield: For nursery purposes or for cultivation, the land must be sufficiently elevated to receive the benefit of natural drainage, because the roots will not live long in a watery bottom. The soil must be deep, rich, light and moist as the sandy alluvia of Louisiana. Manure supplies the defects in some lands in these respects. The field must be thoroughly cleared of weeds, plowed twice to the depth of eight or ten inches if possible, harrowed as much as a thorough pulverizing requires, and carefully drained by discriminate lines of ditches. Water must not be allowed to stand in the rows of the plant. The land being thus prepared, planting becomes easy and promising. December, January, and February are the best months in which to plant. Roots, rattoons, and rooted layers are the only available seed. They are generally four or five inches long, carefully cut, not torn, from the mother-plant. The dusty seed produced by the ramie stalks in the fall can be sown, but it is so delicate and requires so much care during the period of germination and growth that it seldom succeeds in open land. The regular germinating power of that seed is also questionable. The Department of Agriculture vainly tried, a few years ago, to diffuse this seminal cultivation by distributing imported seed, which never germinated. In the presence of these difficulties, and of the sure propagation obtained from fractional roots, sowing has been abandoned and replanting adopted as follows: Furrows five or six inches deep and five feet apart are opened with the plow. The roots are laid lengthwise in the middle, close in succession if a thick stand of crop is desired, but placed at intervals if nursery propagation is the object in view. The first mode will absorb 3,000 roots per acre, but will save the labor of often filling the stand by propagation. The second mode will spare three-fourths of that amount of roots, but will impose the obligation of multiplying by layers. Being placed in the furrow closely, or at intervals, the roots are carefully covered with the hoe. Pulverized earth and manure spread over the roots insure an early and luxuriant growth in the spring. When the shoots have attained a foot in height they are hilled up like potatoes, corn, and all other plants that require good footing and protection from the fermenting effect of stagnant water. The intervals between the rows being deepened by the hilling have also a draining influence, which can be rendered still more effective by ditches dug across from distance to distance, say fifteen feet. Good crops are obtained by thickening the stands. The stems are then abundant, fine, straight, and rich in fiber. Close planting is then necessary, inasmuch as it prevents the objectionable branching of the stalks. Crooked and branchy ramie is unfit for mechanical decortication; it causes waste and yields an inferior quality of fiber. The period at which the plant is ripe for cutting is indicated by a brownish tinge at the foot of the stems. At that early stage the plant, though greenish, yields a fine and abundant filament; it also produces three or four crops according to soil and climate. The first cutting may be unprofitable on account of the irregularity and sparseness of the growth; but if the stand is well razeed and manured over the stubbles the ensuing cuttings will be productive. For that purpose the field must be kept clear of grass until the growth be sufficiently dense to expel the parasites by its shade. That necessary density is obtained by means of the important laying process. This consists in bending down, right and left along the growing stand, the highest switches, and in covering them with earth up to the tender tip, which must not be smothered. One of the causes of the perennity and of the vigor of the plant is the nourishment it draws from the agencies of the atmosphere. Consequently the leaves of the layers should never be buried under ground. When properly performed, laying is very profitable; it creates an abundance of new roots, and fills up rapidly the voids of the stand. After two years the plants may be so thick as to spread out in the rows. Then the plow or the stubble-cutter has to chop in a line, on one side, the projecting rattoons. If well executed this operation leads to notable advantages: It extracts roots or fractional plants suitable for the extension of the cultivation elsewhere. It maintains, as a pruning, a vigorous life and develops a luxuriant growth in the stand. If always applied on the same side of the row, this sort of stubble-cutting has the remarkable advantage of removing gradually the growth toward the unoccupied land in the intervals, and of pushing it into a new position without disturbance. That slow rotation preserves the soil from rapid exhaustion, and the ramie from decay, through the accumulation of roots under ground. Of course this lateral plowing will not prevent the opposite row from receiving the benefit of hoeing after each crop. Experiments made in Louisiana have demonstrated the efficiency of that method; to which are due the preservation and propagation of the plant in that State, while it has been destroyed in other sections for want of similar care. It is through such judicious methods that the old land of China has preserved sufficient fertility to produce constantly the ramie for many centuries. After each cutting Chinese planters plow on one side and make cleanly the stand; then they cover it with a thick coat of manure. That maintains the moisture and fertility of the soil, and, at the same time, preserves the plant from excessive heat or extreme cold. That protective system permits in winter ramie cultivation in latitudes corresponding to those of Maryland and Virginia. It could even be undertaken farther north by another Chinese application. In some cold regions of the northwestern parts of the Celestial Empire, China-grass is cultivated like potatoes. Planters dig up the stand every fall, after the last cutting, and store the roots in cellars to replant them in the spring; yet they generally obtain two crops by such an unfavorable process. We have given this subject prominence for the reason that when cheap means for successfully reducing the fiber is invented and perfected, it may take as prominent a stand as one of the principal productions in the Gulf States, as hemp once did in Kentucky; such means have not yet been found, and the fiber must be separated in a great measure, as is still done in China and India, where labor costs but a few cents a day. Hence, there can be no competition here as against such labor until machinery comes to our aid. That this will at length be done, there is no doubt, and in this light those who are ready to avail themselves of cheap means of reduction, when it comes, will reap profits equal to that on cotton, following the invention of the cotton gin. The British government, years ago, offered a reward equal to $200,000 for machinery that would successfully reduce fibers like that of ramie, for use in India, yet, we believe, it has never yet been awarded.

RAMOSE. Branched.

RAMPION. *Campanula ranunculus.* This is cultivated to a limited extent, for its roots. It is cultivated like radishes, and is fit for use in September and the fall. The soil should be rather moist. The roots are eaten raw, in salads, sliced with the leaves, or they may be boiled and treated as asparagus.

RANIDÆ. The reptiles resembling the frog (*rana*).

RANUNCULUS. Plants resembling the butter-cup and crowsfoot. They are bad weeds in meadows, many of them being acrid and poisonous. Some of the improved varieties are cultivated in gardens for their blossoms.

RAPE. *Brassica rapa.* The cultivation of rape for its seed, from which an oil is expressed, formerly used for its superior illuminating power, and for its other uses in the arts, has, of late years, considerably declined even in Europe. The best varieties for oil are the biennial species, notably *B. campestris olifer*. None of the biennials are hardy in the North. Hence in the cultivation of this plant, chiefly in Wisconsin, an inferior annual variety, the German smoothed-leaved, with upright pods, *B. Præcox*, is sown. The seed may either be sown broadcast or in drills, three pounds drilled or six pounds broadcast. The most economical way, however, is to sow in drills. It is harvested by reaping, and dried and threshed similar to flax. It is comparatively little cultivated now, though at one time there were mills at Fond du Lac, Wis., capable of working 100,000 bushels of seed in a season. Land under fair culture will yield ten to eighteen bushels of rape per acre, though thirty-five bushels per acre have been obtained. The seeds yield about two gallons of oil per bushel. The crop leaves the soil in excellent condition, and the chaff, when mixed with roots, makes an excellent cattle food. The rape-seed cake is highly valued in Europe for feeding dairy cows. In case a crop of grain gives indications of failure, it can be turned under in season for raising a crop of rape in its place, which is subject to no disease or insect enemy. Its broad leaves shade the soil and stifle any weeds that may spring up after it gets fully established, and it prepares the soil admirably for winter wheat; it requires no labor during its growth, and may be cut with a cradle scythe or mower, and harvested at a most convenient time, in the first half of September, after the summer harvests are out of the way, and before the corn and potato harvest begins. One bushel yields about two gallons of oil, superior to the best lard or sperm as an illuminating oil, besides being a good lubricator, and enduring an intense degree of cold before solidifying. The only conditions unfavorable to the entire success of rape as a general farm crop are, that it will not succeed on foul land, where it would be choked out by weeds in its early growth, and that it must be harvested just as the pods are turning from green to yellow or much of the seed will be lost.

RAPHE. A suture. Parts which appear as though they had been united. In botany, the thread passing from the ovule to the placenta.

RAPHIDES. Crystals of oxalate of potash and other salts found in the juice of rhubarbs, docks, and other plants.

RAPTORES, ACCIPITRES. Birds of prey, as the hawk, owl, eagle, etc.

RAREFACTION. The act of diminishing the density of air or other bodies; it is done by the air-pump in the case of air.

RASORES. Scratchers; gallinaceous birds, such as the fowl, turkey, pheasant, etc.

RASPBERRY. *Rubus.* Our native raspberries are the Thimble Berry or Black Cap, (*Rubus occidentalis*), and the Red raspberry (*R. strigosus*). The raspberry is common in some of its forms in nearly every part of Europe and the United States. The variety from which the principal European sorts have their origin, is *Rubus Idæus*, said originally to have been introduced into the gardens of the south of Europe from Mount Ida, hence its name. The five varieties most extensively cultivated throughout the United States are the Mammoth Cluster, the Orange, the Philadelphia, Purple Cane, and American Black. In the West, the Turner is now the favorite for hardiness and prolific bearing, added to fairly good quality. The cultivation of the raspberry is simple. Plant in rows five feet apart by three and one-half feet in the row, in rich, rather moist (not wet) soil. When the plants are three feet high pinch out the tip to make them more stocky. Give clean cultivation, eradicating all suckers, and do not allow those sorts which propagate from the tips to take root. Where the climate is very cold the more tender varieties will need protection, and the more slender sorts must be tied to stakes. It is, probably, its sturdy nature and hardy character that makes it a favorite, since in quality it is below the Mammoth Cluster, and far inferior to such delicate sorts as Knevet's Giant, Imperial Red, and Orange. On page 783 we have illustrated one of the old and, for market, still largely cultivated varieties, Doolittle's Black Cap. It is of small size, but quite hardy, enduring the winters well North, and firm enough to carry long distances. On page 784 is shown the Herstine, a berry of the largest size, obtuse in form, a red berry of excellent quality, but not sufficiently firm for carrying by railway. It is also tender, as, indeed, are all first-class berries. Where protected, however, and the proper conditions for growth and health are present, it is valuable as a fine-flavored, prolific, and large berry. Nevertheless, neither of these cuts are given as showing the best sorts of either black or red raspberries, but as types of each. Soil, climate and situation have so much to do with success and failure in small fruits that the farmer had better take the advice of some respectable nurseryman (not a mere tree pedlar), as to varieties that will probably do well in his locality.

RASPBERRY WINE. (See Gallizing.)

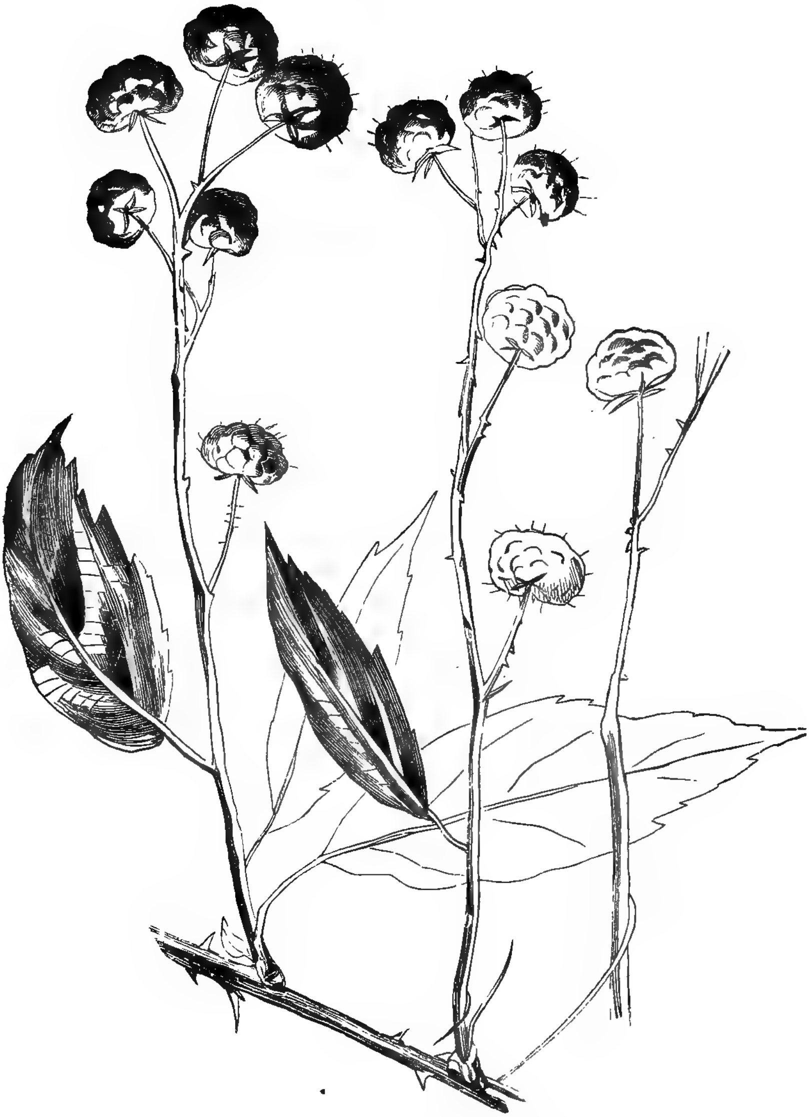
RAT. *Mus Rattus.* The rat now usually found, is an importation said to be originally from Norway. They are on account of their fecundity and voracity, the most destructive of verminous animals, calling for every possible means for their destruction. In large cities rat-catching is made a regular business, and it has been said that when business became dull, the sagacious rat catcher would turn loose those caught in one place upon another. The most successful means of destroying rats is by ferrets, kept for the purpose. (See Ferret). Yet this means will not soon come into general use, since ferrets require to be kept and fed, and it requires some skill to work them in hunting rats. Terrier dogs, with the aid of traps, baiting and poisoning the rats, will generally keep the farm buildings measurably clear. When poisoning, however, is followed care must be taken that farm animals, and especially children, do not get near it.

RATCHET. A small lever which plays into the teeth of a ratchet-wheel, and allows it to turn freely only in one direction.

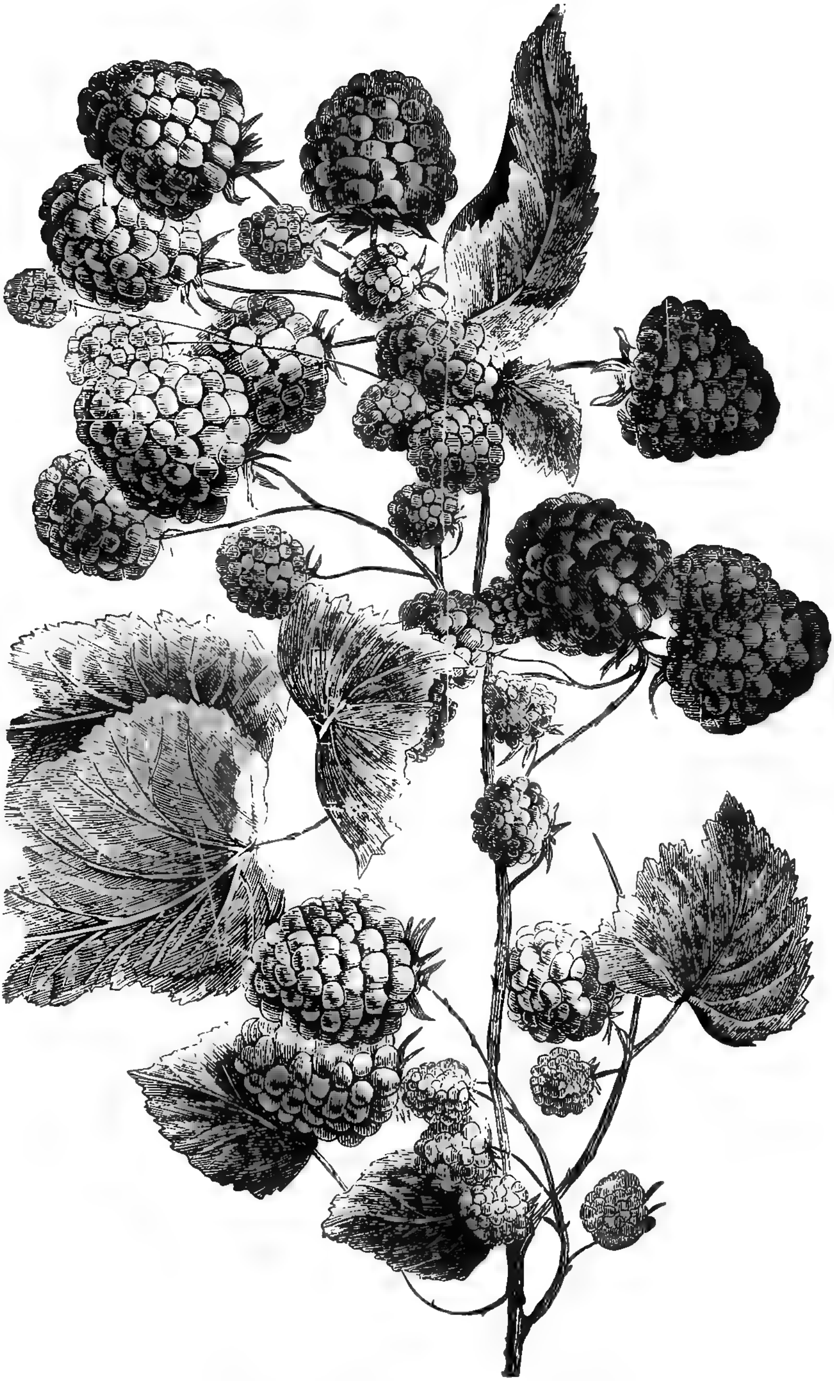
RAT'S TAIL. A disease in horses, in which the hair of the tail is permanently lost.

RATTLESNAKE. Snakes of the genus *Crotalus*. Their bite is extremely venomous. The wound should be cut out and scarified, and the patient sustained by brandy and ammonia.

REAPERS. Reaping by machinery is mentioned so long ago as the time of Pliny, the elder, or more than 2,000 years ago. This graphic writer says: In the extensive fields of the lowlands of Gaul, vans of large size, with projecting teeth on the forward edge, are driven on two wheels through the standing corn (grain) by an ox yoked in a reversed position with the machine forward of the ox. In this manner the heads or ears are torn off and fall into the van. Coming from Pliny's time, and through the dark ages, to about a century ago, a machine was worked in England, driven forward by a horse hitched in the rear, which, as it passed forward, clipped the heads which fell into a box in the rear. When full this was hauled to the granary and deposited, and was the germ perhaps of the modern header. The great statesman of England, Gladstone, is credited with having taken out a patent in England for a reaper which cut the grain and delivered the straw in gavels, to be bound by hand. Curious, is it not, that it should have taken over two thousand years to bring so useful and necessary a machine to its present perfection, and yet not more singular than the parallel history of the perfection of the plow, that has been in use in some crude form since the days of the ancient Egyptians, if indeed they did not get their idea, probably, from the more remote civilization of the Chinese. To come down to the present time. To Mr. Obed Hussey and to Mr. McCormick, are due the merit of first elaborating ideas that have made reaping and mowing machines practi-



DOOLITTLE'S BLACK CAP RASPBERRY.



RASPBERRY—VARIETY HERSTINE

cable. Successive inventors have, with them, carried the improvements forward until, in 1878, machines cut, bound, and delivered the grain ready for shocking far cleaner and better than it could be done by hand. In California, headers are still much used, that dry climate allowing the grain to stand until so ripe that the heads may be safely ricked, or threshed, directly from the machine. In self-binding reapers, their perfection by human means may be said to have been about reached. The history of reaping, and the laurels added from time to time to American machines, have been thus tersely stated. The sickle, which was in almost universal use till within a very recent date, is undoubtedly one of the most ancient of all our farming implements. Reaping by the use of it was always slow and laborious, while from the fact that many of our grains would ripen at the same time, there was a liability to loss before they could be gathered, and practically there was a vastly greater loss from this cause than there is at the present time. It is not, therefore, too much to say that the successful introduction of the reaper into the grain-fields of this country has added many millions of dollars to the value of our annual harvests, by enabling us to secure the whole product, and by making it possible for the farmer to increase the area of his wheat-fields, with a certainty of being able to gather the crop. Nothing was more surprising to the mercantile community of Europe than the fact that we could continue to export such vast quantities of wheat and other breadstuffs through the midst of the late civil war, with a million or two of able-bodied men in arms. The secret of it was the general use of farm-machinery. The number of two-horse reapers in operation throughout the country, in the harvest of 1861, performed an amount of work equal to about a million of men. The result was that our capacity for farm production was not materially disturbed. The credit of the practical application of the principles involved in this class of machines undoubtedly belongs to our own ingenious mechanics; for though somewhat similar machines were invented in England and Scotland many years ago, they had never been proved to be efficient in the field, and had never gained the confidence of the farmers, even in their neighborhood; while the patent issued to Obed Hussey, of Cincinnati, in 1833, and another issued to McCormick, of Virginia, in 1834, not only succeeded in the trials to which they were subjected, but in the face of difficulties gained a wide and permanent reputation. Many patents had been issued in this country previously, the first having been as early as 1803, but they had not proved successful. Hussey's machine was introduced into New York and Illinois in 1834, into Missouri in 1835, into Pennsylvania in 1837, and in the next year the inventor established himself in Baltimore. McCormick's machine had been worked as early as 1831, but it was afterwards greatly improved, and became a source of an immense fortune to the inventor. He took out a second patent in 1845, fifteen other machines having been patented after the date of his first papers, including that of the Ketchum, in 1844, which gained a wide reputation. The first trial of reapers, partaking of a national character, was held under the auspices of the Ohio State Board of Agriculture in 1852, when twelve different machines and several different mowers were entered for competition. There was no striking superiority, according to the report of the judges, in any of the machines. A trial had been held at the show of the New York State Agricultural Society, at Buffalo, in 1848, but the large body of farmers who had witnessed it were not prepared to admit that the work of the machines was good enough to be tolerated in comparison with the hand-scythe. Some thought they might possibly work in straight, coarse grass, but in finer grasses they were sure to clog. The same society instituted a trial of reapers and mowers at Geneva in 1852, when nine machines competed as reapers and seven as mowers. Only two or three of the latter were capable of equaling the common scythe in the quality of work they did, and not one of them all, when brought to a stand in the grass, could start again without backing to get up speed. All the machines had a heavy side-draft, some of them to such an extent as to wear seriously on the team. None of them could turn about readily within a reasonable space, and all were liable to tear up the sward in the operation. The old Manning, patented in 1831, and the Ketchum machines were the only ones that were capable of doing work that was at all satisfactory. One or two of the reapers in this trial did fair work, and the judges decided that, in comparison with the hand-cradle, they showed a saving of eighty-eight and three-fourths cents per acre. Here was some gain certainly, a little positive advance, but still most of the reapers, as well as the mowers, did very inferior work. The draft in them all was very heavy, while some of the best of them had a side-draft that was destructive to the team. The inventive genius of the country was stimulated by these trials to an extraordinary degree of activity. Patents began to multiply rapidly. Local trials took place every year, in various parts of the country, to test the merits of the several machines. The great International Exposition at Paris, in 1855, was an occasion not to be overlooked by an enterprising inventor, and the American machines, imperfect as they were at that time, were brought to trial there in competition with the world. The scene of this trial was on a field of oats about forty miles from Paris, each machine having about an acre to cut. Three machines were entered for the first trial, one American, one English, and a third from Algiers, all at the same time raking as well as cutting. The American machine did its work in twenty-two minutes, the English in sixty-six, and the Algerian in seventy-two. At a subsequent trial on the same piece, three other machines were entered, of American, English, and French manufacture, when the American machine did its work in twenty-two minutes, while the two others failed. The successful competitor on this occasion, says a French journal, did its work in a most exquisite manner, not leaving a single stalk ungathered, and it discharged the grain in the most perfect shape, as if placed by hand, for the binders. It finished its piece most excellently. The contest was finally narrowed down to three machines, all American. Two machines were afterwards converted from reapers into mowers, one making the change in one minute, the other in twenty. Both performed their task to the astonishment and satisfaction of a large concourse of spectators, and the judges could hardly restrain their enthusiasm, but cried out, good, good! well done! while the excitable people who looked on hurrahed for the American reaper, crying out, that's the machine! that's the machine! The report of a French agricultural journal said: All the laurels, we are free to confess, have been gloriously won by Americans, and this achievement can not be looked upon with indifference, as it plainly foreshadows the ultimate destiny of the New World. Five years after the Geneva trial there was a general desire to have another on a scale of magnificence that should bring out all the prominent reapers and mowers of the country. The United States Agricultural Society accordingly instituted a national trial at Syracuse, N. Y., in 1857. More than forty mowers and reapers entered, and were brought to test on the field. It was soon apparent that striking improvements had been made since the meeting at Geneva. The draft had been very materially lessened in nearly all the machines, though the side-draft was still too great in some of them. Most of the machines could now cut fine and thick grass, without clogging, and there was a manifest progress in them, but of the nineteen that competed as mowers, only three could start in fine grass without backing to get up speed. The well known Buckeye, patented only the year before, won its first great triumph here, and carried off the first prize. Every year now added to the list of new inventions and improvements. In 1859 the Wood mower was invented, and soon gained a high reputation. By the year 1864 there were no less than a hundred and eighty-seven establishments in the country devoted to the manufacture of reapers and mowers, many of them very extensive, and completely furnished with abundant power, machinery and tools of the most perfect description while the work had become wisely and thoroughly systematized. The people directly sustained by these factories exceeded sixty thousand, while the value of their annual product exceeded $15,000,000, the number of machines amounting to one hundred thousand. Nine years after the Syracuse trial, another exhibition of mowers and reapers, national in its character, was held at Auburn, N. Y., under the auspices of the New York State Society, in July, 1866. The number of mowers that entered, single and combined, was forty-four; the number of reapers, thirty; or seventy-four in all. It was plain, at a glance, that a decided improvement had taken place in workmanship and mechanical finish. The mowers were more compact, simpler in construction, lighter, and yet equally strong; they ran with less friction; the draft was easier, and the machines generally were less noisy; they cut the grass better, and were capable of working over uneven surfaces. The committee say in their report: Those who had been present at former trials were astonished at the general perfection which had been attained by manufacturers of mowing machines. Every machine, with two exceptions, did good work, which would be acceptable to any farmer; and the appearance of the whole meadow, after it had been raked over, was vastly better than the average mowing of the best farmer in the State, notwithstanding the great difficulties that had to be encountered. At previous trials, very few machines could stop in the grass and start without backing for a fresh start. At the present trial every machine stopped in the grass and started again without backing, without any difficulty and without leaving any perceptible ridge to mark the place where it occurred, thus leaving a clean cut. We may here note the rapid progress of these most valuable labor-saving machines, for while, in the earlier trials, only one or two mowers met with any success whatever, no one doing what practical farmers could call good work, in this trial forty-two of the forty-four machines entered did their work well. In the early contests even a partial success was the rare exception; in the late, failure was the equally rare exception. In 1850 less than five thousand machines had been made and put to use, and few, if any of them, gave satisfaction. Now there is scarcely a farm of any size in the country but has its mowing machine. It is one of the grandest agricultural inventions of modern times, and yet we see that it is less than twenty years since doubts were freely entertained as to whether it would ever become practically useful, whether the numerous mechanical obstacles would be entirely overcome. Its triumph has been complete. We have now many mowers that have not only a national but a world-wide reputation. The successful introduction of these machines was an immeasurable step in advance upon the old methods of cutting grass. They come in at a season when the work of a farm is peculiarly laborious, when labor is held at higher than the usual high rate of wages, when the weather is often fickle, either oppressively hot and trying to the physical system, or catchy and lowering, and they relieve the severest strain upon the muscles at the time of harvest. Our reapers are at the same time self-rakers. We can reap and gather from fifteen to twenty acres a day in the most satisfactory manner. This brings us up to 1870, about which time inventive talent was earnestly directed to self-binding machines. The first successful attempt in this direction was the Marsh harvester, which cut the grain and carried it to tables from which two expert binders would tie the bands as fast as delivered, working from eight to twelve acres per day according to the heft and standing of the grain. It will not be necessary to follow inventive talent further in the perfection of reaping machines, suffice it to say, the ideas of the earlier inventors have been improved on and elaborated. Lightness of draft combined with great strength; the avoidance of undue friction, and last, motion; the power of starting with a clean cut in heavy, and, indeed, green and tangled bottom; automatic raking, and more later automatic binding, and the delivery of the bound sheaves in piles ready for shocking—all these points have been successfully elaborated within the last decade. Besides this, machines do not now easily get out of order, so that from the perfectness of the working parts, twenty or more machines may be put to work in a harvest, working one after the other on consecutive cuts, as illustrated in Landed Estates and Farms, and with almost as much certainty of retaining their respective places in line as may a string of gang plows, as illustrated in the article Plowing. In fact they can be kept as well under control, almost, as stationary appliances.

REAR HORSE. *Mantidæ.* True orthopterous insects which have their legs peculiarly adapted for walking, and known under various expressive names, as Rear-horse, Camel-crickets, or Praying mantids; all, as well as the specters or walking-sticks, are beneficial to agriculture, since they destroy all such insects as they can catch and overcome. They are all insects belonging to the South rather than the North, being seldom found much above the latitude of St. Louis. *Mantis Carolina* is common in Southern Illinois and South. They are of a greenish or grayish-brown color, their heads horizontal, their eyes large and globular, antennæ thread-like, and the body long, linear, and oval, with the abdomen much wider than the thorax or front part of the body, and of a depressed form. The upper wings of the male are long, and have numerous veins. The under wings are thin and net-veined with long parallel veins. The wing-covers of the females are considerably shorter than those of the male, and do not reach the end of the abdomen. When disturbed, this singular insect elevates or rears the fore part of its body almost perpendicularly, fixes its large staring eyes full upon the disturber, and turns its head sideways in a peculiarly human, yet ludicrous manner, so as to follow every movement of its tormentor with at least one eye. If a small object, such as a blade of grass, be then presented, it will either strike out vigorously with its saber-like fore feet, or else retreat to what it considers a safe distance. These insects are especially remarkable in the formation of their fore feet, which are much longer than the others, and are formed particularly for catching and holding their prey, which consists of other insects. The thighs are robust, and armed with a double row of spines, the shanks are short, spiny, and curved so as to fit into the under side of the thighs, when closed, like a clasp-knife. When in pursuit of its prey the insect moves almost imperceptibly along, and steals toward its victim like a cat approaching a mouse, and, when sufficiently near, the fore leg is extended at its full length, the insect immediately caught and impaled by the spines between the thigh and shank, carried to the mouth, and deliberately eaten piecemeal while yet alive and struggling to escape. If gently treated and daily accustomed to the sight of its feeder, this insect may readily be tamed so as to take flies from the hand, and from the oddity of its actions and apparent intelligence makes a most interesting pet. The eggs are clustered together in an irregular brownish mass or case, about an inch long, and fastened to the branches or trunks of trees, on palings, or walls, and even on the under side of window-sills, in Washington, where the insects are very common. Wherever such cases are found, they should be protected and not destroyed, as is generally the case, (being mistaken for the eggs of leaf-destroying caterpillars), as the insects produced from them do no injury whatsoever to vegetation, but, on the contrary, are very beneficial as destroying injurious insects, from their earliest infancy, as when young they feed upon plant-lice and other minute insects. These young rear-horses are so carnivorous that almost as soon as they are hatched and their skins a little hardened by exposure to the atmosphere they will devour their younger and softer-bodied brethren, and we have seen frequently a young mantis of a day old mercilessly devour the young of its own kind when just emerged from the egg-case. When older, these insects disperse and feed at first on very small insects, such as plant-lice and similar small game, until they acquire size and strength sufficient to master small caterpillars and flies. When fully grown, the females, being much larger, stronger, and more rapacious than their mates, the males, will frequently sieze and kill them, and afterward make a good meal from their quivering bodies. Allied to these are the specter or walking-stick insects, *Phasmidæ*. These insects in this country do very little, if any, injury, to the farmers, as they generally live on the shoots and foliage of wild shrubs or trees in the woods. The most common species is the common walking-stick insect, (*Diapheromera femorata*), so named from the close resemblance the insect bears to a dead twig or stick. The egg-sac is said to be flattened, elliptic, with a lid in front, which can be pushed open by the imago when about to hatch. These eggs are deposited in autumn. The young insects resemble the old ones in form and habits, differing only in size. The species never acquire wings, and merely crawl from limb to limb; they are of very sluggish habits, and the males are considerably smaller than the females. When stretched out motionless on a twig, with fore feet and antennæ extended, they can scarcely be distinguished from the twigs themselves, and city visitors, who see them for the first time, can scarcely be persuaded that they are not real twigs, gifted in some mysterious manner with life and motion. These insects are said to be able to reproduce some of their limbs when accidentally broken off. They feed upon the buds, shoots, and foliage of various trees and shrubs, but are not sufficiently numerous to cause much injury.

RECEPTACLE. In botany it has four different significations: That part of a flower upon which the carpella are situated; or, in other words the extremity of the fruit stalk. The axis of the theca of *Trichomanes* and *Hymenophyllum*, among ferns. That part of the ovarium from which the ovula arise, and which is commonly called the placenta. That part of the axis of a plant which bears the flowers when it is depressed in its development; so that, instead of being elongated into a stem, it forms a flattened area, upon which the flowers are arranged, as in compositæ.

RECLAMATION OF LAND. The history of the reclamation of swamps and marsh lands, more especially by shutting out the water of floods, is as old as civilization itself. Its condensed history is given both as showing its antiquity and the importance always attached to such reclamation, from the great fertility of such soils. The periodical overflow of the Nile to uncertain limits necessitated the controlling of the waters within defined boundaries, and this control was most undoubtedly exercised by means of embankments. The Phœnicians—the people of Tyre and the ancient sea-ports of the East, the Greeks and the Romans, erected extensive works on their sea-coasts to protect their cities and ships from ocean storms and foreign enemies, and no doubt they enclosed low-lying lands in many instances for the purpose. The Romans, during their occupation of Britain, raised immense lines of embankments at several points along the coast, the remains of which are still in existence. In fact, all nations, as they advanced in civilization seem to have recognized in reclamation a means of extending the area of land to be distributed among the people without necessitating an emigration of surplus inhabitants. This has been the case in India and China, where the dense population manages to accommodate itself to the limits of those countries, and it is only within the last few years that we have seen any signs of a movement by these people to other countries. The original settlers of the Netherlands were the descendants of those wandering tribes whose emergence from their homes in the North heralded the downfall of the Roman empire, and laid the foundation of the nationalities which at present checker the map of Europe. The first steps toward erecting barriers against the tidal overflow in Holland are stated to have been taken in or about the second century of the Christian era. It is probable that vanguards of the great army of invasion which in later times overran Europe from the north had begun to move forward and occupy in small bodies the country lying along the northern coast. As the population increased, and the groups of mud huts grew into large towns and cities, the necessity for placing under cultivation more extensive areas of land became imperative. The more valuable these settlements grew to the people,. the more desirous were they to guard them against destruction by the sea, and the attention of the government and people was directed to the general and permanent embanking of the whole coast. How they have succeeded we all know. The country which was once a desolate marsh is now a garden. Visitors passing through it acknowledge that in no part of the world is scientific agriculture better understood or applied, although the fields and dwellings are in many places twenty feet below the level of the sea. It was not alone necessary to embank against the sea, but also against the waters of some of the great rivers whose sources are to be found in the very heart of Europe, and which would overflow all the low lands they traverse had not the precaution of confining them to their natural channels been taken by the Hollanders. Many works have been written which give detailed descriptions of the manner in which the diking of the Netherlands was carried on. The foundation of the work was laid by nature. The superstructure was the work of man. Along the coast exposed to the great ocean storms a bank of sand was washed up by the action of the waves, and a natural barrier was erected against the incursion of the tidal waves. A belt of wood which grew along the coast, and against which the sand was heaped, assisted the early toilers in their labors by affording both shelter and material. This wood has since disappeared to a great extent in the constant repairs rendered necessary by the action of the waves in stormy weather. Beyond strengthening and connecting these mounds or banks of sand, and securing the lands in the immediate neighborhood of the ocean from tidal overflow, little was done in the beginning on the main embankment along the coast, while the river banks were left wholly exposed. The great work once initiated, however, it has progressed steadily to the present day, and we find that after a struggle lasting many centuries, the energy and perseverance of man have wrested a kingdom from the sea. Writers on the subject of the early condition of Holland tell us that the country was covered with lakes, varying in size, which have been drained and converted into fruitful farms. The most important operation lately and successfully completed is the draining of the Harlem lake, which covered an area of about 45,000 acres. A description of this work was given in the report of the Department of Agriculture for 1866. Extensive tracts on the western coast of England, called the Fen country, have been embanked and drained, and added to the cultivable land in that section. As many as 680,000 acres of fen have been reclaimed, and the works rival those of Holland in extent. The Encyclopædia Britannica says: This fen country has for centuries been the scene of drainage operations on a stupendous scale. The whole surface of the great basin of the fens is lower than the sea, the level varying from four to sixteen feet below high-water mark in the German Ocean. The difficulty in draining this flat tract is increased from the circumstance that the ground is highest near the shore and falls inward toward the foot of the slope. These inland and lower grounds consist of a spongy peat, which has a natural tendency to retain water. The rivers and streams which flow from the higher inlands discharge upon these level grounds, and originally found their way into the broad and shallow estuary of the wash, obstructed in all directions by bars and sand-banks. These upland waters, being now caught at their point of entrance on the fens are confined within strong artificial banks, and so guided straight seaward, and are thus restrained from flooding the low grounds, and by their concentration and momentum assist in scouring out the silt from the narrow channel to which they are confined. The tidal waters are at the same time fenced out by seabanks, which are provided at certain intervals with sluice-doors by which the waters escape at ebb tide. When this does not provide such a drainage as to admit of cultivation, the water is lifted mechanically by wind or steam mills into the main aqueducts. In the district called Marsh, in Norfolk, extending between the Ouse and the New, in that called South Holland, in Lincolnshire, stretching between the New and Welland, northward of Spalding, and also northeast of Boston, there are considerable tracts of marine clay soil. In Marshland this is chiefly arable land, producing large crops of wheat and beans; but in Lincolnshire it forms exceedingly fine grazing land. This tract lies within the old Roman embankment, by which the district was first defended from the ocean. Outside this barrier are the proper marsh lands, which have been reclaimed in portions at successive periods, and are still intersected in all directions by ranges of banks. The extraordinary feature in this tract is that the surface outside the Roman bank is three or four feet higher than on the inside, and the level of each new inclosure is more elevated than the previous one. The land rises step by step as the coast is approached, so that the most recently reclaimed land is often twelve and sometimes eighteen feet higher than the lowest fen land in the interior, the drainage from which must, nevertheless, be conveyed through these more elevated marshes to the sea. These extensive works are represented by many hundreds of miles of river embankments, and the sea-coast line embanked exceeds one hundred and thirty in length. This fen land, once, like that of Holland, a wild, marshy tract, impassable to man or beast, is now a fertile farm, rich in agricultural products, and inhabited by a healthy and wealthy population. Another instance of successful reclamation is to be found in England; the Bedford level, called after the Earl of Bedford, who in the year 1634 expended over £100,000 to reclaim these lands, and whose son completed the work at an additional cost of £300,000. These lands have since that time been kept perfectly free of water by means of windmills and other pumping engines. Extensive drainage operations have been carried on in many parts of Europe, particularly in France and Italy. The celebrated Pontine marshes, near Rome, are mentioned by early historians as a source of great danger to the public health, and several unsuccessful attempts were made to reclaim them. The popes at different periods renewed these efforts, and their success, though partial, proved that the drainage could be effected with sufficient capital. In Ireland, immense tracts of peat-bog have been drained and converted into arable land. The bog of Allen is an extensive area of peaty soil, extending into several counties, and covering many thousand acres. In the southern part of Ireland, along the rivers and shores of the main estuaries, large areas of alluvial deposits have been inclosed by embankments, and a rich soil made available for cultivation. The cotton lands in the valley of the Mississippi are exceedingly fertile when properly protected by levees from the periodical overflow of the river. The construction and maintenance of these levees are often the subject of discussion in Congress, and it would seem proper that the nation's representatives should interest themselves in what forms so important a protection to the agricultural interests of several of the States of the Union. In Canada the question of reclaiming the marsh lands is receiving considerable attention from both the government and the people. Extensive works are about to be commenced, with a view to these reclamations; and vast areas of fertile soil will be added to the lands of the New Dominion. In the United States the question of utilizing marshes has not attained the importance it deserves. In the neighborhood of New York, a considerable tract of land, known as the Newark Meadows, lying between the Newark and Paterson range of hills, on the west side, and the Palisade ridge of Bergen hill on the east side, has been embanked and otherwise drained and reclaimed within the past fifteen years. Mr. Jerome J. Collins, a civil engineer of New Jersey, who has had large experience in reclaiming the tide water lands between New York, Newark, and Hackensack, originally unproductive salt marshes, but now most valuable and high priced gardening soil, gives the general principles of reclamation as follows: In effecting the reclamation of a tract of marsh land, three distinct objects must be attained before the work can be considered complete. First, the exclusion of all waters, having their sources of supply or operating from the outside of the limits of the marsh land reclaimed. Second, the collection and expulsion, by means of drains, ditches, sluices, and pumps, of all waters lodged on the marsh or having their sources inside its limits. Third, the control of all waters that may afterward acccumulate on the marsh from springs, rains or other causes, so that the danger of drowning the land may be avoided and the cultivation of the soil be uninterrupted. Each of these conditions must exist to insure the harmonious working of the other two; the absence of one is fatal to the usefulness of the others. In case of the first condition, when we undertake to exclude waters having their sources outside the limits of the marsh to be reclaimed, it is necessary to erect a dike; but the shape, size, and mode of construction will be governed by the locality, material, and the amount of resistance the dike must offer to the return of the excluded water. The collection and expulsion of waters accumulated on the marsh from rains, or the interception of that deriving its source from springs within the marsh limits, will depend considerably on area, location, and outfall, as well as on the power and capacity of pumps and other water-engines. The control of the water in the soil and its removal for agricultural purposes will depend on the excellence and completeness of the other works, but will also be affected by climate and the character and treatment of the crops raised. The location of the marsh with respect to high lands is of the utmost importance, as, when adjoining upland, it receives the rainfall of the hills in addition to its own, and unless precautions are taken to control this irregular addition to its own waters, so that the land shall not suffer from it, the third condition for a complete reclamation can not be said to be complied with. Embankments are necessary for the exclusion of water from an area where the source of that water is above the level of the surface to be kept dry. For instance, the embankment of a reservoir must of necessity be above the level of the river, spring, or other reservoir from which the first receives its supply, unless, indeed, the discharge from the latter be equal to that which it uniformly receives, and its embankments lose their retaining character, and become simple diverters of the stream. In like manner, any space enclosed by an embankment for the purpose of excluding water must have that embankment higher than the highest level of the encroaching water, if an inland stream, or the highest known range of the tide, if on a tidal river bank, or the sea-coast, unless, in the case of the inland stream, the water becomes simply guided in its course, and not confined. As our principal marshes requiring embankments are located along the shores of the large bays and inlets, or on the banks of tidal streams, remarks will be confined to such marshes and their requirements. In erecting a dike to resist the pressure of the tide, the shape, the size, and the mode of construction of the dike must vary with the location and the range of the tide. Location affects it because the bank may at one point be sheltered from the eroding action of the waves, while at another point it may be exposed to their full force. It is therefore evident that some dissimilarity must exist between the work to be done by the two sections of the bank, and a consequent difference becomes necessary in their shape, strength, and mode of construction. Many plans have been projected for the erection of dikes, sea-walls, and embankments, each possessing some peculiar merit, while failing to fulfill equally important requirements. No particular form of dike can be recommended for all cases, as the necessity of each case demands special treatment. The Dutch engineers favor long slopes for sea-banks, constructed of sand or other light material, but the length of the exterior slope can be safely diminished, where a durable material, like stone, can be procured, with the additional security of piles and other protection; it is also certain that where the material is not adhesive and durable, long slopes, especially facing the waves, are advantageous when not exposed to the face of the ocean waves, as on the coast of Holland. A base of about five to one, divided between the internal and external slopes, in addition to the width of the bank on top, would afford ample base for an embankment. Thus, if we require an embankment six feet high to resist the encroachment of the tide, we can not with absolute safety construct it with a base of less than thirty-five feet to resist effectually the wash of the waves. This width of base would admit of, in the first place, a width on the top of the embankment of five feet and external slope of three feet and a half to one, and an internal slope of one and a half to one. The bank with a thirty-five foot base is suited to exposed situations, where wind and wave act directly but moderately. Where the bank is subject to a heavy blow from the waves, the slope will be so graduated as to receive and gradually deaden the effort of the wave as it traverses its surface. The shape of the bank is of as much importance as its construction and dimensions, because, if by unsuitable proportions we subject the very best material and workmanship to extreme and unnecessary strains, it can not be expected that the work of resistance will be performed as effectually as if due consideration were given to the relations which should always exist between the shape, material, and amount of resistance the bank is expected to offer to the water. Durable material is not always to be had where wanted for embankments, but in the case of salt marshes, with very few exceptions the soil excavated forms a superior material for their construction. This is generally the case along the shores of large rivers and estuaries, where the silt from the river is continually being washed against the bank, and during high tides carried over and deposited on the surface of the marsh along the river-banks, forming a compact soil, which, when used, in the construction of a bank and dried, becomes hard, durable, and water-tight—the three most important requirements for an embankment. The fitness of these marsh soils for embankments has been tested, and where used not the least trouble has been experienced with them either by a settlement or breach, but the shape of the bank has been preserved unchanged after severe winters and heavy rain storms. When banks are erected to exclude water, they must be made perfectly impermeable to that element. The least leakage is but the forerunner of a burst, unless quickly attended to. These leaks are frequently caused by the imperfect construction of the bank itself, where the material is not packed close, or some of the joints between the sods of soil have not been thoroughly closed by the workmen. Another cause may be the shrinkage of the material when drying in the bank, joints that were close while the moisture swelled the material of the bank being opened by the shrinkage of the soil, and admitting tiny streams, which soon become serious leaks, and finally the cause of the destruction of the bank. Of the two causes, either may be guarded against by proper care in constructing the bank. There is still another cause of leakage and the failure of a bank—the penetration of the bank by muskrats and other boring animals, whose attacks must be steadily resisted by constant vigilance and the adoption of some plan of construction which will defeat their operations. Several attempts which have been made at reclamation in this country owe their failure to the muskrats. These animals are not to be despised as enemies to marsh reclamation. As workers they are unrivaled in perseverance, for they will return again and again to the attack on the same point of an embankment, until they succeed in boring it to their satisfaction, or are killed by a lucky shot. On the Newark meadows, New Jersey, they were defeated effectually by means of the iron plate inserted in the embankment, and covering the space between the range of high and low water. The rats penetrated the bank in many places, but were stopped by the plate, and they either gave up their excavation or cut their way over the plate at a level above that of high water, and the consequent injury to the bank was slight and easily repaired. A core composed of a less expensive material than iron would answer the same purposes, and a well-constructed dike core of wood, hemlock for instance, will probably be found fully equal to all requirements. There are conditions, however, under which the iron core might be preferable. To accomplish the second important condition, the collection and removal of all waters lying stagnant or otherwise, and having their source of supply within the limits of the marsh, a series of main and intermediate ditches or drains must be cut through the marsh, for the collection and conveyance of these waters to points on the line of the main embankments, from which it can be forced or drained out. In the case of tide marshes, where the range of the tide brings the low-water level sufficiently below that of the marsh surface to admit of the drainage of the soil to a proper depth, and a fair outfall for the water collected in the ditches, a number of well-placed and properly-constructed sluice-gates will assist considerably in draining the land, as the volume of water drained into the river or bay will be in proportion to the fall and capacity of the sluice to discharge it. Although many advantages are derived from the use of sluices on marsh lands, they are not to be compared in efficiency with a well-constructed pump, worked by steam-power. No matter how well constructed a sluice may be, or of what material, there is always a weakness about it and a liability to accident that must impress itself upon the observer. The connection made between the embankment and the wood-work or masonry of a sluice is, in nine cases out of ten, the site of numerous leaks, which are continuously enlarging and are the more dangerous on account of their apparently trifling character. The material of a sluice may be iron; it corrodes and gets easily clogged by slight obstructions, such as small branches of trees or tufts of grass. If made of wood, it is liable to rot away under water, and be unexpectedly destroyed by a violent storm or other cause. The stone-work setting of a sluice, on account of the alternate wetting and drying process that goes on, particularly during the winter frosts, will work out all the mortar or cement from the joints, and the whole sluice is liable to be undermined by the action of the current passing through the sluice twice in every twenty-four hours. If the sluice is self-acting, it is a source of danger, as it is liable to be obstructed by floating wood, grass, weeds, etc., and is certain to be frozen up in winter time, and in case it should be so prevented from working properly, the sluice being set to low water, the obstruction to the free flow of the water or to the closing of the gate against the rising tide will not be discovered until, in the latter case, the tide begins to flow in through the sluice, when the obstruction is placed out of reach. In this way considerable damage may be done to young crops by an overflow of salt or brackish water. If the sluice is worked by hand, it is equally dangerous, as neglect will result in a general overflow of the reclaimed land and a probable destruction of valuable property. The best provision that can be made against an overflow from a neglected or defective sluice-gate is the use of pumps exclusively for the drainage of tidal marshes. A considerable saving is also effected by using a pump, as fuel can be economically used and only when required, while the cost of pumping from one station will be much less than sluicing from a dozen points, when a larger staff of workmen is required. The general plan of the ditches and drains is regulated as much by the location of the outfall as by the actual wants of the land. The object being to remove the water as quickly as possible from the place where it accumulates; and by that means to save every inch of the fall, the ditches should be laid out with that object, and every part of the tract to be drained should be connected with the outfall as directly as possible. It is also desirable to keep a current flowing through the ditches to the outfall as uniformly constant as possible, so that no deposit can occur in the drain to obstruct the passage of the water. This uniformity of motion and direction can not be obtained by the use of sluices, or rather can be obtained by no other means than by pumping-power, which has no cause for stoppage by reason of the ebb and flow of a tide, the effect of prevailing winds, or any other obstacle to the free and constant flow of water through a sluice-way. By the use of pumps a uniform and unbroken line of embankment is presented to the outside water, having no weak places to cause a fear for its stability, no wood-work to rot away, iron-work to corrode, or masonry to be destroyed. Complete control is obtained over all accumulations of water that may occur after rain storms; a deeper drainage of the land is possible, as the level of low water outside does not affect the operation; and in the case of heavy rains due preparation can be made by the engineer to deal with the water, for when the barometer indicates a change of weather or the approach of a storm he can pump his ditches dry if necessary, and keep the water very low during the heaviest rains; on the other hand, the pump need not be worked more than one day in the week during dry weather. When certain conditions favor the adoption of the sluice in preference to the pump, it is wise to adopt that system; there are some cases where no choice can be exercised. Where springs are found on these marshes, either isolated or in groups, it is proper to connect them with a main drain through a lateral ditch; and when found in groups to surround them with a ditch by which their waters may be removed as fast as discharged, and not permitted to saturate the soil for any distance around. The removal of water from the soil for agricultural purposes is the last and most important condition to be fulfilled in the work of reclamation. The fitting of soil such as is found on our marsh lands for the reception of suitable crops calls for the exercise of considerable skill on the part of the agriculturist. He finds a virgin soil in the formation of which almost every fertilizing element is employed. His experience of upland farming may be very extensive; but here he has land that requires peculiar treatment, but no manure, no invigoration, to call forth its productiveness; in fact, nothing except the ditching tool and the plow, and the farmer's personal care and management, is required to achieve success equal to the highest expectations. An excess of moisture in a soil hurts vegetation by keeping the temperature of the subsoil low, and weakening the effect on the plants of the various chemical constituents that assist in the development and support of vegetable life. The remedy for this evil must necessarily be drainage. The absence of a proper moisture is equally damaging to vegetation, as many of these chemical constituents of soils are brought into active operation by the water in the soil and the vitality of the plant is thereby sustained. Water is the principal constituent of the sap of plants, and its absence in proper quantity must cause an exhaustion to the vegetable similar to that produced in the animal life by loss of blood. The want of natural moisture is usually supplied artificially by what is known as irrigation. We must seek a mean between the two conditions of excess and total absence of moisture, in order to arrive at that in which a soil is best fitted for the production of a healthy vegetation. Some soils, owing to their formation, will retain moisture more readily than others, and, therefore, require a different style of cultivation. Sandy soils are dry and represent the opposite extreme to the marsh in point of humidity. This is due to the composition of the soil. Sand, being purely granicular, permits water to pass easily through it until it sinks to the level of some denser substratum. Marsh soil, especially alluvial or vegetable deposit, is absorbent; its particles are so minute as to form a closer and more compact combination not easily penetrated by any foreign matter moved by the force of gravity alone, insoluble, and possessing in a high degree the property of inducing capillary attraction. Nothing but deep incisions into the surface of this soil creates that positive disconnection of the mass which is necessary for the liberation of the water held in the soil by the sponge-like substance which enters so largely into its composition. The low situation of marshes and bogs is not a reason for the presence in excess of moisture in their soils. In many instances these bogs are found on high lands or the tops of high mountains. Tracts of peat bog in various parts of Ireland and England, where the surface is soft and shaking, are as high as eight feet above the level of the adjoining dry and arable land, and the water of these bogs rarely interferes with the dry land in the immediate vicinity, as it is held by the soil of the peat bog by capillary attraction stronger than gravity itself, which latter force asserts itself wherever the particles of soil are incapable of losing their identity by being blended in a general mass. The action of this capillary force on the water in the subsoil and the result in favor of vegetation has already been stated in this article and needs no further explanation. When an outfall is secured, and a regular system of main drains established, the freeing of the excess of moisture for the purposes of cultivation is accomplished by the smaller drains, which intersect the areas not immediately affected by the main drains. The size and capacity of these sub-drains will of course be suited to the area affected and the degree of humidity of the soil. In some parts of the same marsh tract the soil differs so considerably in its nature as to necessitate a variation in the plan of drainage. The proximity of high lands, woods, springs, or other causes of excessive moisture in the soil, must be taken into consideration and provision be made accordingly, but the general principles by which the detail drainage of the land is affected must be observed. A general inclination or fall of all minor drains to a main drain is as necessary as the fall of the main drain to the outlet, sluice-way, or pumping station. Where tile drains are laid, a fall of one foot in two hundred is sufficient to carry off the water, but as there are many cases in which drain pipes can not be employed, it is desirable that, while affecting as much ground as possible by a drain, every advantage should be taken of a good fall on the line of each drain, whether a main or an intermediate drain. Various plans for intermediate drains have been suggested and adopted from time to time. Among them may be mentioned one that is formed by a simple trench, cut with a shoulder to support a covering sod, laid grass down, and covered to the surface with the excavated soil. This drain does not last long, but is an economical form. Another kind of drain is made by leaning the flat tiles bridgewise against one another on top, the apex of the triangle so formed being covered with a thick sod, and the remaining part of the trench filled with broken stone and excavated soil. The tile-and-shoe drain has been used extensively in many parts of England. It is a horse-shoe tile, resting on a flat tile, thereby forming a kind of arched drain, from one to four inches in diameter. This style of drain is not now used so much as the simple circular drain pipes, with collared joints, where such a precaution is necessary to preserve the efficiency of the drain. These drain pipes are of burnt clay, about fourteen inches in length and from one to fourteen inches in diameter. In very humid soils it is necessary to provide a sufficient number of drains to carry off the water after heavy rains as fast as it soaks into the ground. Experiments will soon establish the proper positions and distances apart for these drains. As it is necessary to the productiveness of a soil that the warm rainwater should penetrate below the line of vegetation, the drains should be laid at such a depth as to be clear of the plow and spade, and the frost and the tap roots of larger plants. As soils are very rarely broken below eighteen inches from the surface, and roots are known to reach down as far as the soil is rich, while the frost penetrates to an average depth of three feet, it would be safe in districts affected by frost to lay drains four feet under the surface, and in warmer climates at a depth of one foot below the line of cultivation. With a suitable connection between the main and the drains, no soil, no matter how wet it may be, can fail to be reduced to a condition fit for cultivation. As localities differ widely in their physical features, and various circumstances compel special treatment in almost every case, it is not practicable to designate, beyond the general principles that should govern the construction and arrangement of reclamation works, any form of embankment, drain, sluice, or pump to be adhered to under all circumstances. Locality, prevailing winds, climate, range of tide, strength and velocity of local currents, the nature of the soil and vegetation, all combine to alter the character of the works, and a common standard would be impossible. It may be said of all these that locality is the one on which all the others depend for their importance. We find as we traverse the Atlantic coast of this continent a great many varieties of soil in the marshes. This is owing to the different kinds of vegetation produced on these marshes, or which composed their soil originally, and the rapidity of decomposition of this vegetable material in the soil. With locality, climate varies considerably, and climate regulates the character and growth of plants, their development, their time of maturity and of decay. A natural result of all this influence must be that in localities possessing warm climates the vegetation is more varied, more luxuriant, and consequently enters more largely into the composition of the soil than in places where the climate is less favorable for the development of vegetation. The rapid growth and quick succession of crops must tend to a large annual deposit of vegetable matter on the surface, which, before it becomes thoroughly decayed, is itself a soil, from which other plants spring, and the deposit becoming in this way more rapid than the decay which should convert it into vegetable mold, a soil is formed many degrees less dense in its structure than that of a place where the climate is colder and the growth of vegetation is slower and less luxuriant. It has been remarked that spongy, vegetable soils will retain water, when sandy and porous soils will not, and the work of drainage will be increased in proportion to the quantity of vegetable matter found in the soil. It also occurs that this rapidly formed soil is less fitted for the construction of water-tight embankments than that of a more gradual deposit, on account of its being more permeable to water, and it is often found necessary, therefore, to reject the soil we propose to reclaim, as a material for the embankment, and use that from another place. While locality and climate materially affect the manner of reclamation, prevailing winds also exercise an influence by their action on the tidal wave. In exposed situations, the winds exercise this influence to such a degree as to necessitate a complete change in the plan of reclamation, especially on the tidal marshes along the coast and the shores of our rivers. According to the course of the river, against the overflow of which embankments are erected, as well as the direction of the opening by which the waters reach the sea, the wind at certain seasons, causes a raising of the tide wave above its ordinary level, and of course necessitates higher and stronger embankments to resist it. Reference is not made to the semi-monthly occurrence of spring tides, but to the powerful effect of strong winds on the surface of water, forcing it in the direction in which it blows. When a strong wind and a spring tide occur at the same time, the tide will be raised over the level of spring tide in proportion to the strength of the wind; and when both meet a heavy freshet after a rain storm, the increased volume of the stream is not unlikely to overflow the banks, and inundate the surrounding country for many miles, doing much damage to property, and sometimes causing loss of life. In level countries the wind blows in a downward direction at an angle of something over 18° with the horizon. The pressure of the wind is in proportion to its velocity—the former increases as the square of the latter. The following table of velocities and pressures of the wind is taken from Burnell's Hydraulic Engineering:

Character of wind.	Velocity per second.		Effect per yard square.
	Ft.	In.	Pounds.
Light breeze, hardly perceptible.......	1	0	0.04989
Gentle breeze........	3	0	0.19756
Light wind.............................	6	0	0.79130
Rather strong wind, best for sailing ..	18	0	6.06996
Strong wind..	33	0	20.06690
Very strong wind.......................	66	0	80.26760
Tempest or storm.......................	70	0	101.62790
Great storm............................	90	8	146.34430
Hurricane....	118	4	260.05670
Hurricane able to tear up trees, etc., etc.	150	8	406.51180

An instance of the effect of strong wind on water is mentioned by Franklin. A pond, nine miles wide, and of an average depth of three feet, was acted on by a strong wind, which forced the water from one side so that it was laid bare, and the depth of water on the other side was increased to six feet. Next to the influence of winds and waves on reclamation works, is the action of currents. Where the shore is concave, it would be imprudent to erect embankments close to the water-line, unless some protection in the shape of masonry or piling be placed against the wearing action of the current; while, on the other hand, when the shore is convex, the embankment may be placed even at the water's edge, as the fore-shore will continue to gain in the latter case as it loses in the former. In like manner, on sea-coast embankments, where the bank is likely to be washed by any of the numerous currents created by the movement of the tides, the greatest caution should be exercised in protecting the works from injury, and the exterior slopes should be strengthened in the best manner to resist the action of the water. To preserve the embankment against the damaging effects of frost, it is well to cover the face of the exterior and interior slopes with thick sods, by which a protection is afforded to the bank by the covering of grass, and the frost is not permitted to penetrate so deep into the soil composing it. In California it is estimated that there are 3,000,000 acres of swamp lands, which when drained will be the most valuable in the State. Since 1870 this work has been prosecuted with energy, one company alone having a nominal capital of $12,000,000, and owning, in 1872, 120,000 acres of land in the delta of the Sacramento and San Joaquin rivers, and embracing we believe, both salt water and fresh water tide land. In the West there are large areas of what are known as low prairie, not marshes, but lands suffering from excess of water in the spring and interspersed through with ponds seldom dry. In Iroquois county, Ill., vast areas have been reclaimed by a careful system of drainage, rendering them among the most valuable lands in the State. In Iowa there are large tracts of the same nature requiring comparatively little expense to fit them for the plow, also many river bottoms of large extent, subject to overflow in floods occurring both in spring and summer. A good beginning has also been made in that State in the reclamation of these lands by surface drainage and by embankments. In the West there has been so much unoccupied land requiring no drainage, that until within a few years, but little attention has been paid to systematic drainage. It is now found that these lands are the richest in the several States, and that they may be reclaimed at a comparatively light cost. Hence, capital and energy have sought these channels of industry, and have acquired large tracts worth many millions of dollars in the aggregate, and adding a large yearly surplus of agricultural products for export, or for consumption at home, through being fed to fattening cattle and swine. There is another class of soils, the richest in the world, lying along the great rivers of the Mississippi valley, especially those vast areas near the Mississippi and Missouri rivers, subject to overflow in great freshets, because lying below the high water line, that if protected at all must be so by expensive systems of levees, requiring large outlays of capital. This system has been in operation in the South many years, and yet only imperfectly accomplished, since with streams carrying a large amount of sediment, the natural consequence of diking the banks, is to cause a deposit of sediment at the bottom of the stream, so that the bed of the river may come to be ultimately higher than the land itself. This is found to be the case in some of the streams of Europe, that have been diked for many centuries. The same effect seems to be going on in the lower Mississippi, the result being that the levee must be raised constantly higher and higher. Natural reasoning will show that there is a limit beyond which human art may not strive, and already, a number of schemes have been advocated to take the pressure from the banks. The recurrence of destructive inundations like those in the last decade, (1876 and 1881), in the upper Mississippi, and in 1881 along the Missouri as well, would seem to point to the fact that some means must be taken to ease the pressure of water, in very high floods, by straightening the channel, and causing a freer flow, with increased velocity, in connection with higher and more substantial embankments. The floods of 1881 would seem to teach this plainly. Another fact seems plain. The lands lying along the Mississippi are of sufficient value to bear a large outlay in perfecting the embankments. For whatever the cost, it must be done thoroughly. The damage by the flood of 1881 would undoubtedly cover the entire cost of the system of embankments or levees, or at least the recurrence of another such a one certainly would. It would seem to be a wise course that such disasters to property be prevented, if possible, in future.

RECTIFICATION. A second distillation.

RECTRICES. The tail feathers of a bird.

RECTUM. The lowest intestine, ending in the anus.

RECUMBENT. Leaning down.

RED BIRD. The cardinal grosbeak is a southern species, sometimes called the Virginia nightingale. They have been accused of mutilating orchard fruits, for the seeds, and also of catching bees. That they are destructive to a considerable extent there is little doubt. Yet the stomachs of those shot, have been found to contain principally the seeds of wild plants.

RED BUD or JUDAS TREE. *Cercis Canadensis.* Is one of our prettiest early spring flowering ornamental trees, growing from fifteen to thirty-five feet high. The flowers appear before the leaves, small, numerous, covering the branches, bright red in color, fading to a pale pink. The tree is common along the banks of streams, in the latitude of central Illinois and south. A European species, *C. siliquastrum* is similar, but not so handsome as the American species.

RED CLOVER. (See Clover.)

RED LEAD. A mixture of the protoxide and peroxide of lead, used as a paint,

RED SPIDER, PLANT MITE. *Acarus telarius.* A small red insect which spins a net, and lives on the juices of many plants and trees, attaching itself to the lower side of the leaf. It is especially injurious in hot-houses. They are destroyed by frequent syringing with cold water, by fumigations and washes of whale-oil soap and water.

RED-TAILED BUZZARD. (See Buzzard.)

RED TOP. A name sometimes given to herd's grass, and also to a dry perennial grass of the Middle States (*Tricuspis*) of little or no value.

RED WATER. (See Black water of Cattle.)

RED-WINGED BLACKBIRD. (See Blackbird.)

RED WORM. An old name for the wireworm.

REED. The genus *Arundo,* tall, aquatic, and boggy grasses. They may be destroyed by draining the soil, by liming and ashes.

REED BIRD. *Icterus agripennis.* This sprightly summer visitor is known by a variety of names in different parts of the country. In Louisiana as meadow bird, in the Carolinas, the rice-bunting. As the reed bird in Pennsylvania, and as the bob-o-link in New York and East. In the West, it is known both by the names of reed bird, bob-o-link and skunk blackbird. Its song is a sprightly chatter familiar to all, and once commenced by one will be answered by each other male bird within hearing. Its food is principally seeds, but it is also very destructive to the cereal grains when in the milk. In the South, it is the execration of the rice planter, and yet who can help loving the gay, familiar, and chattering skunk blackbird.

REED GRASS. Canary grass.

REFLECTION. The throwing back of the rays of heat or light by a polished surface or mirror.

REFLEXED. Bent back, turned back,

REFRACTION. The action exerted by water, glass, and all transparent bodies of changing the direction of rays of light, so as to make them appear bent.

REMIGES. The quill feathers of birds.

REMIPES. An order of coleopterous insects which are capable of swimming.

REMITTENT FEVERS. Fevers which are subject to periodical paroxysms, as the ague, bilious fever, etc.

RENAL. Relating to the kidneys.

RENIFORM. Kidney-shaped, of the shape of a kidney bean.

RELATIVE GROWTH OF TREES. It is not generally known how fast trees will grow and make timber in a fertile soil. It is not necessary in this article to go into an argument to prove the value of tree planting in treeless regions. It is an accepted fact. As showing the growth of timber in twenty years, we give a table as prepared, some years since, by the late H. H. McAfee, a well known cultivator. It is as follows:

Species.	Diameter of trunk—inches.	Height in feet.	Cord feet in fuel.
Cottonwood monilifera)	24	50	5¼
Cottonwood (*quadrangulata*)	28	50	6
Lombardy Poplar	23	60	4¼
Elm (*Americana*)	17	44	3¼
Elm (*Fulva*)	18	39	3
Maple (*dasycarpum*)	18	39	3¼
Maple (*niger*)	11	37	1
Walnut (*cinerea*)	20	39	3¾
Walnut (*niger*)	14	37	2¾
Honey Locust	14	40	3
German Pine	14	33	2

Thus, actual test shows that cottonwood will make three-fourths of a cord; that even the slow growing black maple will make one-eighth of a cord, while the ash-leaved maple (*negundo*) will make five-eighths of a cord to the tree in twenty years' growth. The same trees if grown in groves thickly, would probably not make more than half the quantities named, which would in time come nearer to the figures as given above. The following will, we think, be a safe estimate for groves or broad belts, in twenty years, planted, say, four by four feet, and thinned out as their good deserves, to a maximum distance of sixteen by sixteen feet for the fast growing varieties, and eight by sixteen feet for the slower ones:

Species.	Cords.
Cottonwood	70
Ash-leaved Maple	60
White Walnut (Butternut)	50
White Maple	44
Elm	43
Honey Locust	85
White Pine	32
Black Walnut	30
Black Sugar Maple	20

A very simple and easy way to plant and cultivate, either for wind-breaks or groves, is to bring the ground into a good deep tilth by plowing and harrowing, and then plant the trees of two, three, or four years' growth, in straight lines, and at a distance of four feet apart. Cultivate with an ordinary two-horse cultivator so long as you can stride the rows, if the trees be small enough when set, or with double-shovel plow if larger. Continue this until it is no longer easy to get between them with a horse. All the willows will grow readily from cuttings, so will the cottonwoods, and Lombardy poplar; but, do not plant Lombardy poplar, it is good neither for shade, timber nor fuel. Walnut, either white or black, does not transplant unless raised in the nursery, root pruned and moved at two years old. It is better that you raise them from roots yourself. The same is true of hickory and all the oaks. They seldom succeed transplanted; never under ordinary circumstances. All the other trees named in the list transplant kindly—especially when small. Other trees that will be found valuable for timber are, white, black, green, blue, and, on moist soils, red ash. Of evergreens, White Pine and Norway Spruce do well generally in the West. Of deciduous coniferous trees, European larch should not be omitted. When it attains a fair size—and I have seen it grow to a diameter of twelve inches in thirteen years—it is valuable for all purposes except burning. This it is said to be almost impossible to do. Basswood or Linden is also valuable. As a shade tree it is unexcelled. The cultivation of timber is not the terrible task it has been represented to be; certainly not when undertaken systematically, as one would a crop of corn. Too many of the failures are made in consequence of planting trees too large. Evergreens two years old may be bought by the thousand at very light cost. These should be placed in a nursery bed, at a distance of six by twelve inches, and protected by a scaffold, high enough to work under, and over which enough boughs should be placed to keep off the direct rays of the sun. At the end of two years they may safely be planted where they are to stand, and at a distance of four by four feet. Other trees should be planted at an age of from one to three years from seed, according to the habit of growth. Plant wind-breaks of a width as directed; not necessarily along roads, but where they will afford shelter to orchards, farm buildings, pastures and field crops. We repeat—what we have heretofore frequently said—there is no safer investment for money, nor a better heritage for children in a prairie country, than wind-breaks and plantations of valuable timber. If the plantation is strictly for timber uses, many waste places unfit for cultivation, such as the tops of knolls, steep hill sides, along ravines, etc. For soft wooded trees, as willow, cottonwood, etc., the edges of ponds are admirable; whitewood grows admirably on sandy ridges sufficiently out of water so they are never wet. Hickory, black walnut, butternut, maple, beech, and elms do well on any prairie soil that is dry, and the two latter on soils somewhat moist. Thus we think you may be able to decide not only whether it will pay you to plant, but also what to plant, for in this respect every man must be the judge of his own action.

REMOVING FRUIT AND OTHER TREES. Unless much care is taken, the greater part of the small or fibrous roots of fruit trees are destroyed in digging; or if not thus destroyed, they are allowed to get dry, and consequently become worthless for the purpose for which nature intended them—that of supplying sap to the tree. This is especially the case with the evergreen tribe. Once dry, they can not be soaked into life again. The small roots are sometimes, though incorrectly called spongioles. The true spongioles—or root-hairs, as they have sometimes been called—are of annual growth, and are said to die with the fall of the leaf. They are supposed to extract plant-food from the earth, to be conveyed by the roots proper to the stems, branches, and leaves of the plant. The leaves have been called the lungs of the plant. They, however, decompose the air—consuming the carbon and nitrogen, and liberating the oxygen. So, also, in the decomposition of water; they hold the hydrogen only. Animals are said to liberate heat, vegetables to imprison it, and therefore it is by antithesis, and not by harmony that the relation exists. Science is gradually throwing more and more light upon the economy of plant life, but the road seems as yet dark and wearisome to travel. But to return to the tree. If, when carefully dug, the roots being kept from the air and quite moist, they are honestly planted and thoroughly mulched, but little loss will ever ensue, even should the entire tops be left upon the tree. In fact, we have always had better success where we have left the top intact—cutting out only the irregular and superfluous branches—than we have ever had by the old method of excessive trimming. There is no doubt but that foliation stimulates activity in the root. The roots should be spread naturally, and fine soil packed carefully about them. If the ground is dry, a little water may be added and the earth leveled and mulched. If the tree is likely to be blown about, it should be staked. Trees so planted never fail to reward their owners.

RENNET. The membrane of the stomachs of the suckling young grass-feeding animals, including swine, furnish the secretion called rennet, as used for coagulating milk in the manufacture of curd and cheese. Rennet skins, as these membranes are called, are better at one year old, or when thoroughly cured, than when green, or fresh, and that of the suckling calf is superior to all others. Rennet, in its broad sense, may therefore be called an infusion of animal membrane. This infusion, as prepared, is slightly acid, yet it is not the acid that curdles the milk, since if the rennet be made slightly alkaline by the addition of potash, and milk rendered alkaline, even so the whey will show an alkaline reaction, it will be curdled by rennet. The presence of lactic acid, however, from the conversion of milk sugar, does facilitate coagulation. Rennets should not be saved from calves less than a week old, since before this time the stomach is not normal and those of the age of from three to four weeks furnish the best rennets. The stomach of no animal out of health should ever be used. The rennets should be taken out immediately after the animal is killed, turned inside out without washing, thoroughly cured with dairy salt, perfectly dried, and then kept in strong paper sacks until wanted for use. For use the rennets should be soaked in clean whey, saturated with salt for twenty-four hours before using, frequently squeezing them with the hand, that they may become thoroughly macerated. After being soaked, the liquor should be kept as cold as possible, and in tight covered vessels until used. In regular dairies the rennet is prepared to a given strength and this strength ascertained, a definite quantity may then be relied on to produce the coagulation in a given time. Another point, in preparing rennets, is that the liquor may be smelt of and tasted without experiencing anything disagreeable. A very good old recipe, omitting the spices or not according to taste, is as follows: Rennet never should be taken from the calf till the excrement shows the animal to be in perfect health. It should be emptied of its contents, salted and dried, without scraping or rinsing, and kept dry for one year, when it will be fit for use. It should not be allowed to gather dampness, or its strength will evaporate. To prepare it for use, into ten gallons of water (blood warm) put ten rennets, churn or rub them often for twenty-four hours, then rub and press them to get the strength, stretch, salt and dry them as before. They will gain strength for a second use, and may be used when the weather will admit of soaking them to get the full strength. Make the liquor as salt as can be made, strain and settle it, separate it from sediment, (if any,) and it is fit for use. Six lemons, two ounces of cloves, two ounces of cinnamon, and two ounces of common sage are sometimes added to the liquor to preserve its flavor and quicken its action. If kept cool in a stone jar, it will keep sweet any length of time desired, and a uniform strength can be secured while it lasts. Stir it before dipping off to set milk, take enough of it to curdle milk firm in forty minutes. (See also article Cheese.)

REPENT. Running on the ground.

REPTILIA. Cold-blooded vertebrate animals, as snakes, tortoises, frogs, lizards, etc.

RESIN. An inflammable product of the vegetable kingdom, rich in carbon and hydrogen, soluble in alcohol, but insoluble in water There are a great number of species, some of which are used in varnishes.

RESERVOIR. A tank or artificial excavation to hold water. (See Irrigation and Watering Stock.)

RESOLUTION. In farriery, the discussion or dispersion of inflammatory gatherings or abscesses, by applying leeches, poultices, and fomentations.

RESPIRATION. The act of breathing. It is accomplished by the movements of the diaphragm and muscles of the chest. Atmospheric air passing into the lungs is changed, oxygen being separated from it and absorbed into the blood, and four per cent. of carbonic acid thrown out. Water also passes off from the lungs. By these changes heat is produced. The effect of respiration is to alter the color of the blood from dark to bright red; it begins at the commencement of life, and any interruption of the function is rapidly fatal.

RETICULATE. Like a net.

RETICULUM. The honeycomb stomach of ruminants.

RETINA. The nervous layer at the back of the eye which receives the image of objects.

REVOLUTE. Rolled backward.

RHAPONTICIN AND RHEIM. Substances obtained from the roots of rhubarb.

RHEUMATISM. Horses, cattle, and swine are subject to rheumatism, a disease often confounded with founder or stiff disease, as it is called by many persons. Rheumatism is an inflammation of the joints, tendons, ligaments, and muscles, accompanied with stiffness and lameness, and changing from one part to another. It would seem to be hereditary in some cases, but if not, is generally found in old animals, or those weak, and is generally brought on succeeding colds, or else accompanies catarrh, influenza, and other disorders of a like nature. It may be acute or chronic. Acute rheumatism is known as rheumatic fever. There is sudden lameness, with or without swelling, of a joint or joints. There is fever, with quickened pulse, sweats, thirst, scanty urine and constipated bowels. The treatment is to keep the body well clothed, the stable warm, using slings, if necessary, to support the animal. If the constipation is strong, move the bowels. Good nursing and care is the strongest point in this disease. In addition to this, give three or four times a day, mixed in a pint of water or gruel, one ounce each of salicylic acid and bicarbonate of soda.

RHIPIPTERANS. An order of insects, the *Strepsiptera*; having wings which fold like a fan.

RHIZANTHS, RHIZANTHÆ. A small order of plants resembling fungi, but having sexes.

RHIZOMA. A root stock like that of the flag.

RHODIUM. A rare metal, of great hardness, found in some of the platina ores.

RHODODENDRON. It is to be regretted that these noble flowering plants should be so little cultivated in the grounds of our wealthy citizens, who could give them the conditions of moisture and partial shade they so much desire. Those who saw the admirable and extensive collection from an English propagator, as shown at Philadelphia, at the Centennial, will not soon forget the magnificent display. Unfortunately, those varieties that are hardy East, even as far north as Long Island, require protection—removal to a light cellar preferable—in the winter. With this care they may be grown about any farm homestead, and well repay the labor devoted to them. Thus treated, even the so-called half hardy ones may be grown. There are nearly thirty species, and many varieties, some of the newer ones, and also the hybrids with azalia, a close relation, are magnificent when in bloom, as well as attractive in their foliage.

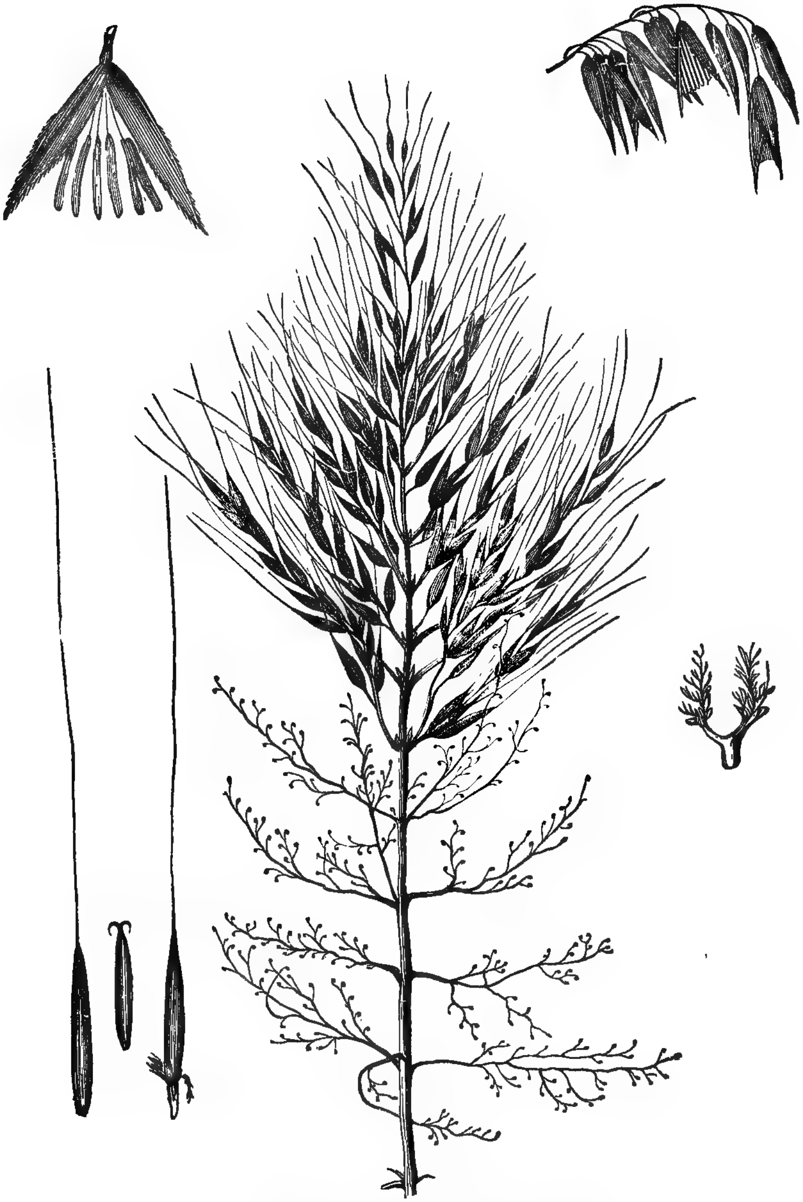
RHUBARB. Pie-Plant. *Rheum. Rheum Rhaponticum*, is the medicinal rhubarb, a native of the interior of Asia, introduced into England, and now broken up into many garden varieties, and within the last fifty years universally used in spring for tarts, pies and sauce. Its cultivation is exceedingly easy, requiring only plenty of water and plenty of manure, the more of the latter in the shape of strong compost the better. The eyes should be planted three feet apart each way, and covered about four inches deep. In the autumn cover the crowns with litter, removing it early in the spring. They will furnish plenty of stalks, and the plants will get larger and larger until five years old, when they should be separated and removed to new soil. Many persons get inferior stalks for want of attention. The only secret is to dig in plenty of manure every year, and to keep the soil about the plants deeply and frequently stirred. The stalks are separated from the attachment, by a quick, sharp, sidelong jerk. The stalks are sometimes partly blanched by putting a headless barrel over each plant and allowing the stalks to grow up through it. Thus they are tender and succulent. If the old stools, not less than three years old, are lifted with earth about the roots in the fall, set thickly over the cellar bottom, they will produce tender blanched shoots sometimes by midwinter, and give a succession for some time. A better way is to force them in a gentle hot bed, or under the staging of a greenhouse.

RIBAND GRASS. Canary grass, and the striped leafed *Phalaris;* grown as an ornament in gardens.

RIB GRASS. A name for the plantain (*Plantago major.*)

RIBS. The curved bones attached to the vertebræ behind, those which meet at the chest and are articulated to the sternum are called true ribs; those whose extremities are only furnished with cartilage are the false ribs. In building, curved timbers for roofing.

RICE. *Oryza. Oriza sativa*, and its varieties have been cultivated from time immemorial in Oriental countries as human food. It ranks next to wheat, as a sustenance for the human family as a constant food, however, it is only used by the nations of hot climates, containing a dense population. Asia, Africa, and sub-tropical North and South America are its principal areas of cultivation, though it has been grown in the United States as far north as Virginia on the coast, and in the west as far north as Illinois. Alluvial bottoms that may be flooded at will, or tide lands above brackish water are the best lands for the cultivation of the varieties of aquatic rice. The leaves of rice are broad and leek like, the seed stems of the plant from four to six feet high, terminating in a panicle, not altogether unlike a panicle of oats. A species, adapted to dry land, *O. Mutica*, has occasionally been cultivated in the United States, even as far north as Virginia and Illinois, but its cultivation was unprofitable, the product being inferior; in some Oriental countries this species is extensively cultivated. Indian rice, *Zizania*, or water oats, of several species, *Z. aquatica, Miliacia.* and *fluitans*, is common in all suitable waters in the West as far north as Minnesota, in ponds, shallow still streams, and ditches of gently and constant running water. It is not cultivated, but was an important article of sustenance to the Indians, who would tie the heads together in bundles just before ripening and when the seed was mature, beat it upon blankets laid in their canoes. The green plants are eaten greedily by all kinds of farm stock, who will wade into water up to their backs in order to get the last blade. It also makes the best of fodder when it may be obtained without too much labor. (See illustration, Wild Rice.) Since the late war the cultivation of rice has declined in the Southern States, and other crops have taken the place of this once important industry there, perhaps, from the well known unhealthy nature of the industry. Within the last year or two, however, attention has again been directed to this crop. Therefore the means used in irrigation on the coast, and also in the delta of the Mississippi, these two systems will be sufficient to designate the proper means, in connection with different water systems. On the Savannah river tide water, the plan is as follows: Main canals, having sluices on their mouths, are dug from the river to the interior, about twenty feet in width; and, as they very frequently extend across the whole breadth of the swamp, they are more than three miles in length. The rice plantations are subdivided into fields of about twenty acres each. The fields have embankments raised around them, with sluices communicating with the main canal, that they may be laid dry or under water separately, according as it may be required. Numbers of open ditches are also dug over the grounds for the purpose of allowing the water to be more easily put on or drawn off. In all cases the water is admitted to the fields as soon as the seed is sown, and when the young shoot appears above ground, the water is drawn off In the course of a week the crop usually receives another watering, which lasts from ten to thirty days, according to the progress the vegetation makes. This watering is chiefly useful in killing the land weeds that make their appearance as soon as the ground becomes dry But, on the other hand, when the field is under water, aquatic weeds, in their turn, grow up rapidly, and to check their growth the field is once more laid dry, and the crop is then twice hand-hoed. By the 1st of July the rice is well advanced, and water is again admitted and allowed to remain on the fields until the crop is ripe. This usually takes place from the 1st to the 10th of September. The water is drawn off the day previous to the commencing of reaping. It will be seen that large capitals are necessary in the culture of rice on the tidal swamps. A great expenditure of labor is constantly required to maintain the banks in good order, and to clear out the drain and canals, as well as to keep the sluices and valves in repair. The fact, however, of the rice grounds being higher than any land devoted to any other crop, is quite sufficient to attest the profitableness of rice culture. On rice grounds of the delta of the Mississippi, the culture is carried on differently from that followed in the tidal swamps of Carolina. The Mississippi usually begins to swell in the delta about the end of February, and continues to rise till the 1st of June, from which time it again gradually subsides. It is thus in flood during the hot season. A ditch having a sluice on its mouth, is dug from the river toward the swamp. The land immediately behind the levee being the highest, is cropped with Indian corn and potatoes; but at a little distance from the river, where the land is lower and can be flooded, it is laid out in narrow rice fields, parallel to the river, inclining off from the river's edge. The narrow strips are banked all around, so that they can be laid under water after the rice is sown. The land is plowed in March, and shortly afterward it is sowed and harrowed. As soon as the young plants appear above ground, the water is admitted for the purpose of keeping the weeds in check. The crop grows rapidly, and the depth of the water is gradually increased, so as to keep the tops of the plants just above it. There is a constant current of water flowing from the river into the fields and over the swamp, so that there is no stagnation, and the fields are not laid dry till the crop is ready to cut. The only labor that is bestowed in the culture of the crop is to pull up by hand the weeds, which are mostly grasses; and this operation is effected, by men going to the fields knee-deep in water. The produce varies from thirty to sixty



WILD RICE—ZIZANIA AQUATICA.

bushels of rice in the husk. The quality, however, is not equal to that of Carolina rice. The lands adapted to rice, the preparation of the swamps, the cultivation, harvesting, and cleaning, from a paper on the subject written for the United States Government, is as follows: In this article we will confine our attention chiefly to what is known as golden or Carolina rice. There is a species of bearded white rice, known as Highland rice, but as it is unknown to commerce, of very limited culture and inferior quality, and not suited to the system of cultivation herein to be described, it will not command our attention. The best lands adapted to growing rice are those swamps and rush lands lying immediately adjacent to tide-water rivers, between twenty-nine degrees and thirty-five degrees north latitude. For the purpose of economical and successful irrigation they must be perfectly level. They are always alluvial, and consist of blue clay, yellow mottled clay, or black bay lands. The former two contain a large per cent. of isinglass, highly important to their value. There is another class of lands adapted to rice culture, known as inland swamps. These are large basins or lakes, surrounded by highlands, having water leads running into them, by which they are inundated. These basins, being drained, are easily reclaimed, and a portion is usually set aside as a reservoir for holding a sufficiency of water for irrigating purposes. These lands, though not usually so prolific as the river swamps or tide-water lands, generally, under good management, produce a heavier grain, which is much sought after for seed. As a general rule they have heavier soils, are harder to cultivate and not so remunerative as the river swamps. Tide river plantations are usually located a little above the junction of salt and fresh water, and extend up the banks of the rivers so far as the rise and fall of the tides are sufficient for flooding and draining. This rise and fall should not be less than three or four feet, and six or eight feet is to be preferred, on account o the more perfect drainage these latter figures afford. Rice plantations are located above the junction of salt and fresh water, from the fact that rice, being an aquatic plant, requires a vast amount of fresh water during its growth; salt water being fatal to it at all stages. These swamps are usually reclaimed by means of embankments or levees, which are made high and strong enough to effectually bar out the river. Smaller embankments, called check banks, subdivide that portion of the plantation lying between the main river embankment and the highland, into squares or fields, generally from fifteen to twenty acres in area. These squares are all subdivided again into beds or lands, of twenty-five or thirty feet width, by a system of main ditches and quarter drains. Canals from twelve to thirty feet wide and four or five feet deep, are sometimes cut from the river embankment, through the center of the plantation, to the high land, for the purpose of introducing or draining off the water to or from those fields situated far back from the river. These canals also form a very conspicuous feature in the harvest scene, as they serve as a medium of navigation for the large flat-boats which convey the rice to the stack-yard in quantities of eight or ten acres at a load; and as rice usually yields from two to three tons of straw per acre, the value of this immense water carriage can be easily conceived. Flood-gates or trunks having doors at both ends are buried in the embankments on the river, as well as in the canal embankments and the check banks, those at the outlet of canals being so constructed as to permit the flat-boats to pass into the river. By means of these flood-gates or trunks the whole system of irrigation is carried on under the complete control of the planter, and the lands are flooded or drained at will. The canals and ditches being all carefully cleaned out, down to the hard bottom—the banks neatly trimmed and free of leaks—the flood-gates and trunks all water-tight, either to hold out or hold in water—the planter commences his operations, as early in the winter as possible, by plowing. These lands, being yearly enriched by alluvial deposits from the river, do not require deep plowing, four or five inches being generally sufficient to furnish a good seed bed, and on account of the numerous ditches subdividing the fields, a single mule plow is always preferable. When lands are plowed early in the winter and nicely shingled, it is of very great advantage to put in a shallow flow of water, and suddenly draw it off, in severe weather, for the benefit of freezing the furrow slices. But it is not a good practice to flood deep, as the weight of water packs the land, which becomes run together by the action of the waves, and renders good harrowing afterward an impossibility. Harrowing is usually begun only a few days previous to planting, in order that the seed-bed may be as fresh as possible, to encourage germination and, by its pliancy, permit the young roots to expand rapidly and take good hold on the soil, in order that the plant may resist the birds and a tendency to float. The operation of harrowing is perhaps one of the most important to the crop, and no consideration must induce the planter to slight it, as this is the golden opportunity afforded him for killing his potent and pernicious enemy—i. e., grass—his dread all the summer time. By breaking up every clod now, and exposing its roots and seeds to the action of the sun, half the battle is won. Immediately after the harrow comes the crusher, which implement is not abandoned until the field is reduced to garden order. About the 10th or 15th of March, up to the 10th or 15th of May, the process of drilling is carried on—seeding from two and a half to three bushels of clean seed per acre. At this juncture two antagonistic systems are encountered, one known as covered rice and the other as open trench rice. Both have their advocates. The first system, or covered rice, is where the grain is covered up in the soil two or three inches deep, as fast as it is drilled in, which thus protects it from birds, floating away, etc. The other, open trench, consists in leaving the rice entirely uncovered in the drill, and taking the risks alluded to, in order to save time and labor, the grain being soaked in thick clay water before seeding, to hold it to the ground. The seed being deposited, the flood-gates are immediately opened, and, if it be covered rice, and the ground pretty moist, the water is taken in as rapidly as the capacity of the gates may afford; and when it has attained a depth of twelve or eighteen inches, or deeper, if the check banks can bear it, the water from the river is then shut off, and the inside gate is closed, to hold in what water is on the field. The trash now rapidly rises and floats toward the banks, and it must be immediately hauled up with rakes, before it settles down on the rice. In the course of a few days the seed is carefully examined, and as soon as the germ or pip appears the water is drawn off the field to the bottom of the ditches, and kept out until the rice has two leaves. If the grain is planted open trench, as soon as the seeding is done, the water is leaked into the field gradually, until the land sobs and the rice sticks, then it is flooded slowly until the above-mentioned depth is attained; the water is then held until the rice has good roots, or begins to float, and is then drawn off carefully. Here all difference in the culture ceases. The rice having two leaves—or earlier, if the field is inclined to be grassy—the water is again let in to the same depth as before, completely submerging the plants, and is held to this gauge from seven to ten days, the planter being governed by the weather. If warm, seven; if cool, ten days. Then a leaf is put in the gate and the water let off gradually, until a general verdure is seen floating all over the field At this point the water is stopped and a mark set upon the gate as a gauge mark. To this gauge the water is rigidly held for sixty or sixty-five days from the day it first came on the field. This flow, when properly managed, effectually destroys all tendency to grass, and promotes a vigorous growth of rice It sometimes happens that, during this flow, the crop takes a check and stops growing. In this event to take off the water is fatal, as it will produce foxed rice, it must be held firmly to the gauge, and in a few days the plant will throw out new roots and go on growing. If the maggot attack it in this flow the water is drawn off for a day or two and replaced. And where water is abundant and easily handled, the maggot can generally be avoided by beginning, about the thirtieth day, to change the water once a week. To do so skilfully, both gates must be simultaneously opened at the young flood. The stale water will thus rush out and fresh water come immediately back with the rising tide to float the rice leaves and prevent them sticking to the ground in their fall. If the maggot gets serious the field has to be dried immediately and thoroughly. The maggot is a tiny white worm, which is generated by stale water, and attacks the roots of the plant, causing serious injury to the crop. The presence of the maggot may always be suspected by the stiff and unthrifty appearance of the field. If the land is fertile at the end of the sixty-day flow, it will be found, on drawing off the water, that the rice has attained a vigorous growth of about three feet, and is well stocked with tillers, while also, if the field is level, and the harrowing and pulverizing was thoroughly attended to before planting, no grass will be seen, nothing but rice and the clean soil beneath. The field is kept dry now for about fifteen or twenty days, or until the land dries off nicely and the rice takes on its second growth. And if there be no grass it ought not to be disturbed with the hoe, as the hands, at this stage, often do more harm than good. This, however, does not apply to cattails and volunteers, which should, of course, be carefully pulled up by the roots, and sheafed and carried to the banks, to be disposed of by the hot sun. At the end of fifteen or twenty days, as above mentioned, the water is returned to the field as deep as the rice and banks can bear, never, however, topping the fork of the former. This water, where circumstances permit, is changed every week or two, by letting it off on one tide and taking it back on the next, and increasing the gauge with the growth of the rice. When the heads of the rice are well filled and the last few grains at the bottom are in the dough, it is fit to cut, and as little delay is permitted as possible, as the rice now over-ripens very rapidly, and shatters in proportion during the harvest. The water may be drawn off the field from three to five days before cutting the grain, and the land will be in better condition for harvesting. The rice is cut from twelve to eighteen inches from the ground, depending on its growth, usually from four to six feet high, and the gavels laid evenly and thinly upon the stubble, for the purpose of curing and permitting the air to circulate beneath it. Twenty-four hours in good weather is usually required to cure the straw, and the binding does not commence before this period, and never while the dew is on the straw. It is safer always to cut from sunrise to twelve o'clock, and bind the previous day's cutting from that hour to sunset. As soon as bound the rice is shocked up in wind-cocks, and at the end of a week taken to the barnyard and stacked up in ricks, thirty feet long, eight feet wide, and ten feet high. A stake, four feet long, is put into the rick at each end for daily examination, and as long as the stake does not become too hot at its point to be held by the hand, when suddenly drawn out, the rick is not to be interfered with, otherwise it is to be pulled down, aired, and re-stacked. So soon as the temporary heat is over the grain is fit for the thresher. As soon as the rice is taken from the field attention is immediately given to sprouting volunteer and shattered rice, providing the crop has not been allowed to remain in the field for an indefinite period beyond the week alluded to above. This is best accomplished by instantly flooding the field quite shallow, so as to promote fermentation, and drying it again every twelve or fifteen days, for a day or two at a time. This process is continued until freezing weather sets in, and if the season has not been remarkably cool it will be found that most of this grain is destroyed. Threshing as performed by steam power is generally done with great neatness and despatch. The main building is commonly built on a brick foundation, about sixty feet long by forty feet wide, having two stories and an attic; the first story being fourteen and the second twelve feet high, with what is called by workmen a square roof. At the side of this building is the engine house and boiler room; and in front of the main building, a little distance off, is the feeding room, which is connected with the second story of the same by a covered way which protects the feeding cloth. In the second story is placed the thresher, which, for a first-class machine, consists of a cylinder forty-two inches in diameter and thirty-six inches wide, armed with 1,000 teeth. In the rear of the cylinder follow six revolving rakes with spring teeth, all of a diameter and width corresponding to the cylinder. Under the rakes is a hopper which conveys the grain down to two large fans in the first story; from these the grain is taken by elevators and carried to the third, or screening fan, on the second story, whence by elevators and spouts it is deposited into large bins ready for shipment. The feeding cloth consists of an endless canvas, bound with band leather and having slats riveted on it. It extends from the cylinder down to the feed room in the stack-yard. The rice is brought in sheaves from the ricks to the feed room, where several hands are stationed for the purpose of placing it on the feed cloth in close succession. The revolutions of the cloth thus keep a continuous stream of grain flowing into the cylinder, which in turn is relieved by the rakes seizing the straw, and after tossing out the grain they throw it out of a window in the rear into straw wagons below, kept ready to receive and carry it away. A good engine, with machinery of this description, will thresh and clean, ready for market, 1,000 bushels of rice per day. Now the grain is called rough rice; and is generally shipped to market from the plantation in cargoes of from 3,000 to 5,000 bushels at a time. On arriving there, if rough rice is in demand, it is immediately sold in that condition either to European buyers or city millers. The former export it to the European mills, and the latter pound it in their own, and again bring it into market as clean rice, in tierces averaging 600 pounds net. Good, well-cleaned rough rice, weighing forty-five pounds to the bushel, will take about twenty bushels to make a tierce of 600 pounds clean rice. As rice pounding mills are very costly affairs, they are seldom erected by the planters themselves. The building is a much larger one than that mentioned for threshing, and the capacity of the engine and boilers very much greater. The rough rice is first ground between very heavy stones, running at a high speed, which partially removes the rough integument, or hull chaff. This chaff is passed out of the building by spouts, and the grain by similar means conveyed into the mortars, where it is beat or pounded for a certain length of time by the alternate rising and falling of very heavy pestles, shod with iron. These are operated by a revolving cylinder of huge dimensions, armed with powerful levers, which, passing into a long opening in the pestle, about fifteen feet in length, raise it and let it fall suddenly into the great mortars below. From the mortars elevators take the rice to the fans, which separate the grain from the debris. From thence it goes through other fans that divide it into three qualities, known as whole rice, middling rice, and small rice. The grain is finally passed through a polishing screen, lined with gauze wire and sheep-skins, which, revolving vertically at the greatest possible velocity, embellishes it with that pearly whiteness in which it appears in commerce. From the screen it falls immediately below into a tierce, which is kept slowly rotating, and struck on two sides with heavy hammers, all the time it is being filled, for the purpose of obtaining its greatest capacity. The tierce, as soon as full, is removed and coopered ready for market. The cost of such a mill was $1,000 per pestle—fifty pestles being considered a good market mill. Good strong land, at a fair pitch of the tides, well managed and worked with labor that can be depended upon at all times, will average from forty to fifty bushels of clean rough rice per acre, valued at about one dollar per bushel. And ten acres to the hand, with good animal force, and only corn enough for provisions, is easily handled by a good planter, making an aggregate of from $400 to $500 per hand, gross. With the provisions alluded to above, the rice is one of the most agreeable and profitable to cultivate; but, on the other hand, if they are wanting, disappointment and failure are the natural results.

RICE BIRD. (See Reed Bird.)

RICE, PERUVIAN. QUINOA. *Chenopodium quinoa.* A plant of the Andes, similar to the goose foot, the leaves of which are used as spinach. The seeds are very nutritious, and are eaten boiled in soups. In Chili and Peru, the seeds are eaten in porridge or gruel, and made into cakes.

RICE WEEVIL. *Callandra oryzæ.* An insect very similar to the grain weevil, and which produces much destruction in crops of rice and wheat at the South; it is destroyed by kiln-drying the grain.

RICINUS.

RICINIC ACID. An oily acid, produced by distilling castor oil at a high temperature.

RICINUS. As a decorative plant, some of the varieties of the castor oil plant are highly ornamental. Their great stature, and magnificent leaves presenting a fine picture of tropical luxuriance. To produce the best effect, however, the seeds must be planted in pots in a hot-bed, about the first of March, and repotted as they need it, being transferred to a warm, sheltered place about the first of June. If dry weather intervenes, the plants should be watered to thoroughly soak the soil, about once in ten days. But one plant should be allowed to grow in a place, and this is better tied to a strong stake if the situation is at all windy. Thus it will throw up its great flower and seed spike the last part of September, and give full satisfaction for the care and trouble. Among the best sorts for garden cultivation are *R. sanguinarius*, though *R. communis* is sometimes used where the season is too short to ensure maturity. The cut will show the form of the leaves and flower spike. (For field cultivation, and for the seed, see Castor Oil Bean.

RICK. A long stack.

RIDDLE. A coarse sieve to separate grain or other substances from trash, etc.

RIDGE. The upper timber in a roof, against which the rafters pitch.

RIDGING. Laying up the soil in narrow ridges.

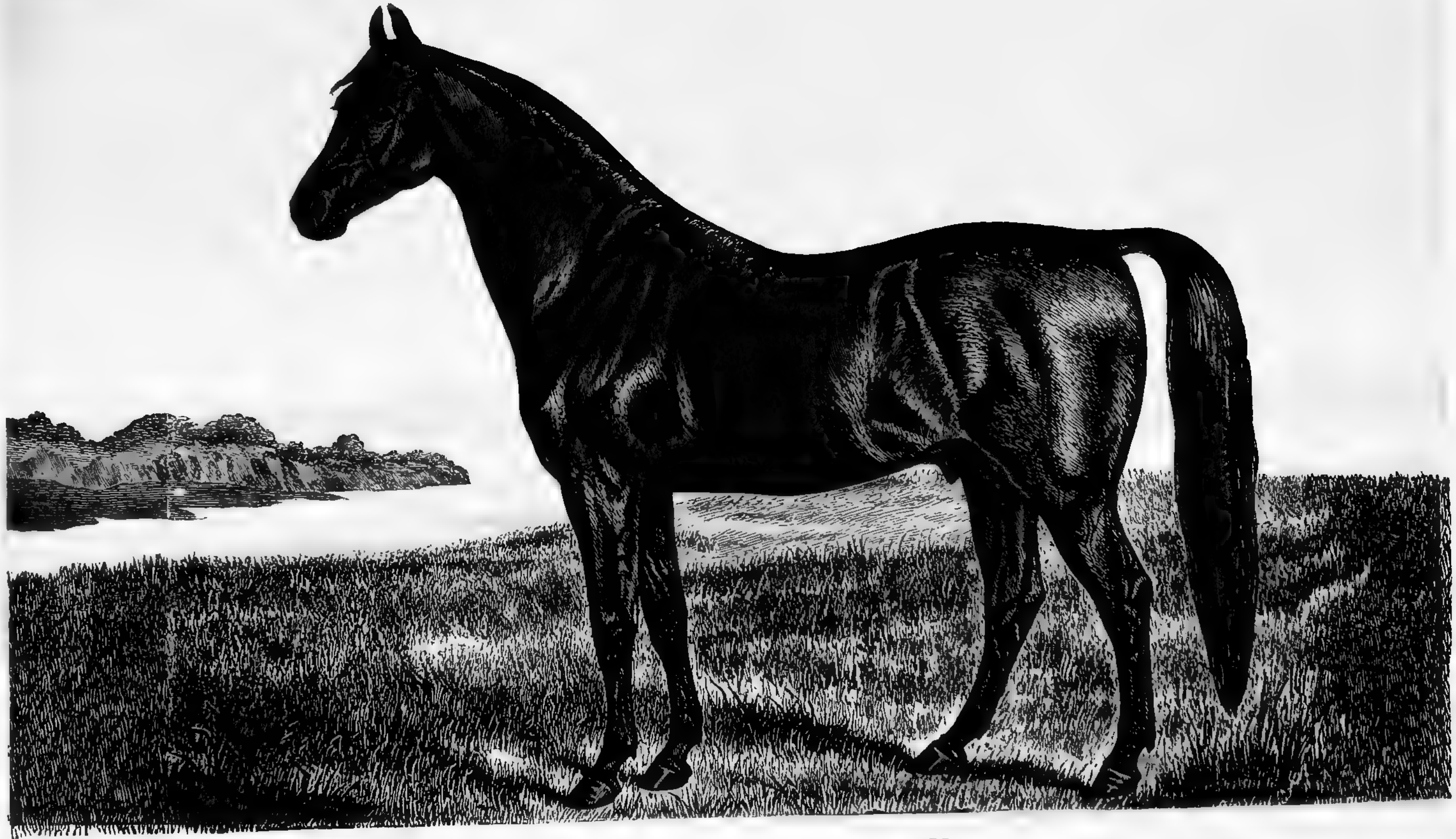
RIDGLING. A male animal imperfectly castrated.

RIGGIL. An imperfect sheep.

RIME. White, or hoar frost.

RIMOSE. Resembling the broken appearance of the bark of old trees.

RINDERPEST. Fortunately this terrible scourge of cattle beyond the Atlantic has never been introduced into America. Probably it is only a question of time, until our country will be desolated with this scourge of horned cattle, for if the equally dreaded, and as contagious Pleuro-Pneumonia could be twice introduced, why not this. For this reason we give an abstract of the report to the United States government in 1879, of this disease as it is known in Europe, introducing the subject with something of its history. The rinderpest (cattle plague, *pestis bovilla*) appears to have been carried from central Asia to Europe as early as the fourth century, but the first exact description of this disease dates from the year 1711, two years after an extensive epizootic outbreak of the same in most European countries. It is estimated that in the course of the eighteenth century, not less than two hundred million head of cattle were carried off by the cattle plague. In the beginning of the present century, Prussia, Schleswig-Holstein, Saxony, and France, were visited by the plague, which was observed to have followed the movements of armies during the wars of the first Napoleon. In 1828, 1829, and 1830, during the Russo-Turkish and the Russo-Polish wars, the rinderpest was carried from Russia into Poland, Prussia, and Austria. In 1865 the plague appeared in Holland, and was carried thence to England. In both countries the disease carried off one hundred thousand head of cattle in the course of a few months. In 1867, Germany was again visited by the plague, which, however, was prevented by timely measures from spreading beyond the eastern provinces of Prussia. In 1870, soon after the outbreak of the Franco-German war, the rinderpest appeared in Germany in consequence of importations of cattle from Russia, and spread over Germany and France, following the movements of the armies. In the beginning of the year 1877, the disease was again carried into Germany by Russian cattle, and made rapid progress, because the imported animals, apparently healthy, but already infected, were allowed to reach the markets of Breslau, Berlin, and Hamburg, from which cities the infection was gradually communicated to other places. In Dresden the disease spread at once through the whole market. Towards the end of August, 1877, the rinderpest was reported by our consular officers as extinguished in the German Empire; but the danger of its reappearance in consequence of possible movements of cattle from the steppes of southern Russia to the borders of Germany, though much lessened by the stringent sanitary regulations adopted by the Russian Government, is not regarded as entirely obviated. Fleming, in his work on Veterinary Sanitary Science, says that, in recent years, several of the most competent veterinarians have endeavored to ascertain the home of the cattle plague, but without much success. Unterberger throws much doubt upon Russia and its steppes being the source of the malady, and he asserts that it is a purely contagious disease in Russia-in-Europe, and also, perhaps, in the whole Russian Empire. It has been seen in southern Russia, the Asiatic Steppes, in different parts of India; in Mongolia, China (south and west), Cochin China, Burmah, Hindostan, Persia, Thibet, and Ceylon. It is as yet unknown in the United States, Australia, and New Zealand. So far as Europe is concerned the geographical limits of the disease may be given as follows: Beyond the Russian frontiers, and even in every part of that empire, the steppes excepted, the cattle plague is evidently a purely contagious malady. It is never developed primarily in Europe, either in indigenous cattle or in those originally from the steppes, and it has not yet been positively demonstrated that it may be primarily developed in the Russian Steppes; the most recent observations even tend to prove that in the European portions of these regions the affection is only present through the transmission of a contagium. Consequently, the plague is a malady which is perhaps primarily developed in the Russo-Asiatic Steppes—perhaps elsewhere—but is never seen in Europe except by the importation of its contagious principle. Nothing certain or definite as to the causes which develop the cattle plague are known. In Western Europe it relies solely for its introduction and diffusion to the presence of a contagium, carried either by animals suffering with the disease, those which have been in contact with them, or media of different kinds which are contaminated with the virus. Once introduced, it spreads from its point of introduction as from a center; each newly-infected animal becomes a focus whence the disease may radiate in every direction, and it usually attacks those animals which are nearest the foci. It spreads with more or less rapidity as the animals or vehicles charged with the contagium are moved about; even the air may, within a certain distance, be credited as an active agent in the diffusion of the deadly malady. The nature of the contagious matter (contagium), has also so far baffled all the efforts of investigators. Neither microscopic examinations nor chemical analysis of the tissues, blood, and mucous discharges of the infected animals, have led to the discovery of the principle of contagion. It is known, however, that from the very beginning of the disease a contagious matter is formed, which attaches itself to every part of the diseased animal. It is principally contained in the secretions of the mucous membranes, but, being volatile, attaches itself also to the urine, the dung, the blood, the skin, and the breath. It may be communicated to the atmosphere by exhalations from any part of the sick animal, or its carcase. Experience has shown that healthy cattle may be infected by coming near the sick animals, or near anything contaminated by their excrements or exhalations, without actual contact with them. The contagious matter has no effect in open air at a distance of twenty to thirty paces, because the air either dilutes or modifies it so as to deprive it of its power. But in cases where a current of air comes directly from an accumulation of infected matter, and also in inclosed spaces the contagion may be carried to greater distances. Therefore, the disease may be communicated in a large stable to a healthy animal quite a long distance from the diseased one, or may be carried from one stable to another as far as a hundred feet apart. This happens only when the exhalations are carried over directly from one stable to the other, by a current of air so rapid as not to allow time for the air to dilute or modify the contagious matter. Where one stable is separated from another by a partition which is not air-tight, the contagion is very easily transmitted. Besides these direct means of infection, the disease may be carried to healthy animals indirectly, in many ways. For instance, objects which have come in contact with infected matter, may be carried to a distant place and there spread the disease. Porous substances, such as woolen clothing, wool, hay, straw, etc., are particularly liable to absorb the contagious matter, which may diffuse itself after some time in a distant place. Thus butchers, drovers, and other persons who visit infected stables, may carry the disease from yard to yard, and from village to village. In railroad trucks, the woodwork absorbs a considerable amount of the contagious matter, and, if not thoroughly disinfected, may communicate the disease to animals subsequently placed therein. The dung of diseased animals may spread the contagion to distant places by being carried away on the wheels of vehicles or the shoes of persons. Dogs and cats may carry it in their fur and birds in their plumage. A small quantity of blood or dung on the sole of a shoe or on the tip of a walking-stick has sometimes been sufficient to carry the disease to a great distance. The modes of possible transmission are, in fact, so numerous and involved as to render it, in many instances, a matter of extreme difficulty to account for the cause of an outbreak of the plague. The vitality of the contagious matter is variable, according to circumstances. Air is its most potent and reliable destroyer. Hay and straw which have lain above the stables of sick animals have been often used as fodder with impunity after an airing of twenty-four hours. Wool, impregnated with the mucus from the nostrils of sick animals, was found to be innocuous when thoroughly aired for five or six days. Stables and pasture-grounds will be thoroughly disinfected in a few weeks by the action of the atmosphere. In the same way clothing and other porous substances become entirely disinfected by airing. The stronger the current of air the more prompt its disinfecting action. On the contrary, if infected porous substances are not exposed to currents of air, the contagious matter is preserved for a long time. Closely-packed hay and straw, the woodwork and floors of closed stables, manure-heaps, packed-up clothing, etc., may remain infected for several months. A case is recorded of the rinderpest breaking out anew in a stable which had stood empty for four months, but had not been disinfected after a previous outbreak. The flesh and hides of carcases which had been buried for over three months were found to be capable of infecting healthy animals. Very high temperature has the same effect in destroying the power of the contagious matter as currents of air, but summer heat is effective only in so far as it promotes the drying up of the contagious particles, and renders them more volatile and more easily diluted by the air. The contagious matter is not destroyed by cold, not even by frost; on the contrary, its power is preserved, as the drying up of the substances containing it is thereby hindered. Dung frozen through the winter spreads the contagion upon thawing in the spring. All ruminating animals are liable to the rinderpest, but goats and sheep are less commonly and less severely affected by it than neat cattle. The disease does not affect non-ruminating animals, nor is it in any way dangerous to man. The rinderpest breaks out generally on the fifth or sixth day from the time of infection, sometimes as early as the fourth, and frequently as late as the eighth or even ninth day. According to some observations, the period of incubation may extend to two or three weeks, but the instances of so protracted an incubation are to be considered as entirely exceptional. The spread of the disease in a herd of cattle is usually slow in the beginning. Often when the contagion is introduced only a single animal is infected. This one, after the few days required for the incubation, becomes sick and commences to evolve the contagious matter, which infects one or more of the animals in the same stable or herd. Then, again, an interval of time elapses before the disease is developed in the new victims. As soon as several animals are diseased, the contagion spreads more rapidly, and many are attacked at the same time. Want of proper caution on the part of stable-men and other attendants is often the cause of an exceedingly rapid progress of the contagion, which is carried in their clothing from one end of the stable to another. Dr. J. Burdon Sanderson, one of the commissioners appointed by the English Government to investigate this disease during its last invasion of Western Europe (1865), in speaking of the phenomena of cattle plague and the general character and progress of the malady during the life of the affected animal, says that it is an essential or general fever, and that it can be shown, more clearly than in any human disease of the same class, that the disturbance of the system which is understood by the term fever may exist independently of local changes occurring in particular organs; and in this respect a fact new to pathology has been discovered, i. e., that the increase of the temperature of the body, which is the one and only symptom which all fevers have in common, exists for several days before any other derangement of health can be observed. Although constitutional or general in its origin, the disease is attended with local alterations of structure, some of which are so constant and invariable that no definition of the malady can be complete which fails to recognize and include them. One or two days before any other change occurs in the condition of the infected animal there appears an increase of temperature, which is most readily detected by means of a thermometer introduced into the rectum. The temperature is found to have risen by 2° to 4° Fahr., from the normal temperature of 102°. At the same time symptoms of fever are observed, such as shivering, muscular twitchings, dryness of the skin, a staring coat of hair, an unequal distribution of temperature throughout the body, and changes of temperature, which are particularly noticeable at the base of the horns. A very important and characteristic symptom at an early stage of the disease is a peculiar alteration of the mucous membranes. This alteration is very soon noticeable in the vagina of cows, which becomes spotted or striped with red. The next day small yellowish-white or gray specks are clearly seen on the red spots and stripes. These specks are formed by the loosening of the cuticle, which can be rubbed off or detached by the finger, leaving in its place a dark-red depression. The same red spots and stripes and yellowish or gray specks appear in the mouth and nose of the sick animals of either sex. The next day after the appearance of the peculiar eruption upon the mucous membranes, there is a disinclination to eat and ruminate, and with cows a diminution and soon a total absence of milk. Two days after the manifestation of the above described symptoms, marked changes in the general appearance of the diseased animal are apparent. It lies down very frequently; when standing it draws the hind legs forward as if suffering from colic. The look is distressed, the head drooping, the ears hanging, the breathing oppressed; the pulse becomes rapid and weak, the discharges from the eyes, the nose, and the mouth become thick and purulent, the breath fetid. The iris, which at the commencement of the fever is generally inflamed and cherry red, resumes its natural color with the increase of secretions from the lachrymal duct. Cows far advanced in pregnancy generally calve in this stage of the disease. On the second or third day diarrhœa sets in. The feces, at first thin and watery, then thick and slimy, are filled with detached masses from the mucous surface very fetid and more or less tinged with blood. When the diarrhœa has lasted two or three days the disease advances with rapid strides. The animal is so weak as not to be able to rise, the evacuations of excrements are involuntary, the breathing is uneven and rapid, the beatings of the heart are no longer perceptible, the pulse becomes very feeble and the temperature rapidly falls. Death usually occurs on the fifth day from the first visible signs of the disease. Sometimes the course of the disease is so rapid as to reach its culmination within two days. On the average seventy to seventy-five per cent. of the diseased animals die. Those that survive have not had the disease in its most malignant form. Once convalescent the animals recover very fast; but the diarrhœa continues for several days after the disappearance of all other symptoms. In summer, when the cattle are grazing, the disease is less severe than in winter, when they get dry fodder and are kept in close stables. The symptoms and progress of the disease are the same with goats and sheep as with neat cattle, but the percentage of fatal cases is somewhat less. Many of the symptoms of rinderpest occur in the lung disease (*pleuro-pneumonia*), the malignant catarrhal fever, and the mouth-and-foot disease. The lung disease is distinguished from the rinderpest by the absence of the characteristic eruptions upon the mucous membranes; the malignant catarrhal fever, by the dimness of the transparent cornea, which in the rinderpest remains clear; the mouth-and-foot disease by the ulceration of the foot, the less degree of fever; and its peculiarly rapid spreading from one animal to entire herds. Among the lesions observed after death there are several, though no more constant than several of the prominent symptoms, that materially assist in establishing a proper diagnosis. The age and general condition, the state in which the animals were kept before they were affected, their breed, the character and intensity of the disease, all appear to have some influence on the seat and seriousness of the lesions. These vary according to the period at which death takes place. Fleming says that if the animal is killed at the commencement of the malady, and the symptoms have been comparatively mild, there will nevertheless be found, on examination after death, such alterations in the mucous membranes as congestion and ecchymoses. The latter are more particularly observable on the free border of the mucous folds in the fourth compartment of the stomach (true stomach) and around the pylorus, although they also exist to a less degree in the small intestine, and often in the vagina. When, however, an animal has died from the disease, or been killed when it had attained a certain degree of intensity, the changes are more marked, the body becomes quickly inflated after death, and sometimes even before death occurs. The rectum is elevated and its lining membrane is tumefied and of a deep red color; the tail and hinder extremities are more or less paralyzed during life, and are therefore usually soiled by the feces. The skin exhibits the characteristic eruption, and in those places where there are neither glands nor hair, as on the teats, it is injected in irregular patches of variable dimensions, the epithelium is thickened, soft or friable, and the integument is often cracked. On removing the skin the vessels which are cut are generally filled with a dark colored fluid blood, and the flesh is red, blue, or violet-tinted. The peritoneum in some cases may be slightly injected or ecchymosed in patches. The whole of the intestines are generally greatly distended with gas, and in some cases the small intestine may be reddened. In the interior of the digestive canal are found the most marked evidences of the disease, though they are not always constant and equally intense in every portion of the mucous membrane. In the mouth, pharynx, true stomach, small intestine, and rectum, they are most frequently present. They are least conspicuous and often absent in the œsophagus, the three first compartments of the stomach, and in the cæcum and colon. They may be so trifling as to resemble the lesions of a slight catarrh, while in other instances they are unmistakable and pathognomonic. In the mouth and pharynx are observed the alterations in the lining membrane and the epithelial changes. It is chiefly where there has been much friction or local irritation that they are most exaggerated, and deep erosions, with loss of texture of the derm of the mucous membrane, may be noted. The œsophagus is rarely affected, though it is not always exempt. In the rumen the quantity of food may be found a little larger than usual. The epithelium on the mucous membrane lining it and the next compartment may be more easily detached than in a healthy state, and a microscopical examination of the cells prove them to have undergone a similar change to those of the mouth. The mucous membrane in these compartments is also frequently injected in a general manner, though more deeply in some places than in others. It is not rare to find on this membrane round, oval, or irregular-shaped eschars, disposed separately or in groups, varying in color from a dark brown to a greenish hue. The elimination of these eschars, takes place gradually from around their borders, and cicatrization occurs, even in cases which have a fatal termination. Submucous extravasation is probably the cause of these gangrenous patches. Around them the tissues are infiltrated, and more or less injected, while beneath the texture is injected or ecchymosed, and red or green in color. The third compartment sometimes contains food, which is hard, dry, and friable; at other times it is soft and pulpy. In the first case, the epithelium of the leaves is readily detached, and adheres to the cakes of aliment removed from between them. This epithelium also exhibits granulo-adipose degeneration. The leaves themselves are injected wholly or partially, and ecchymoses and eschars may be present in them; they are also easily torn. In the fourth compartment and small intestines the contents are at first normal; but they soon change, and there is found a small quantity of thick, yellow, brown, or even blood-colored fluid. The mucous membrane is covered by a viscid, grayish-yellow, or reddish mucus. The cæcum and colon at this period contain a frothy mass of a brownish, sometimes sanguinolent fluid. The rectum has a thick viscid mucus adhering to its inner surface. If the disease pursues its course, the débris detached from the intestine is mixed with exudations and extravasations to form a viscid, albuminoid, whitish-yellow, brown, or red fluid, in which are shreds and the detritus from the membrane. When an animal has been killed in the early stages of the disease, and the mucus has been carefully removed from the mucous membrane of the stomach, it is found that the surface of the latter is irregular, and that its tissue is infiltrated and injected to a degree corresponding with the seriousness of the attack and the stage the malady has reached. The abnormal color, varying from a brick-red to a reddish brown, is generally diffuse, but is most marked at the pyloric portion, attaining its maximum of intensity towards the free borders of the folds. Submucous extravasation are also frequently met with in this part, differing in size from a fine point to a large patch. In the small and large intestines there also exist, at this period, analogous alterations; but, while the redness of the abomasum is usually diffuse, in the small intestine it generally appears in the form of transverse striæ, which are crossed by lighter colored longitudinal streaks, this intercrossing forming a somewhat regular pattern. These extravasations are common in the small intestine, but the infiltrations and exudations are not so frequent in the abomasum. In the duodenum the alterations are usually more intense than in the remainder of the intestine, and it is not rare to find in it a very marked diffused redness and much sanguine effusion. The congestion is often greatest around the solitary glands and Peyer's patches, whose volume is more or less increased. Frequently the areolated aspect of these patches is most conspicuous at the termination of the first period. The same lesions are found, but in a less degree, in the large intestines. In these the most salient portions, such as the borders of the valvulæ, are the parts which are the most deeply colored and most extensively ecchymosed. The infiltration is greatest if diarrhœa has not been present. In cases where the disease has made considerable progress, the lesions are still more characteristic. The mucous membrane of the abomasum and intestine is deeper colored, often blue or black, and in the duodenum of animals which have succumbed, it may even be uniformly black, while the petecchiæ and ecchymoses are more numerous. In the abomasum, but oftenest in the intestine, toward the fifth day of the disease, there appears a pigmentation, varying from a bright gray to a slate color, or even darker, and which takes the place of the abnormal color due to the blood. This appearance is first noticed in the rectum, and in the intestines generally its tints seem to be related to the intensity of the blood coloration, of which these parts have been the seat. It is therefore in the duodenum, and especially near the pylorus, that it is deepest-tinted and most extensive. In the duodenum it is diffuse, but in the remainder of the small intestine it is limited, as a rule, to a double series of perpendicular zones more or less incomplete, and in the rectum is usually in the form of longitudinal lines. This coloring matter is deposited in the most superficial layer of the mucous membrane, and is constituted by minute irregular granules, which, according as they are disposed separately or in clusters, give rise to the different shades. Around the orifices of Brunner's glands, and in the texture of the villi, this deposit appears to be most localized. The epithelium of the fourth compartment of the stomach rapidly undergoes changes analogous to those observed in the mouth. Their intensity depends upon the part examined, as well as the gravity of the attack and its stage. In the first and last portions of the small intestine, in the cæcum, in the first section of the large colon, and in the rectum, they are generally more developed than elsewhere. In mild cases the epithelium, though not yet detached, is always less adherent to the derm than in health. In more serious cases this layer is found completely detached over a considerable surface, and especially in the small intestine. The excoriations thus produced vary both as to extent and number, and are generally covered by a gray, red, or dark colored viscid mucus. The matter is tenacious, and adheres firmly in flakes to the membrane. The extent of these flakes is generally from a quarter to two inches in length. The color is gray, yellow, red, brown, or black; their free surface is smooth, and more or less convex; their variable consistency is less at the border than the center; the membrane beneath them is injected and spotted with small extravasations, and their margin, in consequence of the retraction of the flake, is separated for a short space from the border of the erosion. The mortification which may invade the intestinal wall does not usually go beyond the mucous membrane. In rare and very severe cases it extends to the submucous connective tissue, or even to the muscular layer. The liquefaction of the mortified patches causes a loss of substance in the membrane, and these places are designated excoriations or erosions, according as the derm remains intact or not. Their number is as variable as are the patches. The viscid masses covering the surface of the intestine, as well as the flakes, are produced by the utricular glands of the gastric and intestinal mucous membrane, which are greatly altered and tumefied. Peyer's glands undergo alterations of a particular character. They lose their epithelial covering, and, in the majority of epizootics, undergo changes analogous to those of the solitary glands; though in other epizootics they are rarely affected, and when they are the lesions are not always equally marked. Sometimes they are merely covered with a mucus layer, like the other parts of the intestine, and are injected; at other times they are more salient than usual from tumefaction; and they then may contain contents like that of the solitary glands; again, they may be covered by a croupal exudation or false membrane, several lines in thickness, and gray, yellow, red, or blue in color, adhering by its central part to the mucous membrane. The presence of these patches is not a constant feature in the pathological anatomy of the disease; in certain epizootics it is almost always present, while in others it is exceptional. Among the conditions which appear to have an influence in its production only one is known, and that is the condition of the animal before infection; if it has been well nourished these deposits are most likely to be present. The prominent alterations in the glands of the mucous membrane appear to consist in an exaggerated proliferation of their cell elements, accompanied by a prompt granulo-adipose destruction of the newly formed cells. The liver is seldom much altered, but the gall-bladder is very often distended with bile, and its mucous membrane is in somewhat the same condition as that of the intestines. The mucous membrane of the air-passages is greatly altered. That lining the larynx, the trachea, and also the bronchia is injected and marked by extravasations which, particularly in the trachea, appear in the form of longitudinal striæ. The lungs are frequently emphysematous (interlobular) to a degree corresponding to the intensity of the malady. This condition is chiefly noticed about the borders of the lungs and in the mediastinum, and, passing along the large blood-vessels toward the lumbar region, it may reach the loins. The lungs are also occasionally œdematous. The pleura, like the peritoneum, is occasionally congested in places, and even ecchymosed. The heart is usually flabby, dark or clay colored, and friable, and at times there are subendocardial extravasation towards its base; the blood is darker colored than in health, and coagulates imperfectly, or not at all. The kidneys may be tumefied, congested, and more friable than usual. The bladder is rarely empty, but generally contains a quantity of urine, which may be pale, dark colored, or muddy, and have suspended in it shreds of epithelium. Its mucous membrane may also be congested and ecchymosed and covered with viscid mucus. The vulvo-vaginal mucous membrane presents a very marked redness, which generally extends to the cervix of the uterus. As in the mouth, there are little elevations of altered epithelium on this membrane, with erosions covered by viscid matter. The udder, frequently congested, sometimes contains a small quantity of thick milk. According to Reynal, the latest observations on the pathological anatomy of cattle plague are those of Damaschino, who has made a complete study of the histological alterations occurring in the disease. This investigator states that the ulceration of the mucous membrane is due to a unique process, which presents a great resemblance to that of pharyngeal diphtheria of man. At the commencement, the lesion consists in an exaggerated production of epithelial cells, which are infiltrated with an amorphous substance, become deformed, throw out multiple prolongations, and acquire an abnormal adhesion, which finally gives them a pseudo-membranous aspect. But beneath these false membranes the young epithelial cells do not submit to the same alterations. Instead of the prolongations adhering to each other, and becoming matted together, they are the seat of a purulent transformation, whence results less adhesiveness, and soon the casting off of the pseudo membrane. At this moment ulceration commences, and as these tissues are softened it happens that there is found implanted on this surface fragments of hairs, which are recognized by the microscope. The loss of substance is not always superficial. On the tongue, sometimes, the lesion ceases at a portion only of the thickness of the papillæ, but in other cases it extends throughout their texture. In the stomach it is often deeper, comprising a portion of the substance of the glandula, and even the entire thickness of the mucous membrane to such a degree that, without the presence of a thick layer of adipose tissue at these points, the stomach would frequently be found perforated. On the surface of these ulcerations the adipose tissue exhibits all the characters of inflammation proper (nuclear proliferation in the conjunctival parietes). In two cases there was found a lesion of the venal and hepatic parenchyma, consisting in a granular degeneration of the glandular elements. In the liver, the lesion, as is usual, showed a predilection for the periphery of the lobules in the vicinity of the vena portæ; there the cells were found in a very advanced stage of granular degeneration. The epithelium of the kidneys, more especially, showed the peculiar tumefied troubled appearance already indicated, though the granular condition was less marked. The muscular alterations consisted in the presence of numerous elongated bodies, very abundant in the right side of the heart, and incontestably situated in the substance of the muscular fiber. These bodies are blunt at one end, pointed at the other, and are composed of a regular mass of cylindrical cells lying together in such a manner that at the pointed extremity there is only a single cell, at the obtuse end two cells, and in the other part sometimes two, sometimes three cells, clustered on a given segment. It is surmised that these minute bodies are entozoa in their primary stage of development. There being no remedy known for this disease, human intervention in dealing with it has thus far been necessarily restricted



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to measures for its prevention and extinction. Most European governments have passed laws and prescribed regulations for the purpose of protecting their respective countries from the invasions of the plague, and for its speedy extirpation on the occurrence of an outbreak. Of all these enactments the regulations now in force in the German Empire are considered as the most complete embodiment of the results of experience and scientific investigation in regard to this subject.

RING-BONE. Splint and ring-bone in the pathology of the disease are the same, produced by the same causes, and preceded by the same stages of morbid action. From the relation of the parts, however, ring-bone at its forming stage shows earlier and greater lameness, while splint may perhaps go forward and escape attention except from a critical eye, unless the bony tumor be felt in pressing the hand over the part. Ring bone shows itself in lameness, with the first inflammation, and the earliest effusion calls the attention of the horseman. In all diseases resulting in exostosis, or the formation of bone matter, it is essential to take it in the inflammatory stage. Rest is essential; use a high-heeled shoe if the animal inclines to walk on the toe, and a shoe thin at the heel when the animal walks on the heel. Absolute rest from labor is necessary sometimes for months. If the inflammation is active, reduce it with a persistent application of cold water, or with warm embrocations. Then apply the following blister: twenty grains corrosive sublimate, twenty grains camphor, ten drops muriatic acid, one ounce oil of turpentine. The blister must be carefully watched and when sufficiently raised the mixture should be washed off to prevent chance of blemish. Firing should not be resorted to except by a veterinary surgeon. If so the iron should burn in spots, rather than over the whole surface. If the first blister does not suffice apply again when the old one is healed. It is better to keep the blister running as long as possible, by means of simple cerate or plantain leaves.

RINGENT. A name given to the personate corolla, as in the genus *Antirrhinum*.

RINGING FRUIT TREES. This operation has long been known as a means of inducing fruitfulness and increasing the size of the fruit on the particular branch operated on. At one time it was extensively practiced on the grapevine. The fruit sometimes under this system will attain great size, but lacks in flavor, the texture of the fruit is coarse and the skin thick, and as formerly practiced it resulted usually in the subsequent death of the branch. The operation consisted in cutting out a ring of bark, more or less wide up to a quarter of an inch, down to the wood but not into it, since this will certainly kill. This arrests the flow of sap, checks too active inflorescence, and favors the setting and subsequent growth of the fruit. Roots are sometimes so acted upon, to induce the formation of fibrous roots. The modern application of this system of increasing fruitfulness, under expert hands has been found to be very successful, and not injurious to the tree. The system is advocated by such practical men as Messrs. Turner, Spalding, and Weir, of Illinois. We have operated successfully on shy bearers, like yellow bell-flower, and without final injury to the tree. Trees of any bearing size are girdled just before the season of inflorescence, especially those varieties that blossom and yet are inclined to shed the fruit. In some cases a fine saw is driven carefully just through the bark, but not so as to injure the wood. Generally a ring of bark is carefully excised with a sharp knife, varying in width from an eighth to a quarter of an inch in width, and sometimes the wound is protected from the air by wrapping. In other cases strips of bark are left to connect the upper and lower portions of the bark. Sometimes a section is taken half round the tree on one side and a little above, another half round on the other side. Again a simple incision is made about the tree with a sharp knife, down to the wood, and again another, or not, as the case may be, a little above, allowing the upper cut to run to nothing when it meets the first incision next the wood. If the ringing is done in June, or when the tree is in its full elaboration of sap, the wood will invariably heal. In fact there are numerous instances of the bark being maliciously stripped from trees at this season even up to the branches and without subsequent injury. The practice, however, is dangerous, and will kill if the succeeding weather is hot and dry; even ringing is not to be commended except under the direction of one experienced in the performance, and sufficiently well versed in horticulture not to err.

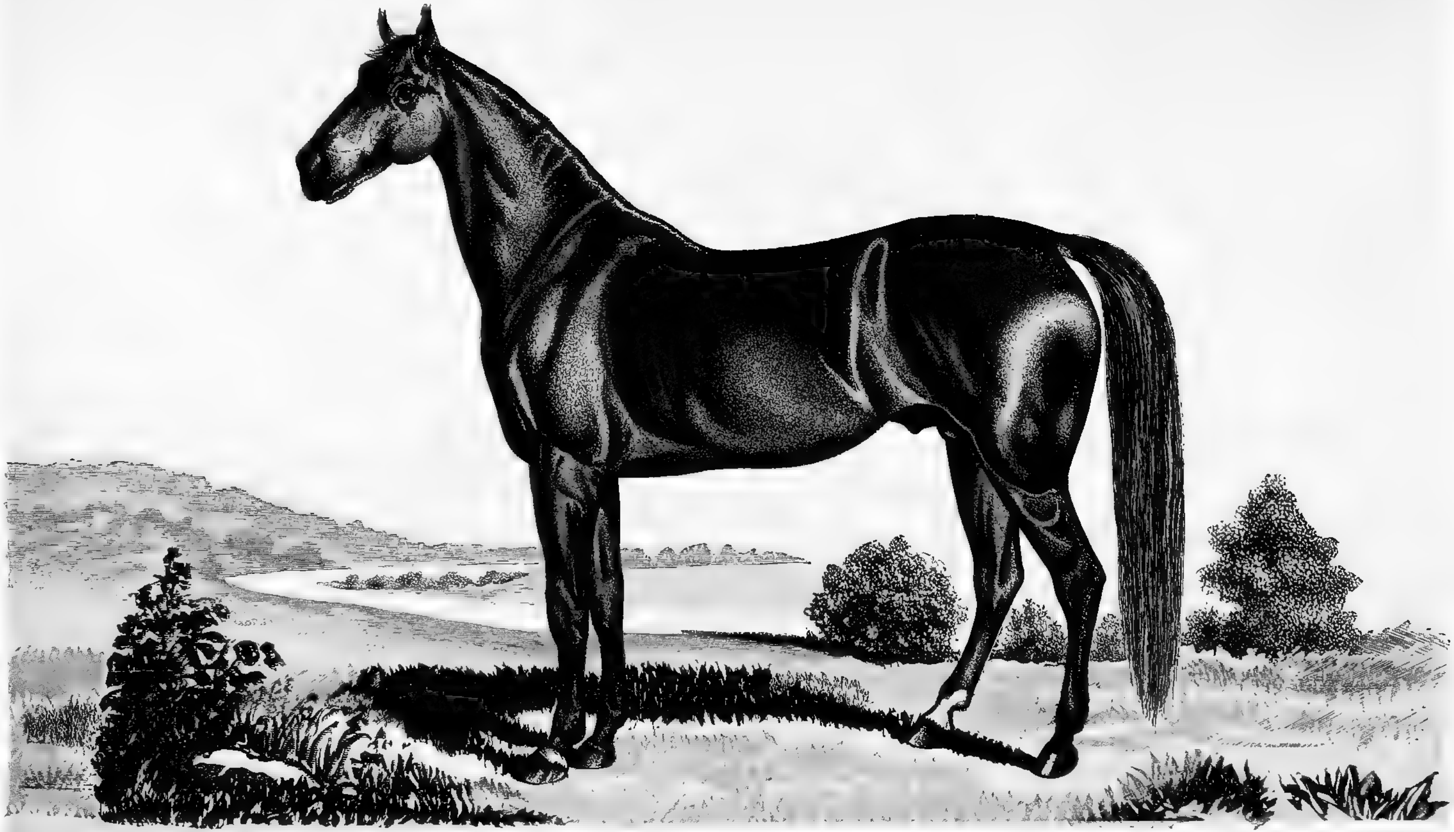
RINGS, FAIRY. Rings of green grass, enclosing a less fertile spot; they are produced by the growth and decay of fungi, the green grass appearing where the fungi have just died.

RIPPLE GRASS. The smaller plantain.

RIPPLING FLAX. Separating the seeds by beating the plants against a board or other contrivance.

RIVOSE. A surface marked with irregular furrows.

ROAD HORSES. The possession of wealth in the Northern States, both East and West, almost invariably shows itself in the desire to possess horses for driving single or double, and that may combine handsome form, style and docility, with a high and continued rate of speed. The wants of business men require horses possessing all these characteristics, but in a lesser degree; still another class, the sons of well-to-do farmers, and those of other producing classes, require horses that will be either above or below the business man's horse, according to the state of their respective purses. This has created a demand for horses sufficiently well bred to unite speed, stoutness and style, and many intelligent farmers have of late years turned their efforts, and with profit, to the breeding of such horses; these are now called road horses, in contradistinction to the trotting horse, which, if he can go fast enough, is a fortune to his possessor, even without the added qualification of style and beauty of form. The roadster, like the trotting horse, is essentially an American invention. American horsemen have taken the initiative in the breeding of these horses; and in no other country in the world will be found either roadsters or trotters capable of doing what these American bred horses will do, either on the trotting course, the road, or on the pleasure drives of our parks. The passion for driving upon the road is undoubtedly one of the means through which our trotting horses were developed, and it seems more than probable that thus were developed some of the best traits that have descended to many of the best trotting horses. Thus a horse of the style of Edward Everett, (see cut), combined with bottom and speed, would be far preferable to a faster horse, but not so handsome. The faculty of fast and natural trotting has been called the trotting instinct. To our mind the trotting instinct is more due to generations of horses, trained to trotting, and which through heredity becomes a fixed characteristic, than anything else. This, with high breeding, careful training, and a cool temper, both in horse and horseman is what has produced the wonderful speed and endurance, both in the American trotting horse and in the American roadster. For light driving, the descendants of Hill's Black-hawk, and many others of the Morgans, may be regarded as almost the perfection of this class of horses. Where greater range of stoutness, and faster work is required, we must look to the descendants of Messenger, Bellfounder, Duroc, etc. Hambletonian, for instance, stands for all that is excellent as a trotter (See Trotting Horses), but his head, if perpetuated in a descendant, would be against him as a stylish road horse. In relation to breeding trotters from roadsters, or rather the development of the trotting stock of our country, Mr. Helm, a practical horse breeder, and author of American Roadsters and Trotting Horses says: It is important to note the fact that, while we recognize the blood of Messenger as the great trotting blood of our country; this trotting quality has come to us mainly, if not altogether, from the sons and daughters of Messenger that were either part bred or kept and bred from in localities where the horse was used as a roadster; and that, of his thoroughbred sons and daughters used for racing purposes, for which they were also distinguished, a much smaller percentage of trotting qualities has been disseminated. Carrying out the supposed teachings of experience in this same matter, it is also claimed that to produce great trotters with certainty and success, the parents must both be trained and developed in the way that our great trotters are trained, and that as a sequence of this doctrine such animals alone can be relied upon for the highest degree of success as breeding animals. Whether it is true that this high degree of development in sire and dam is beneficial or can be relied on with increased confidence, is a matter of uncertainty, and also one of some difficulty to determine with any degree of satisfaction. Whether the process of training and fitting which we call the grand preparation for the great struggles of the race-course, do tend to give the nervous and physical organism the same degree of fixed character and constitute such traits into the permanent elements of the animal nature and being as the regular and constant use as a roadster and fast trotter in daily road work, we can hardly decide. Theory and practice might not agree—the doctrine started with, may not correspond to the results of experience. There may be many reasons why a fair test can not be expected. It takes so many years to develop the trotters, and bring them to the highest degree of excellence, that before they are ready to be transferred from the department of performance to that of reproduction, their age unfits them for the greatest excellence in the latter. Thus far but a small number of great trotters have produced stallions that approach the front rank. Princess enjoyed a short career on the trotting turf after several years use as a roadster, in both of which departments she was distinguished, and then produced the stallion Happy Medium, who undoubtedly displays much of the trotting quality for which she was noted. Sally Miller, the dam of Long Island Black Hawk, was a trotter and road mare of distinction in her day, her claims to that rank being founded both in her performances at one and two-mile heats, and in her being either a granddaughter or a great-granddaughter of Messenger. Flora Temple has also left a son that has some claims to trotting excellence, but is yet not known to rank as a distinguished stallion. Lady Thorn has left a son yet too young to settle the question whether her high degree of perfection as a trotter was in her favor as the dam of a great stallion, and the same observation will apply to the son of Lucy, her distinguished companion and old-time competitor. It is certainly true that the renown of Lady Thorn as a trotter, and her brother Mambrino Patchen as the sire of trotters, in large part originated in the fact that their dam was a highly bred and fully developed road mare, in constant service and of great reputed excellence. Amazonia, the dam of Abdallah, was the most noted road mare of her day; bred from the most noted road stock, but without any of the so-called development in any way, except hard and constant use on the road, where she had no peer. In her blood constituents, and in her acquired and steadily maintained excellence, she was the worthy maternity of the greatest trotting family of our country, but not less distinguished, in each of the above respects, was the Charles Kent mare, the dam of Hambletonian. She was deeply in-bred in the best trotting blood—herself a daughter of one of the best natural trotters our country then had, and for many years was as much famed on the road as the distinguished dam of Abdallah. From such parentage it is no strange phenomenon, in breeding, that there came the founder or progenitor of a trotting race or family the greatest the world has yet seen. The dam of Alexander's Abdallah, the most successful of the sons of Hambletonian, for his short existence, was a developed road mare, but not entitled to be classed as anything beyond. So was the granddam of Volunteer, the dam of George Wilkes, the dam of Ericsson and granddam of Clark Chief, the dam of Trustee, who trotted the twenty-mile race, and the dam and granddam of Knickerbocker. The dam of Gov. Sprague, in addition to the qualities of a fast road-mare fully developed, had the additional element of being a daughter of Hambletonian. The dam of Mambrino Chief, by her good qualities as a roadster, first proved herself to be worthy to produce so great a stallion, and in later years, by the qualities of her descendants, also fully established her claim to the double distinction of possessing as good blood as was on the calendar. From her Abdallah would have produced the peer of Hambletonian, and, perhaps, a more generally successful stallion. The dams of Aberdeen, Cuyler, Middletown, Mambrino Star, Argonaut, and many other distinguished stallions, came from superior road-mares—the first on the above list, from a trotter of considerable distinction. It is rare indeed



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EDWARD EVERETT.

that a truly great road-mare of good breeding has failed, when bred to a good sire, to produce something worthy of her own excellence, and still more rare, that a really great stallion can be shown whose dam was an unused and idle mare, whose blood qualities had never been called into exercise and proved by actual use and the capacity for hard work. Many mares in the breeding farms of this country have no other claim to superiority than a pedigree showing the blood of distinguished families. That many such fail may be owing to the fact that they never wore a collar or performed a day's work in their lives. It might be that many of these long-pedigree mares would acquire the harmony of nerve organism and blood traits which they seem to lack, if they were put into actual service on the road for a long and uninterrupted period. Nothing else, perhaps, would call out the dormant qualities of nerve and muscle which they carry hidden and unseen. It seems to be a law of animal existence, not confined to the human race, that without labor there is no great excellence, and that it is the trials and contests of life that call out and develop the capabilities of a race. The reader will find elegant photo-illustrations of Lakeland Abdallah, and also of Edward Everett. These horses will serve as object lessons of first-class horses, either for the course or the road.

ROADS AND ROAD MAKING. The question of good roads is one of the most important of any outside the farm proper, for without roads upon which fair loads may be hauled, the produce of the farm can not be carried to market, nor can the general traffic of the country be carried on. In the settlement of a new country the ridges and dryer portions of the country are used for roadways, often causing deviations from the shortest lines, and very often these roadways remain after the settlement of the country, to the great inconvenience of the traveling public and the owners of farms, near villages these detours are gradually shortened, and straight roads are laid out, properly graded and, at length, ballasted with suitable material. In alluvial countries such as the prairie regions of the West, the greatest difficulty is experienced in making roads that shall be solid and constant in their nature during wet and dry weather. Fortunately, the soil is of such a nature, that during the dry months of the year, or from June to November, the earth when kept properly graded forms smooth and tolerably firm roadways. And in winter, also, when frozen, they are soon worn smooth. In older settled countries engineering talent is brought into constant requisition in the making of roads and various materials, gravel, cinders, broken stone, slag from furnaces, blocks of wood or stone, and planking are used. In England, in some places, burned clay has been successfully used in the ballasting of roads, it having the peculiarity once thoroughly burned that it does not again come into a plastic state but acts on plastic soils, in the nature of sand and gravel, forming under the pressure of travel a tolerably firm roadway. It would require a large volume to treat the important subject of roadways and road making exhaustively. It is more the study of the civil engineer than the private individual. Nevertheless, the subject is so important to farmers especially, that we append the chief points relating to earth road, and road making, as originally suggested by Mr. W. J. Edwards, who was eminently fitted to understand the whole subject, both as inventor of road-making machinery and a practical road-maker. Without good roads there can be no material development, beyond that mediocrity which mere civilization gives. Even the most degraded savages have well defined trails; and the knowledge of the conservation of manual force, which it would almost seem that they possess intuitively, leads them, from point to point, over the easiest grades consistent with a direct route. So, the early settler finding soon the necessity of roads, first blazes a bridle path through the timber, or else, follows the trail of the Indian across the plain. Speedily, however, the wagon or cart must be used for the transportation of crops and other goods, and these usually follow the ridges or higher lands, until, with the further settlement of the country, water courses are bridged, sloughs are ditched, and at last continuous tracks, and next roads, crude and imperfect, it is true, but yet distinctly defined, are made from point to point. Nature knows no roads; and savages, like some species of animals, wear tracks only. Therefore, it may be set down as an axiom, that one of the first indications of increasing civilization in man, is the steps he takes to improve the roadways over which he must travel; and therefore the completeness of the roads are as landmarks, which show the degree of enlightenment which a nation has reached. Not only this, but the higher civilization, the nearer approach to true utility in designing and forming the road beds of a country—if we except mere pleasure roads, as seen in private grounds and also in landscape gardening. However pleasing curved lines may be, or however delightful the views caught here and there, however charming the vistas that now and again appear in the driveways of the wealthy man's estate, yet, in the formation of public roads, all this must be sacrificed to the tyrant, utility. They may not be employed in purely ornamental driveways, even without some apparent cause, artificial though it be, for the curvature of the road. A change of level in the ground, a pond, a tree, a group of shrubbery, or some similar natural or artificial obstruction, must be present to afford an opportunity to demand a change of line. Thus, in landscape gardening, where the ground is irregular, the deviations from a straight line necessary to follow an easy grade and at the same time adhere as closely to the natural surface of the ground as possible, will generally develop graceful curves. And in no case should any but the easiest curves in long sweeps of roadway be attempted on a level surface; for they would be just as incongruous as would be a Gothic cottage, with its acute angles, standing in the middle of a marsh, or a fine mansion in a wilderness. Granted, then, the necessity for roads, both useful and ornamental, let us explain how roads develop a country. First, they render traffic practicable. Even the mere bridle path to the nearest mill does this, but in a country where no other roads are asked for, the inhabitants will too often be found carrying a stone in one end of the sack to counterbalance the peck of corn in the other, if, indeed, they do not pound their grist between two stones. Their village will be irregular; their implements of the crudest kind; education among them will be wholly wanting. The men will be barbarians; the women slaves;

while the land itself will be divided between wild beasts and savage tribes. But soon the inventive faculty of the settler devises a rude vehicle, for he finds that the log may be rolled far easier, than it can be drawn lengthwise. The inventor, from his superior intelligence, acquires wealth more rapidly than his fellows, and with wealth comes the desire for luxuries. His compeers are stimulated to like efforts. Fields are opened, improved implements are devised, villages are built, and so roads must be made to them, and, lo! the problem of civilization is at last solved. In the formation of roads for the carriage of loads, or those of utility, they should go as directly from point to point as the nature of the ground will permit. This portion of the work is the first duty of the engineer. He must survey the country, and the various obstacles; figure upon the relative economy of passing over, through, or around them, and so form his grades as to present the least possible obstacle to the passage of teams. In this direction, and in spanning chasms; passing around or through mountains; bridging great rivers, or tunneling under them, some of the greatest engineering feats in the history of the world have been performed. It is obvious, that, as a rule, the roads of a country should be built of the material found in the vicinity, and that will combine in the greatest degree, cheapness, indestructibility and smoothness of surface, with the requisite degree of firmness. And whatever kind of roads are made, they must present a slightly convex surface, be of easy grade, and also be thoroughly drained, else the labor of their construction is expended in vain. In localities where sharp gravel is obtainable, there is no doubt but that a covering of from ten to fifteen inches upon a perfectly graded and well drained road is one of the best and most economical; at the same time it is easier to keep in repair for country roads, for the reason that it costs merely the digging and hauling. Washed and rounded gravel should not be used, for it will never cement together to form an even surface. It may, indeed, in time become so incorporated with the soil as to increase the solidity of the roadway, but it can never become a really efficient medium over which loaded vehicles can pass at all seasons of the year. In California, which is well known for the miry nature of its soil, during the rainy season, even in the mountains, a covering of sharp gravel, twelve to eighteen inches thick, over carefully graded road beds, has proved entirely satisfactory, and it is quite well known that, for ordinary travel, there are no roads more agreeable to travel on, than carriage ways, carefully drained, graded, and then ballasted with sharp, strong gravel. Some years since plank roads were all the rage. It is scarcely necessary to notice them here, since they are expensive to build, annoying and costly to keep in repair, quickly wear out, are absolutely torturing to animals driven fast over them, rack vehicles severely, and are little less than horrifying to those travelers who are compelled to ride over them. These two classes of roads, if we except the poor make-shifts usually found, patched here and there, by throwing irregularly to the center of a roadway a ridge of earth scooped from the sides, with no definite idea of the first principles of road making, have been made to do duty as roads. The first is found only at long intervals; the second is, happily, now a thing of the past. The third, or earth roads, if properly made and kept in repair, would, at a comparatively light cost, add infinitely to the average value of the farm lands of the entire prairie region of the West. The proper construction of roads adapted to continuous and heavy traffic by loaded teams at all seasons of the year, must depend measurably upon local circumstances; for their perfection and durability will be in direct ratio to the materials used, other circumstances being equal. In large cities, and near great marts of trade and commerce, the first cost of such roads is only a secondary consideration. They must perforce be perfect at any reasonable expense. Fortunately timber is cheap, and had plank roads served no other purpose, they should be respected as being the initial movement toward the Nicholson pavement that is now held in such justly high repute in the great cities of the West. The next in point of endurance and easy travel is, undoubtedly the Telford pavement; next, the MacAdam roadways; next, gravel roads; and last, but not least, will be the roads of loam, clay, or other materials which form the natural soil of the prairie region. To briefly describe the more artificial roadways that can only be made under the direction of competent engineers and trained workmen, would seem desirable, but before proceeding to this, there are some questions that suggest themselves, which may well be considered here. The first requisite in any road, as has been before stated, is drainage. The second is the sub-road or foundation, but since this must always be of the soil natural to the country, it may safely be left until that class of roads is considered. Drainage must be absolutely perfect. For any road, if water soaked, however great the expense incurred in its construction, will not stand. This drainage may be made by open ditches or gutters at the side, if the water be carried away from the vicinity of the road bed at every available point. Whenever practicable the fall should be made both ways from a point as nearly central as may be, and each water way should be extended to a point of discharge lower than the plane; but if the distance between such points of discharge be so great as to lead to the fear of the washing of the road bed, the proper means must be taken to prevent this, no matter what the cost. Where gradients are so steep that the water will flow along the road in spite of the rounded surface, then catch or water bars, transverse gutters must be provided to carry the water into the proper channels at the sides of the roadway. The transverse grades of roads is a most important consideration. On perfectly hard roads, such as the Nicholson, Telford, MacAdam, or others with so hard and uniform a surface, that they will not under any circumstances wash, a very slight decline only from the center to the sides should be given, for much lateral slope is one of the most objectionable features in hard roads, and is permissible at all, simply to carry off moisture; therefore, in every case this should be reduced to a minimum on the last slope consistent with the perfect drawing of the water of rains into the gutters at the sides of the road. Consequently, it is scarcely practicable to give any rule that will meet even a moiety of the constantly changing conditions, or that will meet even approximately the cost of the various materials of which roads are made. Some ancient nations carried road making to a high state of perfection. They were made of as various materials as they are at the present time, including gravel, asphalt, and numerous concretes. On these it will be useless to expatiate, since the civilization that called those roadways into existence has passed away, and nothing remains save the traditions. There are, however, two systems of roadways of nations that lived and bound together ancient and modern times—the Chinese and the Roman—whose roads were of the most solid and enduring nature. Those have been the basis from which our system arose. The Chinese roads are perfect to-day, because that nation still exists to keep them in repair. The remains of some of the Roman roads still stand in a state of good preservation, although centuries have elapsed since the nation which made them as perfect as they were enduring, became a thing of the past. The system which the Chinese adopted in building their roads was to grade the roadway and then cover the whole with hewn blocks of stone, carefully jointed and cemented together so that the entire surface presented a perfectly smooth plane. They are immensely costly to build, and indestructible by time. The block pavements of modern days are of this type. They would not, however, be tolerated now, since teams have but little traction power on these roads, owing to the hard, smooth surface of the exterior, and horses are liable to slip, fall and injure themselves. The Roman roads were built by laying a concrete foundation of proper thickness and then cementing therein blocks of stone or other material. The knowledge of engineering was superior and the sums of money they expended prodigious. We are all conversant with the feats of Hannibal in his passage of the Alps. His engineers forced a passage over rocky promontories by heating the surface and then disintegrating it by means of acids (vinegar). Modern science, in road making, is as far superior to the ancient as is gunpowder, nitro-glycerine and dynamite to the old method of blasting by heat and the application of acids. The Nicholson pavement undoubtedly combines more excellencies than any other form of pavement for vehicles. It is easily laid, durable, and also easy of repair, is pleasant for travel, comparatively noiseless, and not especially injurious to the hoofs of horses. In constructing these pavements the first step is to grade the roadway; a layer of sand or fine gravel is laid smoothly and evenly over; inch to inch and a quarter boards are then placed over the sand so as to break joints; this is now thoroughly swabbed with boiling gas tar. Four inch timbers are then accurately sawed to a length of eight inches, and laid either directly or diagonally across the roadway, and securely nailed to the planking beneath, or to the narrow strips used to divide the lines of block, thus leaving a space of an inch between the upper half of the row of blocks. These interstices are filled with fine gravel of uniform size, gas tar at nearly a boiling point is then poured in, and the whole rammed compactly with suitable implements. A layer of gravel of a quarter to a half inch size is then thinly strewn over the pavement. The whole is swept so as completely to fill the interstices, and then we have a type of the best roadway ever devised by man. Many variations have been made from this plan, as laying the blocks directly on the bed of sand or gravel beneath, doing away with the narrow strips, etc., etc. They have some advantages, but the real improvements on the original plan more than counterbalance them. It would appear, however, that if the foundation could be made on the Telford plan, and this be covered with sufficient fine gravel to thoroughly cement the whole and the wooden pavement laid directly over all, it would leave little to be desired either in point of solidity, permanence or facility for repairs. The expense of such pavements, however, preclude their adoption except in cities and their vicinity where the travel is heavy and constant, for the interest on the cost and wear and tear of any road can only be fixed on a just percentage of the traffic thereon. In making MacAdam roads, in tenacious soils the surface on which to place the broken stone should be at least one foot above the bottom of the waterways. The margins and slopes must be of such a nature that they will not wash or abrade, and if an under-drain be placed at each side of the rock covering, so much the better. Indeed, the value of under-drains beneath any road, with lateral drains at suitable intervals, into the waterways at the sides of the road, are not appreciated as they should be by many otherwise good engineers. The stone with which the road is ballasted should be broken so that the most of it would pass through a two-inch ring, this being found by experiments made both in England and other countries to be the largest size allowable. Indeed, MacAdam himself declares that cubes of one and one-quarter inch are better than a larger size; but in speaking of cubes of a certain size it is neither understood that absolutely square pieces are meant, nor that the sections of rock shall be of uniform size. In fact, a considerable irregularity of size and shape is more conducive to a perfect cementing of the whole, so that when settled by rolling and travel it shall form a continuous, even surface, over which vehicles may be easily propelled. Years ago the laborious process of breaking the stone by hand formed an item of considerable expense in the formation of these roads. Later, machines were invented which perform this work most perfectly. In the application of the broken stone to the road-bed care should be taken that the earth's surface has not been worn into ruts, for if this be the case it will inevitably cause the road to settle unevenly, and such depressions can not be mended save by picking up, remetaling and again ramming. In this case the stone should be rather smaller than that used in the building of the road. The same rule will also apply to all the repairs of the road. Whenever depressions or ruts are worn, the surface must be picked to sufficient depth to permit the packing used to thoroughly cement with the metal below. To cover or metal a mile of road twenty feet wide to a depth of twelve inches, will require something more than 903 cords of stone or other material, so that, given the cost of the rock, and knowing the value of labor, it will be easy to figure the cost of the superstructure. So the rule will also apply to any portion of the labor required to form any road. The conditions are so varying, that even an approximation can not be reached; and these always mislead. The exact conditions must be studied by the commissioners as they always are by contractors. If this be done, there will seldom be much difference between the contracting parties. For ballasting or metaling roads, as it is called, limestone is most generally used, probably for the reason that it is the most evenly distributed, and when available, being of easy and even fracture, it is cheaply prepared for the road-bed. Nevertheless, it is not the best material. Granite, from its extreme hardness, is much superior; but this rock, being one of the primary formations, is comparatively rare at the surface of the earth. As it will not pay to convey the metaling long distances, the most available rock near by must, perforce, be used. The surface of the road having been properly ballasted, a dressing of clay, from one to two inches, should be laid over all, and the whole surface thoroughly and continuously rolled with a heavy roller, until the superstructure is alike even and compact, and the angularities of the metal have been thoroughly interlocked and rendered solid, before vehicles are allowed to pass over it. Many object to this surfacing, but without this or some other binding covering, the top will be a long time in coming into a smooth surface, and is far more likely to be worn into ruts, especially if it be a country road, where there is comparatively little turning out from the center to avoid teams going in a contrary direction. Another advantage of the clay surfacing, besides its binding action, is that it prohibits passing wheels from destroying the angularity of the broken rock, and thus preventing cohesion, by reducing them to the shape of water-worn pebbles; for it is well known that stones once worn round never after cohere and bind together to form a perfect surface. Another advantage of this clay surfacing is, that it at once renders the road comparatively water-proof, and, gradually working down, does not in the least add resistance to the draft of teams, as has been claimed, but, on the contrary, does render the draft much easier, at first, than if the rock surface were on top. A width of twenty feet of rock is ample for any travel, except in isolated cases, where a road is thronged with teams constantly passing and re-passing, as is the case in large cities or contiguous to them. On all roads there should be side tracks corresponding with and forming an unbroken grade with the macadamized portion of the roadway. This metaled surface may be diminished, both in width and thickness, down to a width of eight feet and a thickness of six inches, to meet cost to be expended on the requirements of travel. The great cost of hauling material of any kind to form the superstructure of a road, renders it imperative that the most careful calculation be made as to the amount of traffic thereon. If, for instance, the heavy travel be nearly all one way, as in country places, ten feet of ballasted portion will be ample; fourteen feet will easily allow for turning out, and for the passage of loaded teams; eighteen to twenty feet will allow teams to go in contrary directions continuously; and twenty-four to thirty-two feet will admit of the road being thronged in both directions, and yet leave sufficient room for turning out and the passing and repassing of light vehicles, swiftly driven. When the earth of the roadway consists of gravel of proper size, and clay in due proportion, or if there be an admixture of cementing material, as combinations of iron, etc., as is sometimes found, the work of making the road is comparatively easy. It has merely to be graded by the proper machines, (and these should be employed in every town, whether metaled or natural roads are to be used,) and then the material, by repeated rollings, cemented firmly together. Of course, in making any road, it is understood that the proper engineering must first be employed, the gradients established, sharp hills leveled or passed around, valleys filled, natural obstacles cut away and removed, so that, whatever grade be established as the maximum, the surface may be made to correspond. This is the work of the surveyor. This done, the proper slope of the road adjusted, the drainage provided for, the culverts established, and other minutia attended to, all the contractor then has to do is to carry out the plan according to the specifications. Unfortunately for the constructing of perfect roadways in alluvial countries, this variety of soils rarely exists; but if unfortunate in this respect, the disability is amply compensated for by the exceeding richness of the soil. A country composed of material suitable for superior roads, is never worth much for anything else—certainly not for agricultural purposes. But, as before stated, we propose to show here how the whole prairie portion of the West, may have roads good enough, during the seasons of principal travel, to allow the carrying of 4,000 pounds per team of two horses; and this can be done at an exceedingly light cost for labor. While its soil is one of the richest on the face of the earth, there are few countries where the material can be made into as good roadways as there. They have only to be properly drained, graded and compacted to form most admirable roadways, that will rarely become bad for travel, except, it may be, a short season in the early winter and spring. In the construction of gravel roads, as in all others, the sub-stratum must be, of course, the natural soil of the locality. The drainage must be as well attended to, and the engineering must be the same as for other roads. The lower portion of the road-bed may be of any material that will make a solid foundation for the upper strata, or the whole may be composed of gravel of different sizes, the larger being placed and kept at the bottom. For light traffic and easy travel, both for teams and individuals, there is no question of the superiority of well made and well kept gravel roads over all others. A combination of the Telford foundation with a gravel surface, when the cost may warrant it, will, undoubtedly form the perfection of a roadway for ordinary travel. At the bottom, on a properly graded sub-way, may be placed the rough foundation of the road-bed, consisting of irregular stone, or small boulders, from the size of a man's fist to a two-quart measure, or larger, according to the amount of travel expected. Over this the top work of smaller gravel should be laid, still keeping the larger gravel at the bottom and evening up with the smallest. Great care should be taken to secure the foundation properly. The large pieces of rock forming this should not be laid in at random, or in rows, and never on their flat side; but should be placed so as to break joints, as it were, and yet be left sufficiently even on top to receive the covering of gravel. This is done by breaking away those projections of rock which rise much above the general surface; or when square, they may be embedded in the soil beneath. There is one fact which should never be lost sight of; and that is, the foundation must ever remain pervious to water, so that whatever moisture finds its way through the surface, may immediately pass to the soil below, and thence easily percolate to drains which should always be provided, unless the nature of the soil and subsoil be such that the drainage is naturally thorough. It is essential that the foundation of any road be rolled when laid. It is absolutely imperative that the surface covering be so rolled, until the whole is entirely compacted into one cohesive mass. The very best roads are made thus, whether with a covering of gravel, or macadam, or any other cohering material; the larger in the bottom, and the finer on top, while no material the size of a hen's egg should ever be allowed within four inches of the top; and the harder the rock material the smaller the cubes or fragments of rock or gravel may be, for a complete cementing of the whole. Now, as the perfection of a road made of broken stone is, to have a foundation of coarse, angular fragments, followed by a covering of two-inch cubes, surfaced with cubes of one inch, or smaller, according to the hardness of the material, so the most complete gravel roadway is made by placing the larger stones at the bottom, over which the smaller are laid; the whole to be finished with that of less and less size, until the surfacing shall be the smallest sharp gravel obtainable. It will not be necessary to speak of the various concrete and cement roads, except in the way of mere mention, since they are valueless for heavy and steady travel, unless we except the so-called cinder roads, or those composed of the scoria from blast furnaces. These do make excellent mediums for ordinary travel. The material, when obtainable, cements most perfectly, and is pleasant to travel over, if kept free from dust; but, from the soft and porous nature of the material, under heavy work, they soon wear out. For the foundation of road-beds this scoria is most valuable, and is extensively used in the vicinity of Chicago and other places where smelting furnaces, rolling mills, or other works for the melting of iron are in operation. Asphalt is used in many combinations in the formation of roads. Its cementing qualities and the indestructible nature of the materials, through exposure to the elements, make it valuable when it is readily obtainable. In Paris, France, and its vicinity, asphalt is extensively used, but the dust arising from it is obnoxious in the extreme. Concrete roads are made under several patents, and are composed of a great variety of materials, gas tar, and gravel, and cements of several kinds, with gravel; often with some form of lime as the base, or entirely of lime or plaster. As mere pleasure walks or lawn drives, to be covered with gravel, they may answer for a make-shift, where nothing better can be obtained. Concrete, of which lime is the base, made upon the road, and laid to the depth of six inches, and then covered with gravel, pressed into it before it sets, is excellent as a foundation, where stone can not be procured. There are remains of old Roman roads so made, that are sound to-day. We have so far carried the reader through some of the more expensive kinds of roads in use in various countries. We now proceed to give tables and other data from actual experiments made by celebrated engineers in Europe. These might be multiplied indefinitely, and quotations made from such authorities as Law Morin, MacNeill, Sir H. Parnell, Bevan, Edgeworth, Flachet, Gerstner, Kassak, Minard, Navier, Perdonnet, Poncelet and others. The four first named, however, must suffice. They establish important facts that should be known to all who have anything to do with the making or the management of roads. The experiments of Morin, made in 1838–41, appear to have been made with a painstaking degree of care and accuracy, thus leaving nothing more to be desired, and the table, as given, an extract from his results, will be found valuable as showing that fraction of the weight of the vehicle and load, which is required to move them on a level road. As an example, suppose a truck weighed, with its load, 9,000 pounds, how many pounds traction will be required to move the same? On firm soil, gravel four to six inches deep, that is a newly repaired road as we often find it, (one-ninth by table) 1,000 pounds; on best kind of embankment (one-twenty-ninth by table), 310.3 pounds; on broken stone roads in good condition (one-fifty-fourth by table), 166.6 pounds: on broken stone roads, deep ruts and mud (one-fourteenth by table), 643 pounds; on a good pavement (one-sixty-fifth by table), 138.5 pounds. Or since the tractive force of a medium

CHARACTER OF ROAD.	Character of the vehicle.					
	Carts.	Trucks, four horses.	Stage coaches.		Two-horse carriages.	
Firm soil covered with gravel, four to six inches deep	1–12	1–9	1–8		1–8.	
Firm embankment covered with gravel 1¼ to 1½ inches deep	1–16	1–11	1–10		1–10	
Earth embankment in very good condition	1–41	1–29	1–26		1–26	
Bridge flooring of thick oak plank	1–70	1–46	1–41		1–42	
Broken Stone Road.			Walk.	Trot.	Walk.	Trot.
In very good condition, very dry, compact and even	1–75	1–54	1–48	1–41	1–49	1–42
A little moist or a little dusty	1–53	1–38	1–34	1–27	1–34	1–27
Firm, but with ruts and mud	1–33	1–24	1–21	1–18	1–22	1–19
Very bad, ruts 4 to 4½ inches deep, thick mud	1–19	1–14	1–12	1–10	1–12	1–10
Good pavement { Dry	1–90	1–65	1–57	1–38	1–59	1–39
Good pavement { Covered with mud	1–69	1–50	1–44	1–33	1–45	1–34

horse, when working all day, is said to be about 125 pounds, we need in the first case, eight horses; in the second case, two and a half horses; in the third case, about one and a quarter horses; in the fourth case, about five horses; and in the fifth case, only one good horse to move the same entire load all day with ease. The following are the general results of the experiments made by M. Morin, at the expense of the French government, on traction: The traction is directly proportional to the load, and inversely proportional to the diameter of the wheel. Upon a paved or hard macadamized road the resistance is independent of the width of the tire, when it exceeds from three to four inches. At a walking pace the traction is the same, under the same circumstances, for carriages with springs or without them. Upon hard macadamized and upon paved roads, the traction increases with the velocity; the increments of traction being directly proportional to the increments of velocity, above the velocity of 3.28 feet per second, or about two and a quarter miles per hour. The equal increment of traction thus due to each equal increment of velocity is less, as the road is more smooth, and the carriage less rigid or better hung. Upon soft roads of earth, or sand, or turf, or roads fresh and thickly graveled, the traction is independent of the velocity. Upon a well made and compact pavement of hewn stones, the traction at a walking pace is not more than three-fourths of that upon the best macadamized road under similar circumstances; at a trotting pace it is equal to it. The destruction of the road is in all cases greater, as the diameter of the wheels are less, and it is greater in carriages without than with springs. Experiments made by Sir John MacNeill, with an instrument invented by him for the purpose of measuring the tractive force required on different descriptions of road, under various circumstances, will be of value. The general results which he obtained are given in the following table, the numbers in which exhibit the tractive force in pounds requisite to move a weight of a ton, under ordinary circumstances, at a very low velocity upon the several kinds of road mentioned:

Description of Road.	Force.
On a well made pavement.	33
On a road made with six inches of broken stone, of great hardness, laid either on a foundation of large stones, set in the form of a pavement, or upon a bottoming of concrete	46
On an old flint road, or a road made with a thick coating of broken stone laid on earth	65
On a road made with a thick coating of gravel, laid on earth	147

Mr. H. Law, C.E., in the work—Construction of Roads, edited by Rob't Mallet, C. E., etc.—gives the table, on next page, which is of importance, as showing the comparative disadvantages of hilly roads, with light and heavy travel. It is also valuable as showing the resistance upon various grades, and also the angle which these grades will present to the horizon. It shows, with sufficient exactness for most practical purposes, the force required to draw carriages over inclined roads, and the comparative advantage of such roads and those which are perfectly level. The first column expresses the rate of inclination, and the second the equivalent angle; the two next columns contain the force requisite to draw a common stage wagon weighing, with its load, six tons, at a velocity of 4.4 feet per second (or three miles per hour), along a macadamized road in its usual state, both when the hill ascends and when it descends; the fifth and sixth columns contain the length of level road which would be equivalent to a mile in length of the inclined road, that is, the length which would require the same mechanical force to be expended in drawing the wagon over as would be necessary to draw it over a mile of the inclined road; the four next columns contain the same information as the four last described, only with reference to a stage coach weighing with its load, three tons, and to travel at the rate of 8.8 feet per second, or six miles per hour. The following table will show the force required to move a ton, the limiting angle of resistance, and the greatest inclination which should be given to the roads named. The values of the resistances on which the table is calculated, are those quoted previously:

Description of road.	Force in pounds required to move a ton.	Limiting angle of resistance.	Greatest inclination which should be given to the road.
Well laid pavement	33	°0 ′50	1 in 68
Broken stone surface on a bottom of rough pavement or concrete	46	1 11	1 " 49
Broken stone surface laid on an old flint road	65	1 40	1 " 34
Gravel road	147	3 45	1 " 15

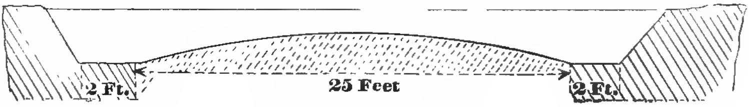
As indicating something of the cost of the construction of roads, as also their repairs, the following condensed account will be interesting and valuable for reference: According to all the returns from different States, the average construction of gravel roads is $2,241 per mile, and the average annual cost per mile for repairs is $103. It appears, from the reports, that only a very few of the roads are improved by a gravel bed, and neither the width of the beds so improved, nor the quantity of material applied, is given. We may reasonably infer, however, that neither is greater than is absolutely required, and yet we find the cost of construction, per mile, to range from $700 to $4,000, and to average $2,241. The annual outlay per mile varies from $4 to $200, the average being, as above stated, $103. By reference to the table, showing the cost of repairs to common roads per mile, throughout the country, we find it to vary from $1 to $59, and the general average is $18.11 per mile. The returns show that the average cost of construction of macadamized roads per mile is $3,290, and it varies in the different States from $500 to $336. The average annual cost per mile for repairs of macadamized roads, as reported, is $40—varying from $10 to $100 per mile. The average cost of construction of plank roads per mile is reported to be $3,000, and the average annual cost of repairs per mile is $550. The table, page 816, compiled

Rate of Inclination.	Angle with the horizon.	For a Stage Wagon.				For a Stage Coach.			
		Force required to draw the wagon up the incline.	Force required to draw the wagon down the incline.	Equivalent length of level road for an ascending wagon.	Equivalent length of level road for a descending wagon.	Force required to draw the coach up the incline.	Force required to draw the coach down the incline.	Equivalent length of level road for an ascending coach.	Equivalent length of level road for a descending coach.
		lbs.	lbs.	Miles.	Miles.	lbs.	lbs.	Miles.	Miles.
1 in 600	0° 5′ 44″	286	241	1.085	.9150	373	350	1.030	.9690
1 “ 575	0 5 59	287	240	1.088	.9116	373	350	1.032	.9676
1 “ 550	0 6 15	288	239	1.093	.9074	374	349	1.033	.9662
1 “ 525	0 6 33	289	238	1.097	.9029	374	349	1.035	.9646
1 “ 500	0 6 53	291	237	1.102	.8979	375	348	1.037	.9629
1 “ 475	0 7 14	292	235	1.107	.8926	376	347	1.039	.9605
1 “ 450	0 7 38	294	234	1.113	.8869	377	347	1.041	.9588
1 “ 425	0 8 5	295	232	1.120	.8801	377	346	1.043	.9563
1 “ 400	0 8 36	297	230	1.128	.8725	378	345	1.046	.9535
1 “ 375	0 9 10	300	228	1.136	.8642	380	344	1.049	.9505
1 “ 350	0 9 49	302	225	1.146	.8543	381	342	1.053	.9469
1 “ 325	0 10 35	305	222	1.157	.8443	382	341	1.056	.9437
1 “ 300	0 11 28	309	219	1.170	.8301	384	339	1.061	.9381
1 “ 290	0 11 51	310	217	1.176	.8245	385	338	1.064	.9358
1 “ 280	0 12 17	312	216	1.182	.8179	386	336	1.066	.9336
1 “ 270	0 12 44	314	214	1.189	.8111	386	337	1.068	.9314
1 “ 260	0 13 13	315	212	1.196	.8039	387	336	1.071	.9286
1 “ 250	0 13 45	317	210	1.204	.7963	388	335	1.074	.9259
1 “ 240	0 14 19	320	208	1.212	.7876	390	334	1.077	.9226
1 “ 230	0 14 57	322	205	1.222	.7785	391	332	1.080	.9192
1 “ 220	0 15 37	325	203	1.232	.7683	392	331	1.084	.9156
1 “ 210	0 16 22	328	200	1.243	.7573	394	330	1.088	.9115
1 “ 200	0 17 11	331	197	1.225	.7451	395	328	1.092	.9071
1 “ 190	0 18 6	334	193	1.268	.7319	397	326	1.097	.9024
1 “ 180	0 19 6	338	189	1.283	.7171	399	324	1.103	.8968
1 “ 170	0 20 13	343	185	1.300	.7004	401	322	1.109	.8908
1 “ 160	0 21 29	348	180	1.319	.7814	404	320	1.116	.8839
1 “ 150	0 22 55	353	174	1.341	.6587	406	317	1.123	.8761
1 “ 140	0 24 33	360	168	1.364	.6359	410	314	1.132	.8673
1 “ 130	0 26 27	367	160	1.392	.6079	413	310	1.142	.8573
1 “ 120	0 28 39	376	152	1.425	.5752	418	306	1.154	.8451
1 “ 110	0 31 15	386	142	1.451	.5491	423	300	1.169	.8308
1 “ 100	0 34 23	398	129	1.510	.4903	429	294	1.185	.8142
1 “ 95	0 36 11	405	122	1.537	.4634	432	291	1.195	.8045
1 “ 90	0 38 12	413	114	1.566	.4338	436	287	1.206	.7937
1 “ 85	0 40 27	422	106	1.600	.4004	441	282	1.219	.7801
1 “ 80	0 42 58	432	96	1.637	.3629	446	278	1.232	.7677
1 “ 75	0 45 51	443	85	1.680	.3204	451	272	1.247	.7522
1 “ 70	0 49 7	456	72	1.728	.2719	457	266	1.265	.7345
1 “ 65	0 52 54	470	57	1.784	.2161	465	258	1.285	.7143
1 “ 60	0 57 18	488	40	1.850	.1505	474	250	1.309	.6903
1 “ 55	1 2 30	508	19	1.926	.0736	484	239	1.337	.6620
1 “ 50	1 8 6	533	....	2.019	....	496	227	1.371	.6283
1 “ 45	1 16 24	562	....	2.133	....	511	212	1.412	.5871
1 “ 40	1 25 57	600	....	2.274	....	530	194	1.464	.5354
1 “ 35	1 38 14	648	....	2.456	....	554	170	1.530	.4690
1 “ 34	1 41 8	659	....	2.499	....	559	164	1.546	.4535
1 “ 33	1 44 12	671	....	2.544	....	565	158	1.562	.4370
1 “ 32	1 47 27	684	....	2.593	....	572	152	1.580	.4193
1 “ 31	1 50 55	697	....	2.644	....	578	145	1.599	.4007
1 “ 30	1 54 37	712	....	2.699	....	586	138	1.619	.3805
1 “ 29	1 58 34	727	....	2.758	....	593	130	1.640	.3592
1 “ 28	2 2 5	744	....	2.820	....	602	122	1.663	.3363
1 “ 27	2 7 2	762	....	2.888	....	610	113	1.688	.3129
1 “ 26	2 12 2	781	....	2.960	....	620	103	1.714	.2854
1 “ 25	2 17 26	801	....	3.038	....	630	93	1.743	.2566
1 “ 24	2 23 10	823	....	3.120	....	641	82	1.774	.2257
1 “ 23	2 29 22	847	....	3.213	....	653	69	1.808	.1919
1 “ 22	2 36 10	874	....	3.313	....	666	56	1.844	.1554
1 “ 21	2 43 35	903	....	3.423	....	681	42	1.884	.1150
1 “ 20	2 51 21	935	....	3.538	....	696	26	1.926	.0730
1 “ 19	3 0 46	970	....	3.677	....	714	8	1.977	.0221
1 “ 18	3 10 47	1009	..	3.826	....	734	....	2.032	....
1 “ 17	3 21 59	1053	....	3.991	....	756	....	2.092	....
1 “ 16	3 34 35	1102	....	4.178	....	780	....	2.160	....
1 “ 15	3 48 51	1157	....	4.388	....	807	....	2.234	....
1 “ 14	4 5 14	1221	....	4.629	....	839	....	2.322	....
1 “ 13	4 23 56	1294	....	4.906	....	875	....	2.423	....
1 “ 12	4 45 49	1379	....	5.229	....	918	....	2.540	....
1 “ 11	5 11 40	1480	....	5.611	....	968	....	2.679	....
1 “ 10	5 42 58	1600	....	6.067	....	1028	....	2.846	....
1 “ 9	6 20 25	1747	....	6.623	....	1101	....	3.048	....
1 “ 8	7 7 30	1929	....	7.315	....	1192	....	3.300	....
1 “ 7	8 7 48	2162	....	8.199	....	1308	....	3.621	....

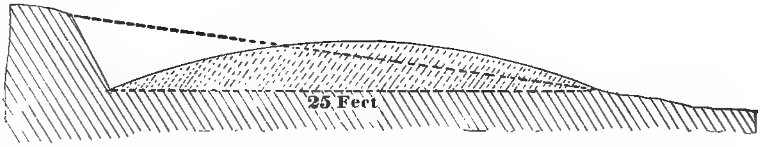
from replies to circular issued by the Department of Agriculture, United States, shows the average annual cost per mile of repairs of common roads in the respective States:

State.	Cost per mile.
New York	$21 82
New Jersey	27 50
Massachusetts	59 16
Rhode Island	33 75
Michigan	23 60
Wisconsin	24 70
Pennsylvania	18 28
Maine	40 00
Connecticut	9 00
New Hampshire	16 00
Vermont	25 00
Maryland	11 00
Delaware	14 50
Virginia	6 00
North Carolina	6 50
South Carolina	1 00
Georgia	7 53
Florida	18 00
Alabama	4 84
Mississippi	8 00
Louisiana	2 00
Texas	7 95
Arkansas	6 43
Tennessee	17 00
West Virginia	8 40
Kentucky	13 57
Missouri	10 59
Illinois	10 31
Indiana	38 23
Ohio	23 60
Minnesota	20 00
Iowa	20 00
Kansas	8 00
Nebraska	5 00
Utah	43 00
Colorado	.....
California	23 00
Nevada	10 00
Oregon	25 00

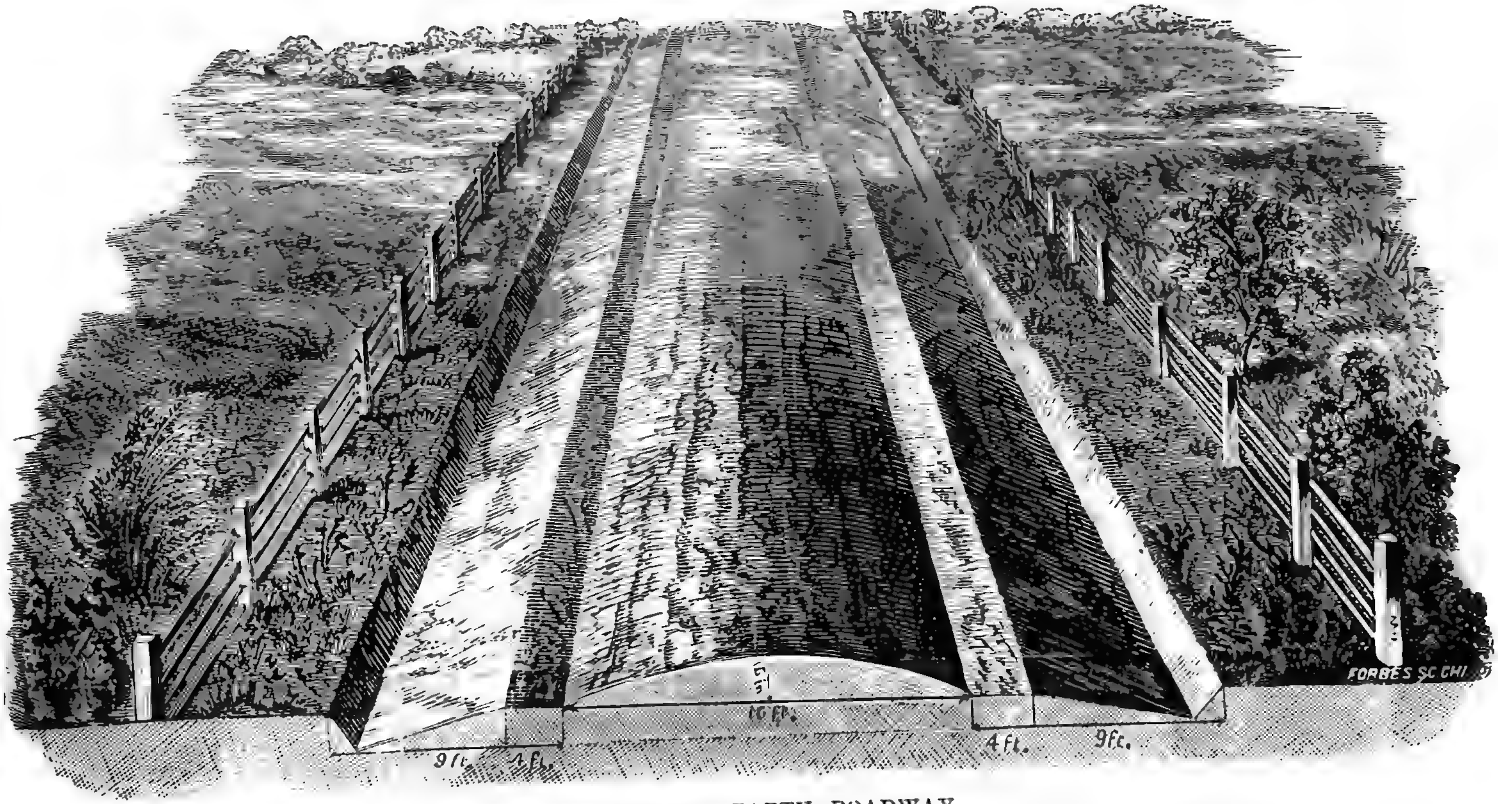
It has often been asserted that the West could never have a good system of roads, for the reason that, except in widely scattered localities, good gravel could not be found, and that it was still more rare to obtain rock suitable for the formation of roads. This very scarcity of what has heretofore been deemed indispensable, to road-making, has led to the perfection of implements for casting up from the sides of the road-bed a continuous ridge of earth, leaving the grade perfect, the slopes of the roadway light or heavy at will, the sides gradually descending to the ditches or gutters, so that the whole surface, and even the water ways, when not wet, may be made use of as a roadway. Indeed, the making of earth roads by machinery may be said to have been reduced almost to a science; since, given the miles of clear surface to be graded, the cost of making the road may be estimated to within a fraction of the cost. We think it will be admitted to be beyond contradiction that the prairies, composed as they are of a strong loam, that, when dry and under pressure, will compact, will make a smooth, even surface, upon which the wheels of loaded vehicles scarcely make an impression, and this fact ought to have suggested their admirable nature for this purpose long ago. Certain it is that during the droughts of summer, and when frozen and worn smooth in winter, they are among the best of any natural causeways in the world. Upon any of our well drained, carefully graded, and tolerably well traveled prairie roads, there is but a small portion of the year—say a short time in the spring, when the frost is just coming out, and another equally short time, when it is freezing and thawing in the fall—that a good team can not haul 3,000 pounds with ease. Therefore, given good drainage, an even grade as to the slopes of the sides, and a soil that will pack solid, the question of good roads is solved. It has also been objected to by those who have studied works on drainage, where certain gradients being determined on by the engineer, every slope of the various undulations must be cut away, and the materials used to fill the slight hollows, so that the road when completed shall present a continuous line of equal rise and fall, like a railroad. Indeed, railroad engineers are beginning to find out that it is cheaper to run over rather light grades than always to cut through them; and hence railroads have become practicable where once it was believed it would not pay to build them. It has furthermore been found, in practice, that the ordinary undulating surface of our prairies offer no obstacle to the continuous running of roads, and that the grades may follow the surface, unless, in exceptional cases, where a sharp, high ridge may intervene. These may require some cutting, but far less than has generally been supposed. As a rule the grading may be made continuous over hill and dale, and seldom will it be found necessary to deviate from a straight line in order to avoid serious obstructions. Therefore no engineering is required; nothing but good implements, a set of flags by which to drive, sufficient team and men to operate the machine, and the work may go on continuously at the rate of a mile to a mile and a half per week of road completed, perfect in its slopes and drainage, through valleys and over the gentle slopes that are found everywhere on our grand prairies. The superior drainage which this system of roads would give to prairie farms is itself one of the most eloquent pleas possible for its general adoption. But valuable as this one point really is, it is but an integer of its final value to the entire West, and really almost insignificant in comparison with the development that would follow. The wealth that a system of building first-class earth roads would create, is simply enormous. How to do this to the best advantage, is the question. One of the mistakes, but still a very pardonable one, where the work is done with old fashioned implements, is that the road-beds are commenced too narrow. When it becomes necessary to widen them, as it inevitably does, in order to accommodate increased travel, not only the original labor is lost, but where the ditch once was it can with difficulty be made solid, since here must be placed a thick layer of comparatively soft earth, and adjoining on each side the ridge of compact earth that formed the original road-bed. It is, therefore, advisable that the road-bed be made at least twenty-five feet wide, with the ditches not less than seven feet wide, and nine feet is preferable. This extreme width for road-beds and water-ways will leave twelve and one-half feet on each side for the planting of such shade trees as may be needed, and yet give ample space for the passage of pedestrians. The ditches should commence at nothing, running gradually back until the extreme depth, eighteen inches to two feet, is reached. This should be at a point only so far from the extreme width as to correspond with the height of the bank, so that the rise to the bank may be as one to one, or an angle of forty-five degrees. In making a road by means of a machine, it must be arranged so it will carry the earth directly to the center of the road and drop the material excavated continuously as the machine passes forward, to correspond with the width of the ditches; so continue until you have the ditches or water-ways of sufficient depth and regularity, and the whole is ready for spreading or finishing. This finishing is done by taking an eight by ten inch square timber, twenty-four feet long, and drawing it diagonally, the rear end in the water-way, up and back. This will spread and grade the earth evenly over the required space for the road-bed, leaving the surface crowning to the middle just as may be required. It is not necessary in every case that it be cast all over the roadway, so that if only a narrow track is required the bermes next the ditches may be left of any width desired, and still preserve the integrity of the transverse grades. Start a road and run it clear through a township, if possible. Why not? A machine with eight horses and two men should grade a first-class road six miles in thirty working days, and at an expense for labor of not more than fifteen cents per rod. Plenty of cases might be cited where an average of a mile in four days has been easily accomplished, and this with green teams. The impression wished to be conveyed is, that the time has come when perfected machines are doing this work in the very best manner, and at a cost of about twenty-five cents on the dollar for what it would cost with the plow and old fashioned scraper; that roads made with modern implements stand more and rougher usage than the old style of roads, and with far less expense for repairs; that the drainage supplied to the adjacent farms by a good system of roadways on every section line, necessarily will add materially to the productiveness of the soil, and the increased facilities for travel will diminish the cost of transportation fully one-half. In fact, it is the want of good drainage, and the difficulty in transporting produce to market, that is doing more to reduce the profits of farming than any other two causes combined. Therefore, what the low value of the land years ago would not allow to be done may now be accomplished at so light a cost per capita as to form no objection to the making of earth roads, at least, over the whole prairie region of the West. Let us now examine for a moment the advantages of carrying the grades of roads over the undulations of the surface. One of the difficulties over the old system of simply grading the hollows is, that on the declivities and acclivities where there are no lateral slopes to the roadway, the water seeks the ruts, if there be such, or if the roadway be smooth, then the middle of the roadway; since, being without grade, these must soon become the lowest portions of the road. Gullies are formed which wear larger and larger, until the road becomes impassable, and a new track has to be sought. So the process goes on and on, until the whole width of the roadway is ruined. The grade being carried continuously up and down the slopes, and over the summits of the undulations as well as in the valleys, the crowning surface of the road conveys the water naturally to the water-ways at the side. If the soil be of a sufficiently yielding nature to be abraded easily, protection against this may be readily applied. If the slopes are so steep as to require cutting down, to render the gradient more easy, when this is done the road grade to the ditches may then be established as on an ordinary surface, remembering always, as a rule, that the steeper the grade the more rounding the roadway should be, and this for very obvious reasons. The following figure will show a cutting through a sharp ridge, and the grade of the road. Again, suppose it be easier to go round a hill than through it; then the figure of the road will be as given in the following cut; a ditch being needed only on the side next the hill. These, however, are only isolated cases, and will never be required in a gently undulating prairie region, except, perhaps, in the descent to and ascent from a river, ravine, etc. In the hilly portions these cuts will often be found necessary, and in rare cases in other sections. The illustrations are given so that with a little study of the tables previously given, and a simple level and plumb, the gradients can be at once established and the cuttings made by any intelligent man. Again, if from the nature of the country the grades must be made so steep that the water will not run easily to the gutters on the sides, catchways may be provided as previously shown to arrest and convey the water to the ditches. These must be formed of some firm and unyielding materials. This course will be necessary in isolated cases, where the character of the country is exceedingly difficult. One of the most common errors in road making is, that the ditches are left deepest in the middle and rise alike towards the road and the bank. This is entirely wrong. They should slope gradually to a point next the bank, and corresponding to the height from the bottom of the ditch to the bank as heretofore stated. From thence they should rise sharply to the bank. The reason is plain: If the lowest point of the gutter be half way between the bank and the road-bed (the outside of it), and there is enough water carried to wash at all, there will be danger that the roadways may become abraded or eaten into by the flowing water; but if near the bank, then the



ROAD THROUGH A RIDGE.



ROAD ON SIDE HILL.


9 ft.
4 ft.
15 in
16 ft.
4 ft.
9 ft.
FORBES SC CHI

A PERFECT EARTH ROADWAY,

water will wear away from rather than toward the roadway, and all the danger of washing will be avoided. Thus the whole, when completed, should present an appearance as shown in full page cut. When it is necessary to carry the water of the ditches through slight rises of ground the additional work of excavating a channel will be comparatively slight. It may either be spaded and cast out, or a strong horse and plow going back and forth will loosen the earth so that it may be thrown out with a shovel. Thus a slight way once made, the water will speedily wear a channel that will never become choked. One of the most important essentials in road making is sluice ways or culverts, at proper intervals, so that the water may readily be conveyed from one side of the road to the other as the conformation of the surface may demand, to keep up the continuity of the drainage; for, if water be permitted to stand in the ditches at all, the roadway must remain moist and consequently soft. One of the greatest nuisances is the rough and uncouth wooden abomination miscalled a culvert. When these ditches receive the accumulated water of fields, as when the roadway crosses natural water courses, substantial culverts or bridges must be provided; but when the accumulation is simply the drainage of the road, with, perhaps, some addition from the adjacent land, a simple line of tile sunk to the level of the bottom of the ditch, and extending across and under the road, is all that is necessary. These, besides offering no obstruction to travel, are far cheaper than even the simplest culverts formed of wood. These should always be of vitrified tile and may be ordered in any city. They are made of any size, from six inches to two feet or even larger in calibre. If one is not enough, lay two or more alongside each other, and do away with the severe shocks that torture horses, drivers and passengers, whenever the wheels strike those plank water ways. Grade the road as wanted before building your sluices. Then excavate to the desired depth, level the bottom accurately, making it concave to fit the convexity of the tile. Lay them carefully, pack the earth firmly around them until they are so securely held that they can not move; lay a plank upon the soil, say from four to six inches over the tile, and then fill in the earth so that the grade may correspond with the rest of the road. There will then be no danger that the heaviest loaded teams will injure the tile, and there is no reason why they should not last as long as the road itself. We have thus far endeavored to show something of the various ways of making roads, the materials used, and the adaptability to the various needs, seeking to avoid technicalities and elaborate computations that serve only to confuse those not educated to the science of engineering. We have, however, given such data and tables as we deemed serviceable to road-making farmers, road-overseers and commissioners of highways. Our principal aim has been to give you an idea how easy it is to make good earth roads, and to call attention to the fact that improved machinery is now doing as much for the road makers as improved implements have done for the farmers. Arrange for the width of the road and ditches, by means of grade pegs and flags along the edges of the required ditches. Set flags along the center of the road to guide the operators somewhat in spreading the earth. Plow the entire width of the ditches throwing the furrows toward the roadway. Now scrape the furrows well to the center, spreading evenly. Plow again, narrower than before, being careful not to get too deep next the road; again scrape, and so proceed to plow until you have the earth necessary to form the roadway being careful to preserve the bottom of the ditch so that it shall slope very gradually to within about eighteen inches of the outside of the ditch, and rise sharply to the banks next the fences. Thus finished, the work should present the appearance as seen in cut. Illustration on page 818 shows a completed road, with figures indicating the several proportions. Thus, the width of ditches, nine feet; width of ungraded surface, four feet; width of grade, sixteen feet; height of grade, fifteen inches; width between fences being sixty-six feet. Suppose this road be in a slough with slopes rising each way, longitudinally with the road. The accumulation of water will fill the ditches and overflow the road; but a culvert, or a line of tile, according to circumstances, running transversely on, from ditch to ditch, and ending in an open or covered ditch, running down the line of the slough a sufficient distance to form an outlet for the water, establishes your drainage, and your road must, as a matter of course, remain dry. When graded, the surface should be repeatedly dragged with a heavy harrow to smooth all unevenness, and then rolled until it is quite even and hard. Then, when once worn by teams, it will ever after remain almost impervious to water, unless it is allowed to get out of repair. It will probably surprise many to be informed that some years ago it was seriously argued that owing to the spongy nature of the soil, tramways would have to be established over the West to enable the farmers to get their produce to market. We presume there would be few now to advocate this system, in those towns and other sections, where a connected system of earth road-ways has been established. One of the great difficulties in organizing a perfect and uniform system of roads, is the multiplicity of overseers in our towns. It is an onerous position at the best, and one bringing loss rather than profit to the incumbent. These are, or are supposed to be, farmers or business men, who have a direct interest in keeping the roads in repair. From the fact that the position is an onerous one, no man who has business of his own, likes to take it. If a responsible man does, it is simply on account of his public spirit, and they are but seldom men who possess a practical knowledge of road-making. But each does have an indefinite idea of how a road should be made, and immediately proceeds to carry out these ideas. If there are three or a dozen different overseers in a township, there will be as many different kinds of roads. Consequently there never can be, under this system, any uniformity in the road-ways, nor perfection in drainage. The next year comes a new set of overseers, and they proceed to practically demonstrate their ideas. So it goes on from year to year, and our roads, in too many instances, continue to be a horror to travelers; rutted and full of holes in dry weather, and miry and dreadful when wet. The men are not to blame. They are, as a rule, honest and honorable men. They are not road-makers, but farmers, mechanics or business men, who can not be expected to leave their occupations to work upon the public ground, especially when, after their best endeavors, they are compelled to endure the censure of imperfect work. Who, then, is to blame? Well, no one specially. It is the law which made the system. Suppose we change this system, and in lieu of a multitude of road-makers, place the whole matter of road-making in the hands of one competent commissioner in each town, who shall be paid liberally for the labor performed. He may give bonds, if necessary, for the faithful handling and judicious disbursement of the money. Let the commissioners of a county meet at some time in the winter to compare notes and experiences, devise ways and means, report upon improvements, estimate the necessary amount of money required to be raised for the current year, and agree as near as possible upon a uniform system to be pursued. How long would it be before improved drainage and improved roads had added ten times the cost of the work to the value of the lands of the State? Suppose a good road was built on every section line in a township of six miles square, at a cost of fifty cents per rod, or $160 per mile. It can be done for much less. There would be seventy-two miles of road in the town. This, at $160 per mile, would be $5,760. Add as much for bridges and sluice-ways, and we have $11,520 There are 23,040 acres in a township. Thus the roads and bridges have added the enormous sum of fifty cents per acre to the cost of the farms. The value of the drainage alone would pay the bill and leave the roads as clear gain. Will any farmer say that it will not increase the value of his farm by at least five dollars per acre? With this view of the case, would there be any difficulty in inducing every property holder to vote the money necessary to bring about this much to be wished for result? Undoubtedly not. But to do this the law must be changed, and the old system of doing the work by property owners, under the direction of a multiplicity of overseers, working without concerted plans, must be abolished. To do this, the people of the several States, for they are the real power, must be made to see that the benefits arising therefrom, will be at least commensurate with the cost.

ROBIN. (See Thrush.)

ROBINIA. (See Locust.)

ROCHELLE SALT. Tartrate of soda and potassa; used as a gentle purgative.

ROCK CRYSTAL. Transparent quartz.

ROCK SALT. The coarse native salt, found in immense masses in some parts of the globe. It consists of salt chiefly, but adulterated with chloride of calcium, gypsum, and marl.

ROD. The same as a pole, sixteen and one half feet. Four of these make Gunter's chain.

RODENTS, RODENTIA. Gnawing quadrupeds, with two long chisel teeth in the front of either jaw. Rats, rabbits, and squirrels are of this class.

ROLLER. An implement of simple construction, the main object of which is to render smooth the surface of arable lands. It is an implement in which greater diversity of form is found to exist than in most agricultural machines. Rollers are of all sizes, weights, and lengths; and the material of which they are made is occasionally iron, sometimes stone, but most commonly wood. Of these, the first is undoubtedly the best, and particularly for the jointed roller, by which the operation of turning at the ends of the ridges is materially facilitated, and the crowding of the earth which would otherwise take place on the head-lands, not only to their great detriment, but in the increase of labor to the team, is thereby prevented. The use of the roller is now confined to compressing the soil, and except on roads, walks, and causeways, is less used than formerly. It having been found in practice that this implement seldom crushes the clods of hard earth, but simply presses them level with the surface. Hence, other implements which grind as well as press, have in a great measure, taken their place. One of the best of these is a plank twelve or fourteen inches wide, to which the team is hitched, and upon which the driver rides. Another implement for leveling and grinding is made of three two-by-four hard wood scantling, fastened together by rods, and placed about ten inches apart, answers excellently. A roller formed by a series of discs placed together in two ranks, the rear rank cutting between the tracks of the forward ones, grinds hard clays admirably, but is heavy and tedious, and compacts the soil too firmly. Hence farmers are now depending more on fall plowing, in tenacious soils than formerly, using the roller simply to compress the earth about the seeds, and render the surface uniform.

ROOD. A square measure, equal to forty perches or square poles. The fourth part of an acre.

ROOK. *Corvus frugilegus.* The gregarious crow, almost domesticated in England in rookeries. They live, for the most part, on insects. The young are sometimes eaten.

ROOT. That part of the central axis of a plant which is formed by the descending fibers, and whose function is to attract liquid food from the soil in which it is found. It differs from the stem in not having leaves or buds upon its surface, and in its tendency to burrow under ground, retreating from light; nevertheless, some kinds of roots are exclusively formed in air and light, as in the ivy, and other such plants. Roots are of various figures, as fibrous; spindle, as in the radish; knotted, etc. The rhizome of the flag and the tuber of the potato are not roots, but subterranean stems. The cormus of palms and aroidæ is a mere expansion of tissue, which is neither a root nor stem.

ROOT CROPS. By root crops we understand the cultivation of those crops, the roots, bulbs, or tubers of which are used as food for man or farm stock. In England the turnip forms the most important root crop in cultivation, since it has been made the means of feeding stock and acting as a cleaning and fallow crop in the regular rotation. The climate of the United States is not adapted to the extensive culture of the turnip, and Indian corn takes its place as a feeding crop. As a field root crop, potatoes are the most important in the United States, next the onion, then beets, parsnips, carrots and salsify, all these being used for culinary purposes except beets and carrots. No root crop should have green manure applied to it the same year of cultivation. Potatoes and onions suffer least from the application of green manure. It is apt to make the first knobby, and the second thick necked. All the spindle-shaped roots as beets, carrots, etc., are pretty sure to have forked and ill-shaped roots from the application of green manure. A good plan is to precede the cultivation of root crops with Indian corn heavily manured, and give a good surface dressing of well rotted manure or compost the fall preceding the planting of the roots, to be well worked in the soil the succeeding spring. (See articles on varieties.)

ROOT PRUNING. The principal objects sought to be gained by root pruning is, first to so check the growth as to induce early fruitfulness; second, to induce the formation of fibrous roots, third, to prevent blight, and fourth, as a means of preparing a tree for subsequent removal with a mass of earth attached. Root pruning has the direct effect of at once cutting off a supply of sap. Therefore the work should be performed understandingly. The leaves not being furnished with their usual quantity of sap, the branches are checked in growth, and as a fruit bud is well known to be but a modification of a leaf bud, it naturally follows that the energies of the tree being checked, that fruit buds are apt to be formed for the next season's growth. It would therefore follow that root pruning to induce fruitfulness should be performed early in the season or before the full season of growth. To induce the formation of fibrous roots and to check early blossoming, the pruning may be done in the latter part of winter or as early in the spring as the ground is well settled. For the prevention of blight the late Dr. Hull, one of the most successful of Illinois' orchardists, has stated the following: If root pruning the pear is to be done to induce tardy bearing trees to become fruitful, then the pruning should be at such time, and with sufficient severity, to cause the trees to produce their leaves fully grown at least six weeks before frost in autumn. But when the pruning is be done to ward off the attacks of blight, then the roots must be so much shortened that the tree will show terminal buds on leading shoots, at the earliest period that trees are known to show the effects of blight in the sap wood. No rule based on time can be given, since each mile, north or south, would make some variation necessary. Or, to be more explicit, the degree of maturity would be reached earlier South than North. For instance take Seckel trees making moderate growth. These in latitude 39° would show terminal buds, at the ends of the latest growing shoots, about June 1; 3° south, the 15th to the 20th of May; while a similar condition of growth as far north as the 43° could not occur earlier than July 1. For these and similar reasons any rule made as a guide for root pruning must have reference to conditions rather than time. The conclusions given above are based on microscopic examinations, also on observations made on root pruning, extending through a period of more than twenty years. Dr. Hull believed that in no instance can pear tree blight materially injure a tree on which all the leaf growth is well developed by the time the first branch growth of slow growing Seckel trees is ended; provided a second growth is not made. Excellent examples in support of this view may be found in the Seckel growing on poor soils. Under such conditions the trees form terminal buds on the strongest of the current year's shoots at the time we have named. It is probable that these slow growing Seckel trees could not blight, in fact do not, until a second flow of sap occurs. Thus, Seckel, and other trees of similar habits of growth, could be kept in health by a moderate shortening of the roots; while trees which continue branch and leaf growth to a later period, must be more severely root pruned. Theoretically considered, especially for the South, pruning to secure early maturity of wood growth is wrong; since trees which naturally go to rest early, after they have been a short time inactive, generally cast their leaves and then make a partial second growth, which is injurious or fatal to them. Observation, however, has taught the important lesson that root-pruned trees make but one growth the same season. When severe top pruning is done, then the roots grow slowly until the balance in the top and roots is again restored. In like manner, trees which are deprived of a part of their roots push only a part of their germ branches, these are soon grown. After this branch growth has ceased the leaves continue a long while active and change leaf to fruit buds; a large number of buds are so changed. After which, all further growth of the season, if there be any, goes to restore the loss of the roots. Trees pruned as directed, do not again restore the balance between the top and roots before the end of the second season. Hence it was conceded that root-pruned pear trees, growing under any of the conditions described, could not blight until the third summer. For this reason, shortening the roots once in two years, in accordance with the rule it was claimed, would protect the trees from injury by blight. Among other advantages gained by root pruning, besides preventing blight, may be named the following: Root-pruned pear trees generally resist leaf blight. Tardy bearing trees, perfect fruit buds the first summer, after their roots have been cut, and produce full crops of fruit the next. The size of the fruit is much increased. The pears on root pruned trees are smooth-skinned and free from russet patches and bands, and on ripening, color finely; in this respect rivaling the California pears, which they also greatly excel in quality. Root-pruned pear trees, on pear roots, may be dwarfed to almost any extent desired. Trees of any age after they have been several times root pruned, may be safely transplanted. The operation is thoroughly performed as follows: Root pruning may be performed from November to April. The latter part of winter or spring is best, as the subsoil is then easily penetrated by a spade. For trees the circumference of which is twelve inches at one foot above the ground, mark a circle around the tree, the semi-diameter of which shall not exceed eighteen inches from the trunk. For trees larger than twelve inches, for each additional three inches of girth, enlarge the diameter of the circle three inches. Next, with a sharp spade open a trench outside of the circle to the depth of not less than three feet, cutting all lateral roots to that depth. For a tree measuring twelve inches, this will leave a round ball of earth of the diameter of forty inches to contain the lateral roots left after pruning. After having the work inspected, fill the trench with top soil and give thorough cultivation until August at the north part of Illinois, latitude 42°, and until October in latitude 38°. Once in two years repeat the operation enlarging the diameter of the circle three inches with each additional operation. The effect of this pruning is to force the trees to form their terminal buds on the leading shoots by the time the blight first appears, which in the latitude of St. Louis occurs about May 25 to the 1st of June. Root pruning, for the purpose of rendering a tree safe to remove, though the formation of new roots should be performed early in the spring, or better late in the previous fall, so as to allow a full season's growth previous to removal. In root pruning, however, as in ringing, the operator must understand the nature of the tree to be operated on, as well as to have a correct idea of the changes that are to occur. For general orchard work a subsoil plow, with the coulter ground sharp, is simply run deeply both ways in the orchard, cutting the earth in squares about the trees. In more restricted grounds, a sharp, long-bladed spade is thrust deeply in the earth in a circle about the tree. This often has fully as good an effect as the more scientific pruning, and is applicable to all trees and shrubs of rampant growth. In the fruit garden it will pay, when it may not do so in extensive orchard culture, and for one reason that finer varieties are usually grown there than in the commercial orchards.

ROOT STOCK. The rhizome of the flag, ginger, arrow-root, etc.

ROSACEÆ. A large and important natural order of plants, the species of which are, for the most part, inhabitants of the cooler parts of the world. They are in some cases trees, in others shrubs, and in a great number of instances herbaceous, perennial plants; scarcely any are annuals. No natural orders contain more species of general interest, in the beauty of their flowers, or their perfume; there is the rose itself, and various species of the genera *Rubus*, *Spiræa*, *Potentilla*, *Geum*, and *Pyrus*. The apple, pear, plum, cherry, peach, nectarine, apricot, raspberry, strawberry, and similar valuable fruits are the produce of others. As medicinal plants, some are of considerable importance. Prussic acid is obtained from the leaves and seeds of the bitter almond, peach, plum, and other species. This important assemblage of plants is distinguished by having several petals; separate carpels; distinct, perigynous, numerous stamens; alternate leaves, and an exogenous mode of growth.

ROOTS AND VEGETABLES, PITTING. Many farmers in the West, even of those who pay proper attention to the kitchen garden, do not have the cellar room they ought to have; and this, often, from the difficulty and expense in procuring stone for the walls. This, however, need not prevent any one from having a good supply of vegetables during the winter. They may be kept in pits, or, covered on the surface of the land, in the best possible condition, if the proper plan is adopted for keeping them intact; that is, to keep such as are injured by slight freezing, warm enough, and those which will not be so injured, cool enough. Potatoes, for instance, are ruined by the least frost, so when they receive their final covering for winter the pits should have no ventilation. On the other hand, beets, and especially swedes and common turnips, should be kept quite cold; if of the two latter varieties they may be partially frozen, and yet come out intact, if allowed to thaw naturally; indeed, we usually allow them to freeze slightly, and place on additional covering to keep them so frozen. Parsnips and salsify, also, are better so frozen, and so are onions; but beets and carrots, if frozen, are injured. In cold, long winters, pits of potatoes will often freeze, though covered with a great depth of soil. Our rule is to cover with plenty of hay or straw, then with six inches of earth, then another layer of straw, and again six to eight inches of earth. Thus covered we have never had pits frozen, even in the extremest winters; but in very long, cold spells, we usually add a covering of litter over all. The philosophy is this: The frost penetrating to the first covering of straw, is held by the dead air there, and seldom enters the second layer of earth to any great extent. Parsnips and salsify may be safely left in the ground where they grow, all winter; but enough should be put in the cellar, or pits, to last till spring. It is a mistaken notion that these roots are not good until frozen. They are undoubtedly better in the spring; but if left thus until then, the season is so short that but little good is had of them. Late celery is saved and blanched for winter use by digging shallow trenches about two feet wide, and placing the plants upright therein, as closely together as possible, and yet allow to have earth packed firmly about the plants, and nearly to the tops. When so packed the whole should be covered with rails, so that the litter over all, to keep out the frost, will not press heavily on the plants. It is some trouble to keep celery, but the satisfaction of having this delicious vegetable in winter well repays the cost. When wanted for use the end last packed may be broken into, as much as is desired taken out, and the whole again covered secure, remembering that fifteen degrees of frost kills this plant.

ROOT CROPS FOR FEEDING. Very few farmers estimate the relation in value of root crops, to the other crops of the farm. The cultivation of beets in France and Germany, has added one quarter to the number of cattle that may be fed; and also added twenty-five per cent. per acre to the production of wheat in those countries. Why? Nothing is exported but the sugar of the crop. The beet pulp after the sugar is taken, is one of the most valuable of foods for cattle; and the cattle fed return large quantities of rich manure to the soil. Crops of beets are among the best fallow crops known; for the land must be put in first rate condition and kept absolutely free from weeds. This done, there is no difficulty in raising great crops of anything which follows. Among a very important class of western men, the cultivation of root crops might be of great value. These are stock breeders and dairymen. Fortunately this class can afford to cultivate them systematically. Our extreme summer droughts render the cultivation of turnips impracticable. Not so other roots, and especially beets. We do not advocate the cultivation of roots by the general farmer, although if done to such a degree that each horse, sheep, head of swine or cattle kept, could have a certain quantity each day in connection with other food, it would be found profitable in enhanced health to the stock. If Short-Horn herds received a quota of roots every day in the winter, and if milch cows were fed roots during the same season, we should hear much less of infertile animals among the farmers, and of abortions, and that class of disabilities among this class of stock. For this reason we shall give the most feasible plan of cultivation, for experimenting with such crops by these classes. The cultivation and preparation of the soil, it will not be necessary to resume, except to say that the soil must be deeply worked, well manured, and free from the seeds of weeds. Among the implements of culture, a leveler and a roller are indispensable. A leveler is thus made: Take two 4x4 hard wood scantlings, eight feet long. Fasten them together with strong one and a half inch pins, so they shall be two and a half to three feet apart. To the forward piece fasten a chain so that it may form a V to draw by. Put a walking board on the pins, between the scantling, to stand on. Thus by taking proper positions, you may make the leveler draw more or less diagonally, catching the earth at the high places and moving it to the lower. Go over the land both ways if necessary, and you will be surprised at the result, if you have not heretofore known this. Accuracy in marking the land, that rows may be perfectly straight, and at equal distances from each other, is indispensable. A strong plank eight feet long, with runners and a tongue attached, will make five marks, two feet apart, and will run steady if you attach a stout rope of proper length from the near and the off hame rings of the harness, to the outside of the marker. If the marker be sawed into three sections, and again joined with strong strap hinges, it will fit inequalities in the ground. Let the markers be of sled runner shape, as they will press the earth rather than stir it, making the marks as shallow as possible, and so that they can be seen. Having passed once through, in returning keep one shoe accurately in the last track made; and then with a little care your plat will be ready for the drill. Any of the better class of garden drills will sow your seed accurately and perfectly. So soon as the seed appears above ground, work as closely to the rows as possible with a stirrup, wheel, hoe or other suitable implement, and as soon as the plants gain a little size, thin them with a narrow hand hoe; if beets or ruta-bagas, into squares of six inches apart. The latter, however, are better thinned entirely by hand, at the time of weeding. We have given the distance of two feet apart for the rows, since at this distance a common one-horse cultivator may be shut close enough to clean between the rows if care be used, and after the plants get some size there will be little difficulty in working the crop. In seeding, sow thick, not less than four pounds of carrots or parsnips, and six to eight of beets per acre, many sow twelve. It is far easier to thin than to lose a stand, for replanting never pays. Sow from the first to the tenth of May, north of the latitude of southern Iowa, or Central Illinois, Indiana and Ohio. In these latitudes the last of April will be proper. If South, still earlier. Ruta-bagas should be sown about the 25th of May, in the latitude first named, since it is difficult to get a stand if sown later, on account of the fly, drought, etc. If you lose the first crop, sow again. Beets should not be sown more than an inch deep; carrots and parsnips one-half inch, and rutabagas still more shallow. Roll the whole surface even, after planting, since this will make the cultivation easier. The theoretical value of any food is the dry matter it contains. Its real value consists in the power of the animal organism to assimilate the organic matter contained. The amount of the several proximate organic bodies in a ton of kernels of corn, dry, according to the analysis of Salisbury, are:

Organic Matter.	Pounds.
Sugar and extract	266.40
Starch	1186.00
Fiber	17.80
Matter by Potash	119.80
Albumen	85.80
Casein	1.60
Zein	33.60
Dextrine and gum	65.20
Oil	72.00
Water	169.90
	2018.10

The per cent. of dry matter in 100 parts of the kernels of white flint corn, according to the same authority, is 62.56, and 37.44 per cent. water. A proximate analysis of mangold. fresh, by Horseford and Kracker, in 100 parts, gave:

Albuminous matter	2.04
Sugar	12.26
Cellulose and other nitrogenous substances	2.56
Mineral substances	0.89
Water	82.25
	100.00

Thus we have in beets, of solid matter, 17.75 per cent. as against 62.56 in corn, or three and a half times as much. So, theoretically, 100 pounds of corn should go as far as 350 pounds of beets; but practically, 250 pounds of beets will feed as far as 100 pounds of corn, for this reason: the beets are more perfectly digested than the corn. Again, it will require under the most favorable circumstances, the labor of a man and team two and a half days to raise and crib a ton of corn, or an acre; this will represent at $3.00 per day, $7.50. Under equally favorable circumstances four tons of beets may be raised for the same money. But let us look at the matter in another light. We have shown that a ton of corn, which corresponds to a good crop, contains per acre, exclusive of water, 1848.20 pounds of solid matter. According to Johnson, twenty tons of mangold, an average yield per acre, under ordinary circumstances, contains 4,950 pounds of starch, sugar, etc.; 900 pounds of gluten, etc.; 900 pounds of fiber, and 450 pounds of saline matter, equals 7,200 pounds, or about four times the amount contained in the acre of corn. An acre of corn costs $7.50; the acre of beets, if raised by hand, will cost $30; and thus, again, we are even, allowing that both are equally assimilated, which every man knows they are not, unless the corn is ground. The point lies just here: To reach the best results, the grain and vegetable food should be fed together, since one contains largely of fatty matter, and the other of nitrogenous matter, and so one assists the other. For ourselves, we have reached the best results in feeding a half bushel of roots, and a peck of meal, to each fattening ox per day. This was near Chicago, where mills were plenty, and when the culture of roots could be economically carried on. Different results might be obtained where corn was cheaply raised, and roots difficult of culture. Still this does not alter the question of value in the animal economy.

ROSE. This queen of flowers is almost universally cultivated in some form. Every garden however small has its rose bush, too often, however, of old and discarded varieties that have but little merit compared with the varieties of later years. The well known June rose, annual bloomer, is perfectly hardy, and may now be had of splendid varieties, including standard, moss, climbing and pillar roses, or half climbing. Unfortunately, once they have cast their short lived bloom, they bloom no more until the next season. The hybrid perpetuals, however, after their summer bloom is passed, if cut back, will again bloom in the fall, and the color, variety, and substance of their flowers is all that could be desired. They, however, require protection during the winter, North. Without this they are liable to winter-kill. Roses require a deep, rich humus, but moderately compact soil. Pot roses like a soil rather lumpy, that is a soil not sifted. Two parts of rich, black loam, and one part of rotted cow manure, with the addition of a little sharp sand serves them admirably. The monthly or Chinese rose and its hybrids, generally known as monthly roses, are still more tender than the perpetuals. They may be perfectly well wintered in a pit, three or four feet deep, covered with glass, and protected from severe frost, if a little air is given them in winter. So also they may be wintered in a well lighted cellar. They are the roses principally grown in window gardens. The only objection to growing roses in rooms is the prevalence of insects, especially the green fly and red spider, destroying their usefulness and beauty. Semperflorens is among the best for a single variety; for two, add Indica Alba; three, add Eugene Beauharnais; four, add Indica (common daily); five, add La Superbe; and for six, add Jacksonii. These are all firm and free blooms. The tea roses are exquisite and fragrant. Odorata, Saffrano, Compte de Paris, and Adam are among the good reliable sorts. The Bourbon roses, sometimes called China-perpetuals are a fine class, vigorous in growth and hardier than the China rose. Queen of Bedders, Souvenier de la Malmaison, and Hermosa are fine. All the roses described may be wintered in a pit or cool cellar as described. They may be planted out in the ground about April first, in latitude forty two degrees, and taken up before hard and continuous freezing occurs.

ROSE BAY. The handsome *Rhododendron maximum.*

ROSE CAMPION. (See Cockle.)

ROSE MALLOW. (See Mallow.)

ROSEMARY. Handsome species of plants cultivated for their scented leaves and their essential oil. They are not hardy in the North. South these plants have been used occasionally as hedge plants. There are three principal varieties, the green, golden striped, and silver striped. The latter two are ornamental varieties.

ROSIN. The resin remaining after distilling the spirits from turpentine. Colophony.

ROSTELLUM. The name given to the retractile sucking tube of apterous insects.

ROT. This is a name given to a disease in sheep, when infected with the fluke, *distomum Lanceolatum,* and *Fasciola Hepatica* which inhabit the gall bladder and ducts, and passes to the substance of the liver. Once the disease becomes apparent, immediate remedies must be used. This is known by the comjunctiva, or membrane covering the eye-ball in front, and lining it, becoming pale and yellow; in a healthy sheep it is brilliantly red and is of a natural color. As the disease progresses the sheep become pot bellied, rough, ragged, and finally die. When developed there is no cure. As a preventive, or in the very early stages of the disease, give every fourth day for two weeks a wine-glass full of the following mixture, and several hours before food is given: Take one and one-half ounces saltpetre, one ounce powdered ginger, one-half ounce carbonate of iron, one pound salt, three quarts boiling water, mix, and when nearly cool, add nine ounces spirits of turpentine, bottle for use, and shake well before giving it. Badly drained pastures, musty hay or that badly cured, are supposed to be favorable to the flukes. Keep sheep in high, solid, well-drained pastures, feed plenty of salt, and if the fields are suspected keep the sheep off the pasture except when the grass is free from moisture. The foot and mouth disease in cattle is sometimes incorrectly called rot, and, also, hoof rot—the latter comes from unclean usage of cattle. (See Apthous fever.) Rot is a common term used to denote the decay of the growing fruit on the tree, from stings of insects followed by the attack of fungi, or from original epidemic fungi. There is no known remedy except a change of atmospheric conditions.

ROTATION OF CROPS. In all countries when agriculture has advanced to a condition where the same land is occupied from year to year, a rotation of crops comes to be looked on as indispensable, and for the simple reason that all such cultivated and carried from the land, sooner or later exhaust the soil of the elements of fertility required to perfect the species. Hence those crops which are carried off, root, branch and seed, exhaust the soil quicker than those, a portion of which are left on the field or are returned to it. Consequently the poorer the soil the more care must be taken to diversify the crops, and from the well known fact that different plants exhaust different constituents of the soil. Among the ancients rotation was less attended to than manuring, and rest and fallow. In more modern times the value of rotation became more generally known, and in Great Britain and on the continent of Europe, most elaborate systems of rotation in connection with the feeding of cattle, and special manures have been adopted. In the United States, and especially in the West, from the generally fertile character of the soil, careful rotation has been less attended to, yet even on the richest soils of the West, it is quickly found that special crops, as wheat, may not be cultivated year after year, on the same soil, without quick deterioration. In the East and South the system of rotation is in special cases quite elaborate, yet as a rule, our farmers generally depend more on the simple rotation from grain to grass, in connection with manure than any other. In the West, where the fattening of stock is one of the most important industries of the farmers, this simple system has been found fully adequate, and from the fact that nothing is carried away from the farm except the stock fed, and farms being stocked with all the animals they will feed, grass becomes fully half the area of farms, consequently the rotation becomes simplified to a three fold rotation, Indian corn, meadow and pasture, the amount of grain carried away from the farm being small in comparison to that fed. In England and on the continent of Europe, turnips, cabbages, beets, carrots, potatoes, vetches, and in fact all the roots and many of the vegetables, here cultivated only in market gardens, enters into the rotation. As showing something of this, we append a system of rotation for seven years, as prepared at the request of the French government, soon after the Revolution, and also for the purpose of showing the elaborate system in vogue nearly a century ago, and as having relation to the clean culture necessary to grow them. Other points as to their ameliorating nature, and as showing their diversified character in view of preventing undue loss in any of the elements of the soil, will be found as interesting as they are important. As showing that grass is the basis of fertility in all countries in the rotation, we give the experience of various sections of the United States, East, West and South; premising with the fact that in Flanders, celebrated for its great yield of crops, and where every thing, liquid and solid, in the shape of manure is returned to the soil, the soiling of green crops and the turning under of others, enabling them in fact to get a rotation even in one season of certain crops, so that it is not uncommon for plowing, sowing and reaping to be carried forward at one and the same period of time, there, as elsewhere, grass or its equivalent, green crops being the basis of fertility. It is said that by the same or similar alternations of crops that many farms in Norfolk county and other sandy regions of England, once very poor and unproductive, have been converted into the most fruitful, wealthy, and populous districts of that kingdom. This same system has wrought similar changes of agricultural improvements in Scotland and Germany, and it will, if properly and perseveringly pursued, produce equally beneficial results in our own country. There is nothing in farming that requires a nicer judgment, or on which the farmer's profits more depend, than upon the order in which the various farm crops cultivated are made to succeed each other upon our fields. The green manuring and alternating husbandry, so successful in Flanders, has been adopted to a considerable extent in nearly all the other countries of Europe, and is constantly growing in favor there. Turnips in those countries have been used quite generally as a soil-renovating crop with great advantage, their large, spreading leaves drawing more nourishment from the atmosphere than their roots do from the soil. Sheep are turned into the fields and eat off the tops or leaves of the turnips, and as many of the roots as they wish, leaving their manure upon the ground evenly distributed, and the field in good condition for a succeeding crop of grain. One of the difficulties in the way of a perfect rotation is, that owing to peculiar seasons, it is impossible to closely follow any established rule, yet, the intelligence of the cultivator will enable him to provide for such contingences and follow the system which he may have found beneficial, without serious breaks. For instance, we have known extensive meadows to be destroyed by the larva of the May beetle, *Lachnosterna quercina*, usually known as the white grub. This destruction is sometimes so complete, that the turf eaten from one to two inches below the surface, may be rolled up like a carpet; and, since the grub requires three years to attain its growth from the egg, it may easily be seen how this and other causes may seriously interfere with rotation. Nevertheless, this need not prevent an intelligent farmer from keeping a rotation comparatively intact, even under the most adverse conditions, either from insect enemies, drought, or flooding. And more especially when, as may be the case in the West, the rotation is confined to two years of meadow, one year of pasture, one year corn, and one year wheat, and mixed crops, to be varied, according to the stock kept, if for dairying, requiring more pasture, and if for stock feeding, more corn. Let us take a farm of 160 acres. A good Western farmer has recommended the following: Allowing twenty acres of this amount for timber-land, and ten

First Year. Acres.	Second Year. Acres.	Third Year. Acres.	Fourth Year. Acres.	Fifth Year. Acres.	Sixth Year. Acres.	Seventh Year. Acres.
30 Wheat	5 Turnips . 5 Cabbages 2½ F'ld beet 2½ Carrots.. 10 Potatoes. 3 Vetches . 2 Beans ...	10 Oats..... 5 Barley... 15 Wheat.....	15 Clover..... 5 Turnips .. 5 Cabbages. 2½ Field beet 2½ Carrots ...	15 Wheat .... 10 Oats..... 5 Barley...	10 Potatoes. 3 Vetches.. 2 Beans ... 15 Clover ...	30 Wheat.
15 Clover......	15 Wheat ...	10 Potatoes. 3 Vetches.. 2 Beans....	30 Wheat	5 Turnips . 5 Cabbages 2½ F'ld beet 2½ Carrots .. 10 Potatoes. 3 Vetches.. 2 Beans....	10 Oats ..... 5 Barley ...	15 Clover.
5 Turnips... 5 Cabbages. 2½ Field beet. 2½ Carrots....	10 Oats..... 5 Barley ..	15 Clover...			15 Wheat.....	5 Turnips. 5 Cabbages. 2½ Field beet. 2½ Carrots.
10 Oats ...... 5 Barley	15 Clover.....	15 Wheat	10 Potatoes. 3 Vetches . 2 Beans ..	15 Wheat	5 Turnips .. 5 Cabbages. 2½ Field beet 2½ Carrots ...	10 Oats. 5 Barley.
10 Potatoes.. 3 Vetches .. 2 Beans	15 Wheat ...	5 Turnips.. 5 Cabbages 2½ F'ld beet 2½ Carrots..	10 Oats..... 5 Barley ...	15 Clover.....	15 Wheat	10 Potatoes. 3 Vetches. 2 Beans.

·Lucerne, which lasts indefinitely, may be substituted on any ten acres, in the rotation, during the whole course. Very proper for trial in California, in the Southern States, and other localities where lucerne is grown; afterwards to be plowed down and succeeded by wheat.

more for farm-buildings, yards, calf and hog pastures, and lanes, there would remain 120 acres to be specially devoted to crop culture and rotation. These 120 acres divide into six lots, containing twenty acres each; three to be kept constantly in clover, or clover and timothy; one in pasture in connection with the timber-lot; the other two grass-lots to be cut for hay. Of these the oldest seeded may be used for fall pasture, and the other mowed for a second crop of hay or grass-seed. The lot used for summer pasture having been in grass for three years, should be broken up in the spring following for a crop of corn, potatoes, and other hoed crops; this for restoring exhausted, overworked soils. Of course, virgin soils require no close rotation of crops; but the raising of grain should invariably be conducted with a view to the future introduction and cultivation of the grasses and to a regular system of rotation of crops. The rotation of Mr. W. S. Thorp, of Vermont, may be taken as indicative of a good rotation for the New England States. He believes that an eight-year rotation might be used with profit generally. This, allowing the farm twenty acres of woodland, would leave eight ten-acre fields. As labor is scarce and high, all wish to manage with as little help as possible. On that account grass may be grown with as much profit as anything, so apply grass to the rotation if convenient. This course, in going around the eight ten-acre fields in eight years, would allow one to have one ten-acre field in corn or roots; second year in wheat, barley, oats, or some other grain-crop seeded to grass; the next two years mowed for hay, and the next four years in pasture. This is about equally divided for the keeping of stock summer and winter, supposing the owner to feed all the crops on his farm. By using a rotation and feeding all our produce on the farm, we can keep two-thirds more stock than the majority of farmers do at the present time, and farms would be all under cultivation. We should have ten acres in hoed crops, ten acres in grain, and at a very low estimate we should get 300 bushels of potatoes, or 1,000 bushels of rutabagas or mangolds per acre, and four or five hundred bushels of grain annually. In regard to a rotation in the South, grass must still be the basis of reclamation, or of a system to keep the fertility intact. Of late years, the attention of southern planters has been especially directed to this subject, and investigation and trial have shown that the South is not at all deficient in valuable grasses, even outside of clover, alfalfa and cow-peas, which are sometimes erroneously ranked as grass. A writer of repute on Southern agriculture, and one who writes from experience as a cotton planter in one of the Gulf States, in illustrating his views says: A great defect of southern planters is that they do not keep, in the way of fertility, what they get. That is to say, when they make a piece of ground, they afterward continue to work it in exhausting crops until all the richness is gone. They can not get possession of a goose without ripping up the poor bird. The true policy is not merely to keep the ground rich, but to make it richer. To illustrate: If a piece of rich land is put in cotton, it may be followed with corn, small grain, with clover being sowed among the corn in August. If the clover is allowed to occupy the ground for two years, and to go to seed, even under a longer rotation than the above, it will not be necessary to sow it again. As soon as the ground is at rest, it will be covered with young clover. Three years ago, on this farm, a piece of ground was put in turnips, manured in the drill with farm-yard manure. The turnips were eaten on the ground by sheep. The next year it was put in corn, the next in cotton worked very clean, and this year in oats. After the oats were cut a fine stand of red clover appeared. This seed was never sown, but must have been in the manure applied three years since to the turnips. This is not a solitary case. Many similar instances have occurred. It is such plants as clover and peas that not only hold but increase the fertility of the soil. As one suited to the agricultural condition of the South, we will suppose a farm of 500 acres of open land under fence. Let 250 acres be devoted to arable purposes, and the rest to grazing. The rotation might be as follows: 1. Cotton and corn in the same field in suitable proportions. 2. Oats sown in August on the cotton and corn land. 3. Rye, or rye and wheat, sown in September, the land having been twice plowed in order to kill the germinant oats. 4 and 5. Clover, if the land is in sufficient heart to produce it; if not, the fourth year rest ungrazed, and the fifth year sheep and cattle penned upon it every night during the year, using a portable fence. An ordinary farm of 500 acres will support 500 sheep, besides the crops in the above rotation. The oats and rye will feed them during the winter nearly or entirely, without injury to the grain. Five hands would be sufficient to work such a farm and take care of the live stock. During the first year, our authority thinks, the following results might be expected from an ordinary farm, without manure:

25 acres in cotton, 12 bales, at 15 cents	$900
25 acres in corn, 250 bushels, at $1	250
50 acres in oats, 500 bushels, at 80 cents	400
25 acres in rye, 200 bushels, at $1	200
25 acres in wheat 150 bushels, at $1.50	225
Increase and mutton sales of 500 sheep	500
Wool, 3 pounds per head, at 33 cents per pound	495
Manure, at $1 per head	500
	$3,470

Separately each of these products is small, still the aggregate result is more than $600 per hand. Yet this is nearly three times the average products per hand in the cotton States. That average in Georgia, was estimated to be $209; in South Carolina, $202; in Virginia, $211; in North Carolina, $214. These are the lowest averages The farm products given in the case above supposed are the result of the first year of the rotation. The next year the cotton and corn would be more than double by penning 500 sheep at night on fifty acres. It is the writer's experience that ten sheep regularly penned will manure well one acre in a year. Five hundred would, therefore, manure well fifty acres. The appearance of the ground would not indicate this high manuring; but it should be remembered that the liquid manure, which is equal in value to the solid, is not visible. If, in addition, a stock of cattle were kept and penned on the same fifty acres, then fertility would be increased in proportion. It should never be forgotten that accumulating, saving, and applying manure, is as serious a business of the farm as making corn or cotton. At the end of the fifth year of this rotation the change in the farm would be equal almost to a transformation, the crops being doubled or trebled, without (which is a most important point,) any material increase of labor or other expense. This improvement of the soil, accompanied at first by moderate profits, and with a great diminution of vexations and unreliable labor, should be the great end of the Southern planter. It involves a double profit from increased production and increased salable value of the soil.

ROUND-UP. This is a term used by herdsmen, for the gathering together, at regular seasons, the vast herds of cattle in Texas and on the great plains of the West, for the purpose of identification of stock and the branding of young animals. In the article Landed Estates and Farms, on page 550, is given a graphic illustration of a round-up.

ROWAN-TREE. The mountain ash, (*Pyrus aucuparia*).

ROWEL. A seton; also the sharp wheel of a spur.

ROWEN. A name for after-math hay.

RUBBING-POST. An appendage sometimes found in feeding yards, but a poor apology for the curry comb, or card.

RUBBLE-STONE. Fragments of brickbats, loose stones, etc.

RUBEFACIENTS. Substances which produce redness on the skin without blistering.

RUBIGO. Rust in plants. (See *Uredo.*)

RUDDLE. An ochreous clay, reddle.

RUE. *Ruta graveolens.* A fœtid shrub; the leaves are reputed as of use as an antispasmodic. It grows readily in a clay soil without manure, and is propagated by slips.

RUMEN. The paunch, or first stomach, of ruminating quadrupeds

RUMINANTS. Animals having four stomachs, having parted hoofs and which chew the cud. The ox, sheep, deer, and camel are well known ruminants. Rumination is the act of chewing the cud. In feeding, the animals simply gather the food, and swallow it without greater mastication than simply to moisten it, and work it into masses fit for swallowing. It enters the first stomach, is moistened still further in the second stomach, is worked and moulded into balls, raised again to the mouth by regurgitation, leisurely chewed, and swallowed, this time, entering the third stomach, and in the fourth stomach, it is digested. Ruminant animals require leisure for the act, and rumination being interrupted the animal may be known to be out of health.

RUNCINATE. In botany, hooked back, or curved in a direction from the apex to the base, as the lobes of the leaf of the dandelion.

RUNNER. The stolon, or running stem, as in the strawberry.

RUNT. A variety of common pigeon; small black cattle of Wales and Scotland; decrepid pigs.

RUPTURE. A hernia or sinking of the bowels through, so as to form a large, soft tumor. (See Hernia.)

RURAL ECONOMY. The management of all things pertaining to the farm.

RUSHES. The family of sedges, called by botanists *Juncus* and *Scirpus,* growing in rich wet lands; they are destroyed by draining, tillage, and liming. Rushes make excellent mats, coarse basket-work, and bottoms of chairs.

RUSSIAN CATTLE. In Russia there are no distinctive breeds of cattle that have been considered of sufficient good form and substance to warrant importation into the United States. They are principally long-horned, large-boned, rough cattle, better in hide and tallow than meat. The vast plains of the Ukraine, and other inter-Russian southern provinces, furnish grazing grounds for great herds of cattle. The principal races there are enumerated as follows: The Ukraine; Wallach, or Podolian; Little Russian; Donian; and the Black Sea breeds. All these denominations are local; but the original character, which nearly resembles that of the Hungarian race of cattle, has been preserved. They are distinguished for their strength, adaptation for field labor, and facility of taking on flesh and fat. The latter singularity consists in the fat not growing so much on the outside, but penetrating the flesh itself, rendering it juicy and more delicate, especially when the beeves have been fed in the rich prairies of the Caucasian line. It is for this reason that butchers in large towns give preference to this beef over that of the other cattle. The cows, however, yield but little milk. This breed is to be found from Podolia to the Ural, but the finest type is found at Karlowka, in the goverment of Poltawa. It is also met with in some places in the province of Ekathérinoslaw, near the river Samara, and further northward in the provinces of Little Russia, but of not so fine appearance, from the want of good keeping. The Kalmik breed is intermediate between the Ukraine and Russian races. It is of small size and fine flesh, and is able to endure any change of climate. All the year round, such cattle can live on the steppes, and during winter subsist on grass, which they obtain from under the snow, except when, after rain has fallen and the snow is frozen, they can not break through the ice, and are deprived of food. In many districts of country on the Don, the inhabitants prefer this race to the Ukraine, though they are less valuable for the purposes of the dairy and for labor. The Russian race, properly so called, has no peculiar characteristics, as its original type is not easily to be distinguished. In general, the cattle of this race are ill-shaped, diminutive in size, and not well reared. They are found in the middle, northern and western provinces, where they are kept for their milk. In the province of Wologda, and in the vicinity of St. Petersburg, this race is improving from better management. To the above races may be added the Lithuanian breed, which is small, but strongly built, giving an abundance of milk. Among the foreign races introduced into Russia is the Cholmogory breed, of Dutch origin, distinguished by its fine form and good milking qualities. It is found pure only in the districts from which it takes its name, in the Government of Archangel. The heavy bodies of the oxen render them unfit for labor. In general, the cows require good keeping and great care, so that the expenses of their support are rather excessive, which must be redeemed out of the proceeds of their milk. The Foigtland race, introduced into some districts of the Baltic provinces, is remarkable for its medium size and fine appearance. The cows content themselves with a rather common food, and give plenty of milk. The oxen are well adapted for work. The Frisland race begins to be multiplied among the Mennonite settlers of Molotchan. The cows produce a fair yield of milk. The Tyrolese, Scotch and English breeds have been introduced and acclimatized in the provinces of the Baltic. The Swiss breed is extensively diffused, as is also the Tyrolese, in the kingdom of Poland. A cross between the Cholmogory and the indigenous breeds is also found in some districts of the government of Archangel, as well as those of Wologda, Kalouga, Twer, Kostroma, Jaroslaw, and in the districts near the capitals.

RUST. 1. The oxydation of any substance through the action of the oxygen of the air on its surface, in connection with moisture, or during that portion of the day when the atmosphere is moist. Articles do not rust readily when in motion, and bright surfaces withstand the action of rust more easily than others. To prevent rust, a coating of oil, or better, lampblack and oil, should be used on the iron surfaces of planes and other implements when not in use 2. Rust as applied to vegetation, is the effect of fungus in connection with heat and moisture. The rust in wheat is usually produced by a fungus known as *puccinia graminis;* blight, smut, or brand, by *Uredo segetum,* the dry rot of timber is caused by the fungus *Merulius lachrymans.* etc. The natural remedies against rust are dry air, and circulation of air.

RUSTIC-WORK. In building, a term applied to work jagged out into an irregular surface. Work, also, which is left rough.

RUT. To cut a line on the soil with a spade. The copulation of deer in the rutting season; the track of a cart-wheel.

RUTA-BAGA. *Brassica campestris vars.* Known also as Swede, Russian, and French turnip. A biennial plant forming its large, fleshy bulb the first season, and maturing its seed the second. It is extensively raised throughout Northern Europe, and in Great Britain as part of the rotation, and as food for cattle, sheep, and for culinary use. In the United States it is not much raised, only for culinary use, except in some portions of the Eastern States. It is much better adapted to the climate of the United States than the common turnip, though except in the extreme North the bulbs are apt to be long necked and tough. This, however, does not naturally injure them for feeding. For stock, the seed should be sown in rich soil, about the middle of June, at the rate of about two pounds per acre, in drills two feet apart, and thinned to six inches in the row. They must be watched when young for the ravages of the turnip fly, and dusted with dry ashes, soot, or sulphur and flour when the dew is on. The cultivation simply consists in keeping the ground mellow as to its surface, weeding, and thinning the rows. Just before the ground freezes they must be pulled, their tops placed together in double rows, and cut with a sharp spade, then the bulbs stored for winter, in a cold cellar, or in slightly covered pits, but so they will not freeze severely.

RYE. *Secale cereale.* Rye forms a rather unimportant product of American husbandry. It is but little used for bread; Indian corn has usurped its place for distilling, as it has for one other of its important uses in some of the Eastern States, notably Pennsylvania, as food for horses. In the northern parts of Europe, especially Russia and Germany, it is the principal bread grain of the inhabitants. In the United States its cultivation is principally to furnish green forage, except in the extreme North, and upon some sandy soils not so well adapted to the cultivation of other grain. The proportion of rye raised in the United States is as one to fifteen of wheat, and as one to seventy-five of Indian corn, in bushels, per year. It is usually sown broadcast, in October, at the rate of one and one-half bushels per acre, or if drilled, at the rate of one bushel per acre. For late fall and early spring feed, it is often sown among corn at the last cultivation, or if not then, in August, between the rows. The average price of rye per bushel ranges from seventy-five cents to one dollar, the yearly export varies between 200,000 and 500,000 bushels yearly. In 1873-74, however, there was exported 1,568,362 bushels, at an average value of one dollar per bushel, and 59,820 barrels of rye-flour, valued at $6.50 per barrel. As a forage crop, it is superior, and is adapted to a great variety of soils not really wet. The best grain for flour, however, is raised on rather dry, sandy soils.

RYE BROMUS. (See Chess.)

S

SACCHARIC ACID. An uncrystallizable acid, produced by the action of nitric acid on sugar. Its salts are called saccharates.

SACCHAROMETER. An implement for taking the specific gravity of syrups and worts for brewing, etc. Baume's hydrometer is chiefly used.

SACCHAROULMIN AND ULMIC ACID. A brown, brilliant substance obtained by digesting sugar for a long time in dilute nitric or sulphuric acid.

SACCHOLACTIC ACID. Mucic acid is obtained by treating sugar of milk with nitric acid.

SAC OF THE EMBRYO. In botany, the small enclosed body in which the embryo is placed during its growth.

SACRUM. The lower portion of the spine.

SAFFLOWER. (See Saffron.)

SAFFRON. A bulbous, perennial plant, *Crocus sativus,* growing wild in Sicily. The stigmas, or pistils of the plants are collected and kiln dried, and pressed into cakes for use in medicine. It is now not much esteemed. Safflower, or bastard saffron, is an annual plant, *carthamus tinctoria,* the deep red fecula of the flowers forming the colors known as Spanish red and China lake. The meadow saffron belongs to the genus *colchicum.*

ST. JOHN'S WORT. *Hypericum.* The common St. John's wort, *H. perforatum,* is too well known to need description; an acrid and pernicious weed, difficult to extirpate. There are many species, none of them of any value. *H.*

corymbosum, a southern species, has some merit as an ornamental plant, blooming early in the spring at the South, flowers yellow, berries red. In 1861, 3,000 plants were distributed by the Department of Agriculture, Washington. Fortunately it did not prove hardy at the North, and hence that section escaped acclimating another weed.

SAFFRON, MEADOW. Colchicum.

SAGAPENUM. A fœtid gum resin from a species of ferula.

SAGE. *Salvia.* A class of plants containing many species of value, whether we regard it medicinally, as a condiment, or for the splendor of its flowering varieties. As a gargle it is most useful. In China it was once regarded with favor, being used as we use tea, holding a large trade between Chinese and Dutch merchants. The old monks would seem to have thought it a specific for all human ills. Now-a-days it is but little used, except as a gargle, and for flavoring cheese, sausage, etc. The broad-leaved, green sage, Balsamic sage, is esteemed for medical uses, and the narrow-leaved, green sage, Sage of Virtue, is the mildest in flavor. The variety most generally found in gardens is the red-leaved, and the green-leaved sage, *Salvia officinalis.* The cultivation is simple. The seeds should be sown in a gentle hot bed, early in spring, and transplanted, when large enough, in rows twenty inches apart by twelve inches in the row. Keep clean from weeds and cut when in bloom for use. The plants must be covered in winter, since they will not survive freezing and thawing. Thus the bed will continue to produce several years, but it is better to renew the plantation every three years. Another plan is to sow in drills, in May, and thin to the requisite distance, but the plants will be much weaker, and are not apt to furnish a cutting the first season. A subvariety of the common, green, leaved sage, and also of the red-leaved variety, have handsome variegated leaves, and must be propagated by cuttings under a moist heat, as indeed may the other varieties. None of the species, however, are entirely hardy in the West. The flowering varieties are splendid objects, and flourish admirably in the open ground in the West, from June until frost, being covered with a profusion of flowers in August and September. *Salvia splendens*, and *Alba* are the varieties most cultivated, the first-named is red, the second white. *S. gesneriflora* is a soft-wooded labiate, and a most elegant decorative ornament for the greenhouse and conservatory, growing from two to three feet high and compact, the leaves a bright, rich green, and well clothed with abundant deep scarlet flowers, during the whole winter and spring.

SAGITTATE. Shaped like an arrow head, as the leaves of some water plants.

SAGO. A starchy farina from the pith of several palm-trees, as the *Sagus farinifera, Rhumphii*, etc. It is a good, wholesome food, and much esteemed for puddings and gruel. In England, a gruel of ságo is often given to horses after a hard run. The Florida arrow-root is a kind of sago obtained from the pith of the *Zamia integrifolia* and *pumila*, indigenous plants.

SAL AMMONIAC. A salt of ammonia much used in the arts. Very soluble in water, and has been used as a steep; one pound, added to one gallon and a half of water, is sufficient for one bushel of seed. A small amount of it exists in putrescent fluids.

SALEP. The farinaceous product of the roots of the *Orchis mascula.*

SALICIN. A neutral crystalline body existing in willow bark.

SALICYL. A hypothetical compound radical, existing in salicylous acid, etc., bodies derived from salicin.

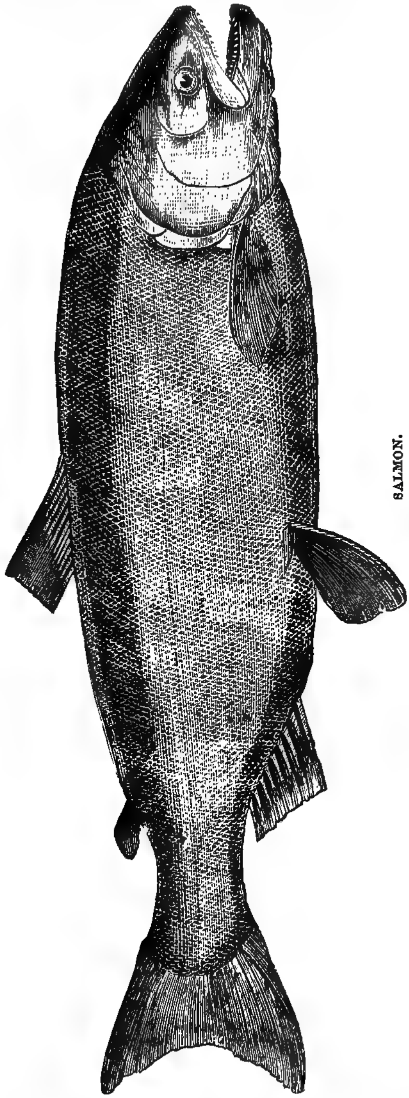
SALIFEROUS. Containing salt; a name given to the new red sandstone formation.

SALIFIABLE BASE. A substance which combines with acids to form salts.

SALIVA. Spittle. It is prepared by the parotid and other glands, and mixed with the food during mastication. According to Liebig, it is a means of introducing oxygen into the stomach to accomplish the first step in digestion.

SALIVATION. An excessive discharge of saliva, slobbering; change of food, with salt, are preventives in cattle.

SALMON. The salmon, as a fish for artificial breeding, has of late years attracted much attention, and they have been successfully transferred to many of our deep and larger waters. The author of American Fish Culture gives full information in relation to the habits of this celebrated fish from which we extract the following: Salmon commence to make in toward the rivers from which they migrated at rather a later period than shad. Of course those of a more southern latitude are earlier comers. On the Bay of Fundy, for instance, at St. John, N. B., some are taken in May, in June they are abundant. If they are introduced in the Hudson and Connecticut they might, doubtless, be taken in Long Island Sound and in the lower bay in April. They continue to come in schools and ascend the rivers all summer, the earlier comers being the earlier spawners, while the late spawners frequently remain in the river all winter, and go to sea in the spring. The latter, as has been ascertained in Scotland, may not spawn the ensuing fall, a period of two years expiring before they reproduce. From the information gained in the British Provinces, I am of opinion that there is only one, and that an annual, migration of the same fish to and from sea on this side of the Atlantic. This is necessarily the case, as most of the rivers are rigidly closed with ice for some months, and many of them for half of the year. On the coast of Great Britain, where the rivers are always open, their migrations occur nearly every month; still there is a throng time when the greater number enter fresh waters. Smolts and grilse have frequently been marked and have gone to sea and returned in six or eight weeks. In Ireland there are fresh run fish in January and fair fly-fishing in February. In the rivers of the British Provinces north of us there is also what may be termed a throng time. This is generally when the first schools come in. In some rivers they are found at the lower rapids within a week (earlier or later) of the middle of June, and in others, even of the same latitude or district of country somewhat later. There are different runs up to the middle of September; the schools being influenced by easterly storms to enter the bay, and by a rise in the river to ascend. Unlike the shad, which are deterred or driven back by a freshet, salmon seem to delight in a heavy rise, after which, there is always good fishing as the water clears. When a school of salmon, coming from sea, reaches a



SALMON.

bay or the mouth of a river entering the sea, some weeks are occupied in working up toward the head of tide, the fish in the meanwhile undergoing a change of system which fits them for their habitation while in the fresh water. During this time they feed on smelts, sparlings, and other small fish as well as crustacea. After entering fresh water no food is to be found in their stomachs; notwithstanding, they will rise occasionally at a natural or artificial fly, and will sometimes take a worm bait. In their journey upwards they generally linger on the way, at the foot of many a rapid or just above, until they reach their native spawning-grounds, or go beyond. They lose the silvery brightness which they bring from sea, and continue to grow darker and fall off as the summer advances. A fish that was a twenty-pounder, when fresh run, in three weeks will be one of seventeen pounds, and so on to the time of spawning, when they have lost half of their weight and are scarcely fit for food. If their native water is some inconsiderable brook, which is frequently the case, they will wait for a rise, or wriggle over shallows scarcely the depth of their bodies. When the young salmon frees itself from the shell it is about three-fourths of an inch long, and has the same umbilical sac which we observe in the fry of brook trout. This it carries for about six weeks, during this time it refuses all food. As soon, however, as this sac is absorbed, its predaceous instinct is observed, rising eagerly at the smallest insect or atom, and seizing animalculæ beneath the surface. In pisciculture the food of the fry is much the same as those of the trout. Although the incubation of salmon ova is similar to that of the trout in breeding them artificially, the manipulation of the fish is different on account of the large size and vigor of the salmon, requiring two and sometimes three persons to perform the operation. If the fish is held pendent by the head, the ova, if mature, will distend the lower portion of the abdomen, and some of it flow without pressure; and this, from all we can learn, is the position in which the salmon is generally held when it is being operated on. The young of the salmon, as long as it retains what are known as the finger-marks on its sides, is called a parr. When these marks are no longer visible, and it assumes a silvery coat, it is a smolt, and is sufficiently advanced for its first migration to sea. On its return, which may be after six or eight weeks, or not until the following summer, it is a grilse, its average weight being about four pounds. After its second visit to its marine feeding-grounds, it is a salmon, weighing from eight to fifteen pounds. Immediately after spawning it is called a kelt, or a black fish; the latter appellation is given to a fish that has spawned and remains in the river for any length of time, which generally occurs in the winter months.

SALLENDERS. (See Mallenders.)

SALSIFY. Vegetable oyster, (*Tragopogon porrifolium.*) This is one of the most valuable of esculent roots for the kitchen garden, as hardy as parsnip, and like that plant may be left in the ground all winter. It should be sown as early in the spring as possible, and requires the whole season's growth. The soil must be deep, mellow, and fertile, as for all the spindle-shaped roots. Sow in drills two feet apart, and thin to about five inches in the row for large roots. It is a perennial, seeding the second year, and has rather handsome flowers. The root is the part used, after the first year's growth, in the winter and early spring, but the tender shoots of the second year's growth, when six inches or less high, are sometimes used as a substitute for asparagus. The roots cooked have the reputation of being good for persons inclined to diseases of a wasting nature as consumption. It is cooked as follows: After the roots have been scraped, and laid in water for several minutes to abstract a part of the bitter flavor, it is to be boiled tender, and either cut in thin slices, or grated and pressed into little cakes, of the size of oysters. Dip the slices, or cakes, into a batter made of wheat flour, milk and eggs; roll them in crumbled bread or crackers; and then drop them into hot lard. When of a light brown color, they are sufficiently cooked, and ready to be carried to the table. Or they may be sliced, cooked tender in milk, and served on toast.

SALT. *Chloride of sodium.* Chemically, salt is a compound of one atom of chlorine and one of sodium, and occurs naturally in every part of the globe as a rock, interstratified with marls, sandstones, gypsum, etc.; also as an element of springs and salt lakes; Salt Lake, in Utah, being the most remarkable of this latter, its water being a saturated solution of salt. The proportion of the constituents of salt are chlorine, 60.4 per cent. and sodium 39.6 per cent. Its impurities, as found in rock salt, are gypsum, oxide of iron and clay, chlorides of calcium, potassium and magnesium, and sulphates of soda and magnesia. The ocean contains notable quantities of salt, and is one principal source of the supply of salt by evaporation. A peculiarity of salt is its power of transmitting heat, clear rock salt transmitting ninety-two parts out of one hundred, while plate glass transmits but twenty-four parts. Salt is the only mineral substance universally regarded as an article of food by man, and the higher orders of the animal kingdom. As a preservative also it is indispensable, and as a manure it is of growing importance, especially in inter-continental climates. In the United States, the principal sources of supply are from the salt springs of New York State, and those of Michigan, though more or less salt is manufactured in various States. In 1797, the first salt was made at Onondaga, New York. At least that was the first date of the lease; 25,474 bushels were manufactured in that year. In 1849, the amount was 5,083,369 bushels; in 1855, it was 6,082,885 bushels. Since then the quantity has fluctuated above and below these figures. Since 1860 the salines of Michigan have supplied the West with a large and increasing quantity of salt. The three principal salines of Michigan are the Salina, the Michigan salt group and the coal measures—of these the Michigan salt group supplies the largest number of productive wells. These salines lie at an average of about 800 feet, the brine being often at or near the saturation point, and practically inexhaustible.

SALT MARSHES. Marshes washed by sea water; the herbage is coarse, but often very nutritious, and preferred by cattle.

SALT OF LEMONS. Binoxalate of potash, used in removing iron mold from linen.

SALTPETRE. (See Nitrogen.)

SALTS. Chemical compounds, which are usually (oxysalts) formed of a base and acid, and possess neither acidity nor alkaline action. Haloid salts are those which are binary, containing a metal in combination with an electro-negative element

SALTWORT. The genus *Salicornia*, which grows on salt marshes; the ashes yield barilla.

SALVE. An ointment.

SALVER-SHAPED. Hypocrateriform. A monopetalous corolla, with a long tube and spreading limb at the top.

SAL VOLATILE. Sesquicarbonate of ammonia, or smelling salts.

SAMARA. An indehiscent, few-celled seed, with an expansion of tissue resembling wings, as the pods of the ash and ailanthus.

SAND. Finely divided silicious matter usually constitutes common river and sea-sand; particles of other substances are often blended with it, and sometimes it becomes calcareous from the prevalence of carbonate of lime. Sand is sometimes employed as a divisor by the cultivator of poor, hungry clays, especially if the sand be calcareous. (See Soils).

SANDAL WOOD. *Pterocarpus santalinus.* Red saunders, a dye wood, but giving fugitive reds.

SAND BATH. A quantity of sand heated by a flue, and used in the laboratory.

SAND-CRACK. Sand-crack is a fissure in the hoof, which begins at the coronet, the thin edge first breaking away. It is a disease of nutrition, the horn of the foot being secreted in diminished quantity and impaired quality. The break, small at first, is extended until it may divide the entire hoof. It usually occurs in the quarter, and perhaps most frequently at the inner quarter. It has been asserted that the whole difficulty is produced by bad shoeing. Low condition, impure state of the blood, and lack of care are predisposing causes. In this conjuncture slight injury to the coronet may be followed by such deficient secretion of horn at that place, that the weakened part may give way and sand-crack take place. If possible, the animal should be given entire freedom from work, and should be turned into a small paddock, or have a loose box, in which he may move somewhat. He should have nutritious food, and sufficient green food or bran mash to keep his bowels free. During the early stages of the disease, and while efforts are being made to restore the soundness of the foot, the horse is better without shoes, as the natural movements of the parts tend to restore their vitality. The bar-shoes, recommended by some writers, are useful only in those cases of long standing which are essentially incurable, and where the horses are to be put to slow work. The part should be interfered with as little as possible; there should be no cutting, paring, or burning; and care should be taken to keep dirt, gravel, etc., from the open sore. The healthy condition of the open and granulating surface should be maintained by frequent washing with soap and water, and the application of the solution of chloride of zinc, three grains to the ounce of water. If the animal is in use, before being taken out the crack should be filled with lint saturated with the solution, which should be confined in place by a strip or cloth completely covered with tar. This should be removed as soon as the horse returns, and the wound be cleansed, if it is at all foul, and carefully dressed again. If treatment is commenced early, a fair degree of expectation of recovery may be entertained; but, in many cases, through neglect or lack of proper treatment, a permanent deficiency of the hoof remains. In such cases, by the use of a bar shoe, properly adjusted, the animal may be made of some use.

SANDSTONE. A rock made of sand cemented together, or merely compressed together.

SANDWORT. Plants of the genus *Arenaria;* they are succulent and harmless.

SANFOIN. *Hedysarum onobrychis.* A perennial forage plant, native of Europe, up to latitude 51°, a legume which has the property of binding light, dry, sandy and chalky soils, by its roots. English and continental writers agree as to its nutritious qualities for stock, and also as to its value as a crop to shade the soil and for plowing under. It has been tried from time to time in the United States, both North and South, but has not met with favor in any locality. In the North it winter kills, as it does in the West. In the Middle States it can not compete with clover, and in the South it is reported to be feeble in growth.

SANICLE, SANICULA. A genus of umbelliferous weeds.

SANIES. A thin, fœtid discharge from sores.

SAP. The circulation of the sap of plants has been the cause of many elaborate theories, each of which in turn has been exploded. Indeed, but little is really known of the precise causes acting in this abstruse problem. Prof. Burrill, of the Illinois Industrial University, who has given much patient attention to the subject of vegetable physiology, (see Vegetable Physiology,) in a lecture before the Illinois Horticultural Society, in relation to sap, stated as follows: The movements and office of sap in the plant have always been interesting topics in vegetable physiology. The physicist, observing the rise of fluids through small tubes by what is called capillary attraction and being also acquainted with the force exerted by liquids of different densities through membranes, (called osmosis,) readily satisfies himself that these are sufficient to account for the rise of the sap in the woody structure of plants. With his laboratory experiments to start upon, he soon learns to modify them sufficiently to meet and explain the ordinary indications of motion of fluids in the tree. Now, it is certainly true that these fluids do not move without some kind of mechanical force to cause them to do so. Being lower in organization than the animal, we might naturally suppose that the forces of the inorganic world would have more direct application in the plant than, for instance, in man, yet we believe the blood is propelled through our bodies by a sufficient mechanical (or chemical?) force. Though the vital powers, whatever they are, preside over and cause the contraction of muscles, the act in itself is a mechanical one, controlled by the laws, as to limit of power, etc., that apply to dead substances. Without material substance to work through, the will or life force, if that term is more suitable for us, can not cause blood or anything else to move through our organs. Then, it is inconceivable that vitality, separate and apart from the laws of matter, can cause the sap to move regularly or irregularly through the plant tissues. There must be somewhere and somehow a power behind the throne. There must be a reason, and a sufficient one, for water, whose course is usually down hill, to change its direction and flow vigorously upward in spite of the down-hill tendencies of gravitation Do, however, the physical laws before cited and the others generally advanced meet the case? Does sap move because of capillary attraction, or of *osmosis*, or of both combined, or from evaporation from the leaves? There are evidences to the contrary. It is found that the fluid passes through the cells and not through tubes, so that the notion of capillary attraction is not consistent with the fact. It is likewise found that two plants, standing side by side, begin to send up from the roots water at very different times and under very different conditions. According to President Clark's experiments at the Massachusetts Agricultural College, each species of tree from which sap flowed upon puncture had its own time of beginning and maximum. Thus the sugar maple begins to flow in October, reaches its maximum about April 1, and ceases about May 1. The black birch begins about the last of March, reaches its maximum the last of April, and ceases about the middle of May. The grape has similar dates in May 1, May 20 and June 1. These experiments accord with our own common observation as to the difference of leafing in different species, but, it will be noticed, are not parallel with them. The maple is not very forward in showing its leaves in the spring, though ahead of all other trees in the flow of sap from a wound. There are other things of similar import which might be adduced here, but with this alone, how is it possible for us to hold to the idea that *osmosis*, the term applied to the passage of fluids through membranes, causes the gorging of the trees in spring time? Neither is it evaporation from the leaves, for at this season of the year there are no leaves. We indeed have reached a partial explanation, but it may as well be confessed that we do not know all about it. The physical laws to which the phenomenon is generally attributed may be in the main the immediate cause, but, if so, they are controlled and directed by a something else. There is, furthermore, no positive clew to the cause of another motion of the fluids in plants, so far as my information goes; I mean the rotation that takes place in an individual cell. The plant, indeed, has a maze of motions going on in its tissues, of which we should be totally ignorant were it not for the microscope. It is more than possible that even this instrument has not revealed all to us yet, and that future investigators will wonder at our ignorance and blindness. But the practical thing here is to so manage our plants that the movement of sap can take place freely. If we had all the facts, doubtless this could be better done, for it is groping in the dark to find how before we find why. This is evident: if fluids are to pass through cell walls, the thinner the walls are the easier the passage. Then, from what we know of the plant growth, the newer these cells are the better this flow. The movement takes place more freely in a young shoot than in an old trunk, and this is the philosophy of the rapid growth seen in sprouts from the side of a tree, and is also a good part of the so-called pruning for vigor. A branch once started to growing rapidly has an advantage over the less fortunate ones, even though afterward having an equal supply of food. A plant from a good seed, capable of throwing out a vigorous shoot, will distance its fellow from a smaller seed far beyond the difference in the food supplied. So, too, when a plant wilts from lack of moisture, the cell structure may be so impaired as to prevent ever after full, healthy action. A tree checked in its growth by transplanting has much more to do than to restore its mangled roots. The whole structure has to be surrounded with new tissues before the normal action is restored. It is not, then, a simple question in transplanting as to what percentage live, but how well they live and perform the first year the full functions of growth. Why, it may now be asked, all this motion of the fluids upward, downward, sidewise, endwise, and around, repeatedly, the confines of a cell? In the higher animals, there are vessels for a regular and continuous flow, and until recently it was supposed the plant juices made a similar circuit from the root to the leaves, through the wood fibers, thence downward through the bark and adjoining tissues. But analogy often leads us wrong. While there may still be something in this specification of tissues in plants, there is certainly nothing comparable to the organs of animals. The latter have a double railroad track, so to speak, upon which freight trains pass and repass without colliding; but the plant gets along, for the most part, with one, switching and backing and jostling, now making time one way, now the other. The change of water and dissolved inorganic substances into sap is another of the mysteries connected with the physiology of plants; but it is believed, upon good grounds, to be effected only in presence of the chlorophyl or green portion of the plants; hence, the material entering the root must in the main reach the leaves, and of course the immense evaporation from the leaves must be supplied by the root. Here, then, is cause enough for motion and reason enough for poor growth, when by any means the fluids are not given the fullest freedom. It is true that the materials which enter the root are forthwith changed to some extent, being no longer simply water and earthy salts; but whether the root itself has any power of changing these newly attained elements is an open question. Since the root has sometimes different properties from the rest of the plant, it is argued that it does modify the food elements; but if so, it is a very different thing from that which takes place in the leaves. The green tissues, in the sunshine, rend asunder the particles bound by chemical ties, working against their ordinary affinities, and make them over anew. The chemist, in a well equipped laboratory, accomplishes wonderful things, but fails utterly in competition with a leaf. This is the function of plants, the one property that gives them value to us, and the one alone that makes them indispensaable to our use, and the one end as well toward which all the motion and commotion in the structure is directed. Maturing and ripening are only other terms for the completion of this work, and are very different things from simple cessation of growth. A large leaf surface and recent and healthy cell structure are, therefore, the requirements of plant culture.

SAPAN WOOD. A dye wood resembling Brazil wood.

SAPHENA. The large vein of the thigh.

SAPROPHAGANS. A tribe of coleopterans, many of which feed on decaying matters.

SAP SAGO CHEESE. Zapzeiger. A Swiss cheese, flavored with Mellilot.

SAP-SUCKER. The word sap-sucker is incorrectly applied to various birds of the woodpecker family, indeed, to any birds thought to be addicted to sucking the sap of trees and plants. The only true sap-suckers are insects of the so-called louse family, aphis, bark louse, mealy bug, red spider, etc. The woodpecker tribe, with one exception, are all innocent of any damage to trees, except so far as may result from the necessary endeavor to extract borers and other insect depredators. This exception is the Yellow-bellied woodpecker (*Picus varius*), known by the bright red spot on the head, and in the male also on the throat. The nuthatches have been ignorantly called sap-suckers by a majority of farmers. They are among the most beneficial of birds, as insect eaters. The name sap-sucker should be discarded by all. Bark-eater would be a more appropriate name, since it is on the cambium, or inner bark, that the Yellow-bellied Woodpecker principally lives, yet to their credit it must be said that in the stomachs of birds shot, together with vegetable matter, have been found the grubs of boring beetles, the beetles themselves, and ants.

SAP WOOD. The alburnum, or new wood.

SARCOCELE. A tumefaction of the testes.

SARCOCARP. The fleshy substance of fruits.

SARCOCOLLA. A kind of gum.

SARMENTUM. A runner, as the strawberry.

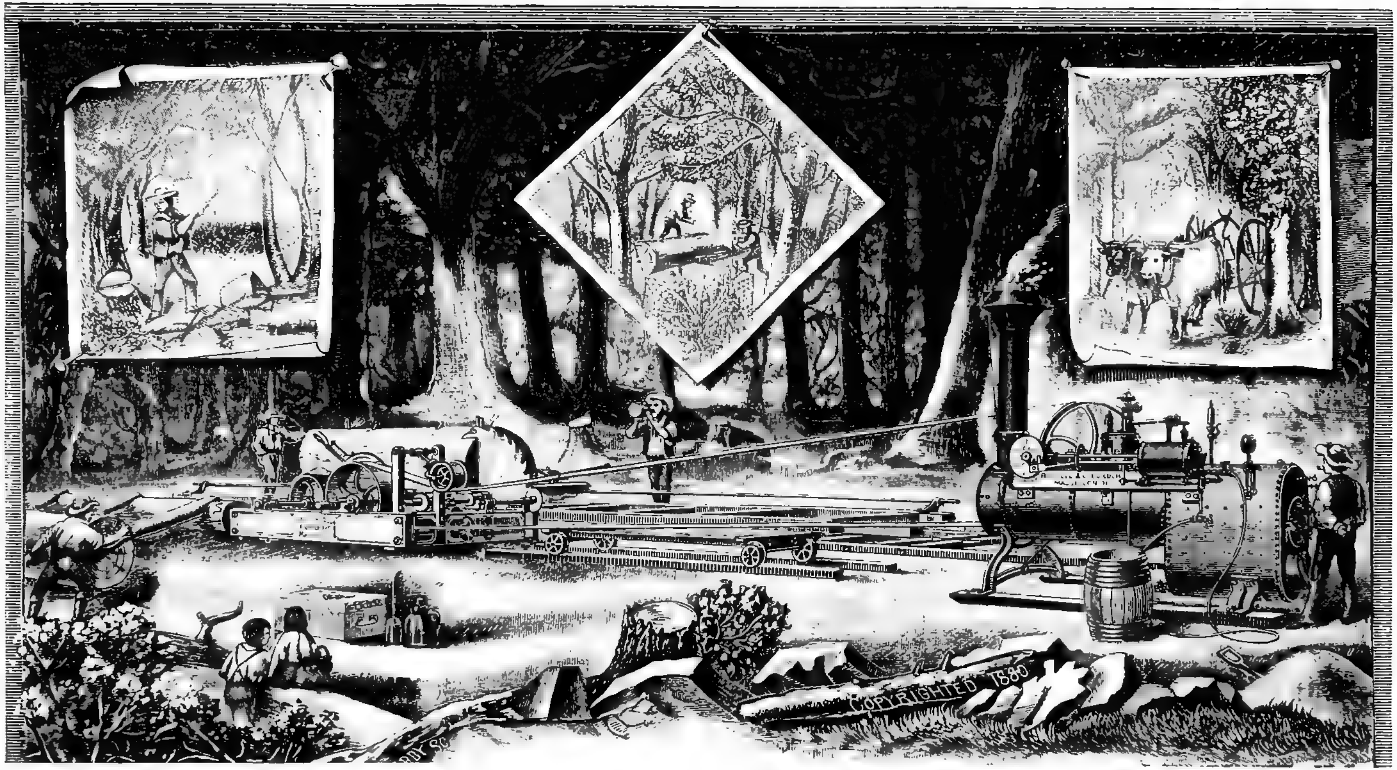
SARSAPARILLA. The roots of several species of Smilax growing in tropical America; the decoction is used as an alterative.

SASH. In building, a piece of framing for holding the glass in a window. It is of two sorts, viz., that called the French sash, which is hung like a door to the sash frame; and that in which it moves vertically, from being balanced by a weight on each side, to which it is attached by lines running over pulleys at the top of the sash-frame. When, in a window, both the upper and lower sashes are movable, the sashes are said to be double hung, and single hung when only one of them moves.

SASSAFRAS. *Sassafras officinale.* The sassafras is widely distributed over the United States, but attains its best development south of 40° and in rich bottoms. It is hardy up to the northern line of Illinois. In Southern Illinois it has attained a size of two feet in diameter, and in the extreme south has been found much larger. The wood fine grained and durable, is said to be vermin proof. The bark of the root is less used now than formerly for its supposed blood purifying qualities. It is propagated by seed or suckers. If by the seed, it is better sown in boxes placed on the north side of a fence and kept moist, since if planted in the open soil it does not always vegetate the first year.

SATURATION. A chemical expression, signifying either that no more of a given substance, or salt, can be dissolved; or that, in a compound, the combination of its parts is complete or saturated.

SAUERKRAUT. Cabbage sliced thin and packed closely in barrels, with salt, and sometimes spices, is called sauerkraut (sour krout). It was formerly one of the specifics against scurvy in long sea voyages, but modern improvement has given better agents, and it is now but little used. It is still, however, regarded with favor as an article of diet in many parts of the country, and is prepared as follows. In October, or before severe frosts, the cabbage is to be cut from the stumps, the outside and loose leaves cut off and the heads quartered and thrown into a tub of clear water, from which they should be taken, one piece or more at a time, and placed in a small box, open at top and bottom, and running in the grooves of the krout machine, which is about four feet long, one foot wide, and six inches deep. The box runs over three or four knives, sometimes made of old scythes, fixed



SAWING TIMBER IN THE WOODS.

diagonally across the bottom of the machine. The edges of the knives are slightly raised above the level of the bottom, and when the box is moved backward and forward in the grooves, and pressure made with a small piece of board on the cabbage, the latter is cut into thin, small slices, which drop into the tub beneath the cutter. As the cabbage is cut, it is transferred to a clean barrel (a pork barrel is preferable) and pounded with a heavy wooden mallet. The more closely it is packed the better; and, with care, from 250 to 300 pounds of cabbage may be put into a barrel of forty gallons. One pint of fine salt to the barrel is sprinkled with the cabbage as it is packed down. No addition of water is required. Fill the barrel to a point two inches from the top, cover the krout with large cabbage leaves, and place over the whole a wooden cover small enough to be inserted within the barrel, where it must be kept firmly, by a heavy stone, until the process of fermentation is past. Place the barrel within five or six feet of the kitchen fire, and in a few days fermentation will commence, which may be hastened by the addition of a little blood-warm water; a frothy scum will rise and run off, when the krout is all right and ready for use, and the barrel may be set in the cellar, porch, or shed. Freezing does it no injury, and it will keep in the cellar until March or April without depreciating, and longer in a cooler place. A barrel of krout can be made in two hours by two men. There are various modes of cooking it, while some prefer it raw, eating it as a salad. It is frequently boiled, three hours or more, with salt pork cut into small pieces. Perhaps the nicest style is to fry it in pork fat or with the gravy from roast pork. For frying, it should be boiled two hours to make it tender. It is a wholesome, hearty food, and is particularly appreciated by men requiring a substantial diet, while it is also relished by many of more fastidious taste.

SAVING AND APPLYING MANURE. The value of manure lies in its soluble parts, except in so far as its mechanical action may change the condition of the soil. So, the value of any given soil, aside from its mechanical texture, is contained in its soluble parts given up through vegetable decompostion, or the chemical action and re-action constantly going on through the growing season. Arthur Young, the celebrated English agricultural writer and experimenter, years ago took five equal portions of a field. One portion of this he manured with dry cut straw; a second with straw soaked five hours in strong urine; a third soaked in like manner for fifteen hours; a fourth treated for three days; to the fifth plat he added nothing. The whole field was plowed alike, sown with grain, and treated alike. The grain product of the first plat was thirty-nine; of the second, fifty; that of the third sixty-three; of the fourth 126; and of the fifth, that left without manure, only nine of grain. The weight of grain and straw in the several portions in the order as before named, was 100, 120, 300, and 48. The straw undoubtedly had some mechanical effect, but could have rotted only so partially as to have produced little effect upon the crop except from its soluble portion. Thus the wonderful effects of manure from this experiment, was due chiefly from the liquid manure with which the straw was saturated; in the extreme case giving in weight of grain as nine to one hundred and twenty six, or thirteen times; that of straw and grain was as forty-eight to three hundred, or six-and-one-half times. The lesson here taught shows: If manure is worth anything it is worth saving in the best manner possible. In other words, it should not be allowed to lie about the yards and run to waste, as is too often the case, especially in the West. In the West especially upon our ordinary nary prairie clays and loams, the sooner manure is hauled upon the land the better. It should be applied to corn, potatoes and other gross feeding crops, in its green state, and, principally from the reason, that thus we get the full benefit, both of its mechanical effects upon the soil through decay, while at the same time it is giving up its soluble properties to the crops tilled. When green, also, it contains a minimum amount of water, and consequently is lighter to haul than when soaked to its full capacity with water. Still again, it has given but little if any of its fertilizing properties to the air, through heating, which always ensues to a greater or less degree when vegetable substances are saturated with moisture. In locations unlike the West, where the necessity of manure is paramount; where sheds and buildings for saving it are used, and where the manipulations attending its mixing and fitting are intricate and expensive, much art is bestowed in scientific handling and its preparation. What would be good practice and economical there, would be the reverse here. Nevertheless, manure is far too valuable anywhere to be wasted; and hence good and careful cultivators everywhere are careful to keep and apply all that is made. This should always be remembered. About the only cost of manure in the West is the hauling and spreading on the field. However rich the soil it will well repay the cost of adding manure to the meadow, the corn field and other crops which are greedy for manure. However rich the soil, unless reinforced, it is surely becoming poorer and poorer each year it is cropped. So, the farmer who constantly takes from it and adds nothing, in the end, finds himself with an impoverished farm, that costs more to bring back to a state of fertility, than it would have cost to keep it so originally.

SAURIANS. The subdivision of the animal kingdom, including the crocodiles, lizards, etc.; they have four legs, and are covered with a scaly epidermis.

SAVANNAHS. Extensive alluvial flats; the prairies.

SAVIN. *Juniperus sabina.* The leaves are a powerful drug. In the United States, the red cedar is called savin.

SAVORY. The summer savory (*Satureja hortensis*) is an annual, and propagated by seed; the winter (*S. montana*) is perennial, and managed in the same way as sage, which it greatly resembles. They are labiate plants.

SAW. The use of the saw has, without doubt, exerted a greater influence in the art of building, than that of any other implement or tool ever used therein. It has enabled all inside and outside finish to be elaborated to the greatest degree, and of late years, steam and water-propelled gang saws, scroll saws, and other perfected forms have not only cheapened the price of lumber the world over, but rendered it available for a great variety of purposes, not previously attainable. Now, so simple has machinery for sawing purposes become, that mills for sawing timber may be set up directly in the forest, and the lumber made as fast as the trees are felled. This is often done, especially in sawing hard wood. The illustration gives a fair representation of the manner of work, including chopping the trees, sawing off the logs, loading, and ripping by means of the steam circular saw. The history of the saw is especially interesting, and hence we give some information relating to this implement, from Appleton's New Cyclopædia. It says: The Egyptians used saws of bronze, and applied them to cutting out planks from logs. The saw was single-handed, and the log was placed on end and secured to posts set in the ground. The inventor of the saw was deified by the Greeks, and called by some Talus and by others Perdix. The saws of the Grecian carpenters were like the straight frame saws of modern times, the blade set across the middle of the frame, with the teeth perpendicular to its plane. The block of wood to be sawn was clamped down upon a bench, and the workmen stood on opposite sides of this, one at each end of the saw. Saws are of various forms and sizes, according to their intended use. The older forms are straight strips of steel, either set in a frame, or simply provided with handles at each end, so as to be moved forward and back by two persons; or the plate is made stiff enough for a single handle to answer, when it is worked by one person holding it in one hand. In modern times saw blades are often circular, the teeth cutting as the saw revolves constantly in the same direction. The teeth are variously shaped for different saws. The most simple are made by angular notches, the angle at the apex of the notch being of 60°. This is most convenient for sharpening, as the common triangular or three-square file is just adapted to its figure. When the teeth are made with equal sides, they are said to have an upright pitch; and when they make a zigzag of alternating long and short lines, they are said to be flat or to have considerable pitch. The former are adapted for cross-cut saws, worked by two men, one at each end. Such teeth lack the chisel-like effect of those of a low pitch, and rather scrape away the wood than tear into it like the latter, which cut only when the saw is moved in the direction toward which the teeth point. Hand saws in the United States and England have the teeth pointed from the handle; in Asiatic countries and in Greece they have always been made with teeth pointed the other way. A straight cut upon a line can probably be made better by the thrusting cut, and in this the sawdust is thrown out more freely; but the force is certainly applied to better advantage as regards the saw in pulling it in the line of its greatest strength than in pushing; and for very slender saws, in which it is an object to dispense with all unnecessary width and thickness, as in the keyhole and other similar sorts, it would appear decidedly better to adopt the East Indian practice. Some large saws are notched at a sharper angle than 60°, and for these special files made for the angle are used, and are known as mill-saw files. Teeth made at a low pitch in large saws would become clogged with sawdust unless the spaces between them were enlarged, and the various forms in which this is done give distinctive names to the teeth. In large mill saws and circular saws the space between the teeth, which may be two or three inches, is hollowed out in a curve, and the outline is much like a fish hook in form, the shank of the hook bending back to make the back of one tooth, and the point curving round to form the under side or face of the next. All saws used for cutting wood require some provision against their liability to become jammed and the teeth clogged in the narrow passage they make for themselves. This is sometimes effected by making the blade thinner toward the back, but the most effectual mode is in the set given to the teeth. The earliest notice of saws being run by power is contained in a manuscript of the 13th century in Paris, in which is a representation of the saw mill with a self action turned by a water wheel. Beckmann finds evidence of saw mills worked by water power in Augsburg, Germany, as far back as 1322. In the island of Madeira one is said to have been in operation in 1420, and the first one in Norway was built in 1530. In Holland they were in use more than one hundred years sooner than in England; and the Dutch furnished the English with lumber. The operation of one at Lyons in 1555 is described by the bishop of Ely, then British ambassador at Rome. The first recorded attempt to establish a saw mill in Great Britain was made near London in 1663 by a Dutchman; but the enterprise was abandoned on account of the opposition of the hand sawyers. In 1700 the advantages offered by this improvement was set before the public by one Houghton; but no one ventured to introduce it till 1767 or 1768, when by the desire of the society of arts a saw mill was built at Limehouse by James Stansfield. It was soon destroyed by the mob. In the American colonies the importance of this expeditious means of obtaining sawed lumber was generally felt, and efforts were early made to obtain the necessary machinery, such as was used in Holland. In 1634 a saw mill was put in operation at the falls of the Piscataqua, between Berwick and the Cocheco branch of that river, and this is supposed to have been the first mill of the kind in New England. In New York as many as three mills were constructed by the Dutch West India company about 1633, to run by water power or by wind. One of them was on Nut or Governor's island, which was leased in 1639 for 500 merchantable boards yearly, half oak and half pine. Another was on Saw Mill creek, a small stream which flowed into the East river from the pond know as the Collect. On the Delaware, saw mills were erected by the Dutch and Swedes before the arrival of Penn.

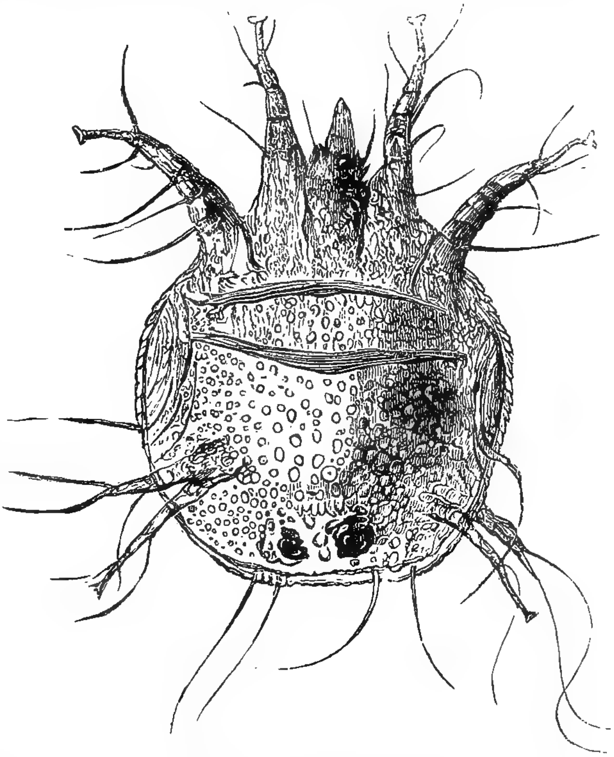
SAWDUST. When rotted in the compost heap, or with lime and earth, it forms a good manure for improving the texture of soils. When partially rotted it forms an excellent mulch, and is often used as a divisor for manure in making hot beds.

SAW FLIES. An extensive family of hymenopterous insects, of the genera *Cimbex*, *Tenthredo*, *Selandria*, etc. The perfect insects, resembling bees and wasps, are seen in summer hovering over the plants they feed on. The female lays her eggs in a slit made in the young stem, or in leaves; the larvæ feed on leaves and buds, and are extremely voracious. In eight weeks, they descend to the ground and form a web either among the dead leaves, in the bark, or under ground. They are very destructive; whale-oil, soap water, tobacco water, and lime are used to destroy them.

SAXIFRAGE. Flowering plants of the genus *Saxifraga*.

SAXON BLUE. A solution of indigo in sulphuric acid, used as a dye.

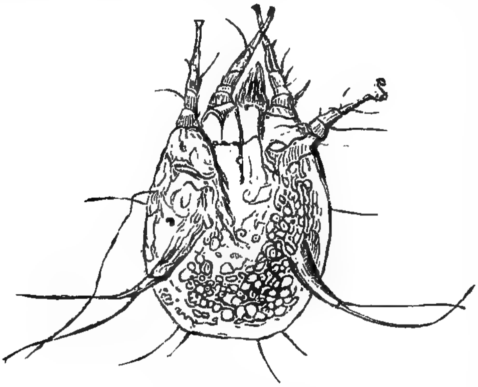
SCAB IN SHEEP. It is more than probable that the disease is occasioned by neglect. That in ill-kept sheep it quickly assumes a virulent form there is no doubt, since on fat sheep, or those in the full flush of growth, it is evident, as in other farm animals, the parasites can not get control of the body of the sheep. Scab is known by the generally ragged appearance of the sheep, and by bare patches of the skin; by their rubbing the irritated parts, and, if closely examined, by reddish, pimply spots, upon which a small blister or vesicle forms. The infested sheep also are rest less, and rub themselves against trees and posts to relieve the intolerable itching. Later sore places will be found, the appetite fails, and if relief is not given the animal dies. The mange affecting the horse, ox, dog, and cat, depends upon the presence of insects. There are different insects, known as *acari*, infesting different animals, having distinctive characteristics in each, and generally confined to that species of animals; yet the mange from a dog is said to have been communicated to man, and a horse has been infested with mange by means of the skin of a mangy cat. The sheep acarus does not bore galleries in the skin, but remains on the surface, clinging to the wool, and finding shelter among the masses of scab produced by the drying of exudations from the wounds inflicted by these parasites. Experiment has shown that increase of temperature hastens the hatching of their ova; fourteen days, according to Prof. Brown, of England, sufficed to hatch a lot in a bottle carried in the trowsers pocket, while two months' time was required with some kept under glass in a room. The young have six legs; the fully grown, after several changes of skin, have eight. The microscope reveals numerous sucking-caps or disks in the legs, enabling the parasite to cling to the wool and skin of the sheep; and renders fully apparent the action of these structures, showing, as the feet advance, how the disks are expanded to grasp the surface of the substance over which the acarus is moving, apparently retaining their hold in obedience to the volition of the animal. Thus its structure adapts it for crawling over and adhering to the skin, instead of burrowing beneath it. Burrowing acari, like the itch insect in man, are always armed with cutting teeth, set in strong jaws, and their legs are very short. The body of the female of the sheep acarus is larger than that of the male, rounder in form, the fourth pair of legs are developed nearly as well as the third, and are supplied with terminal sucking disks. The accompanying illustrations represent a female acarus magnified one hundred diameters, and a young six-legged acarus, also magnified one hundred diameters. Mature mites are visible to the naked eye as pellucid points of the size of a pin's head. Various experiments have been made to ascertain the rapidity of the growth and reproduction of these parasites. The young acari have been detected in fourteen days from the direct transference of the acarus to the skin of the sheep. In a month the disease had spread over a space of five inches; in ten to twelve weeks pretty nearly over the whole body. A greater or less amount of time may be required under different circumstances of temperature, and other modifying influences.



FEMALE ACARUS OF SHEEP SCAB.

The first sign of the existence of scab is rubbing against any projecting body within reach; as it extends, sheep bite themselves, kick with their hind feet at their sides and shoulders. If one is caught and the hand placed on the mouth, while infected parts are scratched, gratification is evinced by nibbling at the hand, and when the infection is severe or general this nibbling movement is regarded as an infallible sign. Examination will disclose spots on the skin, white and hard, the center marked with yellow points of exudation, which adheres to the wool, matting the fibers together The wool may be firm on these spots, and no scabs are seen at this stage.

Then the yellow moisture, evaporating, gives place to a yellow scab, which adheres firmly to the skin and wool. Raw places appear at points which the animal can reach with his teeth and hind feet. The disease is complicated in summer by the presence of the larvæ of the blow-fly, the maggots burrowing under the scab. The animal becomes nervous, excited to wildness, and can not obtain properly either food or rest, thus losing flesh and becoming reduced to a skeleton, from constant irritation and lack of nutrition, only the strongest animals recovering if left without treatment. Destruction of the parasite and its eggs is the only object of remedial treatment. Arsenic and mercury are often employed very effectually, but they are poisonous, and therefore injurious and dangerous to the sheep. These and other solutions are used both as washes and dips. Sudden changes of weather and locality, or a deficiency of food after such treatment, often induce serious or fatal results which can not be guarded against. Whole flocks have thus been lost. Mercurial ointment, with olive oil and a little turpentine, is popular in England, nevertheless, and is regarded as improving the yield of wool. Experiment proves that the acarus will live in arsenic and sulphur for some hours; potash is more fatal, and tobacco is more deadly still, killing in a few minutes. But carbolic acid is probably the most potent remedy used. When combined with one hundred times its bulk of water, it has killed acari in two minutes; when used with fifty times its bulk of water, a degree of potency harmless as a dip, it kills in forty to ninety seconds. Prof. Brown thus describes the manufacture of the carbolic acid dip, which, it is claimed, has never failed when properly used: First, it is necessary that carbolic acid should be obtained of uniform strength, and experience has proved that the crystalline product is less efficacious in the destruction of parasites than the liquid residue, which is sold under the name of terebane, or cresylic acid, which can always be obtained of the manufacturers. The liquid is, when fresh, of a very light straw color, becoming dark brown on exposure to the atmosphere. The pure carbolic acid was employed in many experiments, at first with only partial success, but even had it proved to be superior to the liquid terebane, the price would have been a serious objection; terebane, however, is very much cheaper, and in every experiment was found to be more active as a remedial agent than the pure carbolic acid, while its fluid condition at all temperatures renders it more easy of manipulation. To effect perfect combination between the terebane and the water used for dilution care is essential, as imperfect mixtures are capable of doing injury, and may cause the death of some of the sheep, particularly of those which are first introduced into the bath. The reason of this is obvious. An incomplete mixture allows the separation of the terebane, which floats on the surface of the fluid in the form of a brownish, oily, or rather tarry scum; the first few animals which are dipped become covered with the undiluted acid, which acts at once and energetically as a caustic, causing prostration and death, unless immediately on observing the symptoms of distress means are taken to wash off the agent with warm water and soap; this treatment is not, however, at all times successful. An accident of the kind never ought to occur and, in fact, never can occur if the dip is properly prepared and used. It is not probable that the average farmer will attempt to make the compound; the following directions, therefore, may be taken as meant for the instruction of the practical chemist or the veterinary surgeon who has charge of the diseased flock. A quantity of terebane, proportioned to the number of sheep to be dipped, is to be placed in a convenient vessel of iron or earthenware, and, if possible, the vessel should be suspended in a larger one containing water, and so arranged that heat can be applied. In all chemical laboratories a water-bath will be available; but for the purpose of making small quantities of the dip, an iron bucket suspended in an ordinary copper filled with water, which may be kept hot, but not up to the boiling point, will answer perfectly well. As soon as the terebane is placed in the temporary water-bath, a certain proportion of soap, one bar weighing over two pounds to each gallon of terebane, is to be added. The mixture should be stirred with a wooden rod until the soap is entirely dissolved, care being taken that the fluid does not boil. When the solution is complete the compound should be removed from the fire, and as soon as it ceases to give off vapor, oil of turpentine is to be added in the proportion of one pint to each gallon of terebane. The mixture, when cold, may be poured into carboys or casks ready for use. While the above remedies may be entirely efficacious, and are to be recommended as the best, it may not be amiss to give a few which have been popular heretofore: An infusion of arsenic, half a pound of the mineral to twelve gallons of water. The sheep should be washed in soapsuds and then dipped in the infusion. This treatment is preferred by Mr. Spooner. Mercurial ointment, incorporated thoroughly with four times its weight of lard, rubbed upon the head and upon the skin (the wool being carefully parted) in parallel lines from head to tail, four inches apart. The mixture applied should not exceed two ounces, and a half an ounce may be enough for a lamb. A light second application is sometimes necessary. It is preferred by Youatt. One pound of sulphur gradually mixed with half a pound of oil of tar, the mixture rubbed down with two pounds of lard, may be applied in the same way. Mr. Randall would prefer this, because not poisonous, if sure to be effectual. Another mixture contains a half



YOUNG ACARUS.

pound of corrosive sublimate, three-fourths pound of white hellebore, six gallons whale oil, two pounds rosin, and two of tallow. This is powerful, and should be sparingly applied. Tobacco decoctions are much used in this country and quite effectually, if thoroughly applied after the wool is taken off.

SCABIOUS. Plants of the genus *Scabiosa*, at one time celebrated for curing the itch.

SCABROUS. Rough, from minute inequalities.

SCAFFOLDING. The temporary frame-work put up in buildings.

SCALDED CREAM. Clotted cream; cream raised from milk by heating.

SCALE INSECT. (See Lice.)

SCALPEL. A small knife, convenient for dissection or surgical operations.

SCAMMONY. The gum resin of the *Convolvulus scammonea.* It closely resembles jalap.

SCANDENT, SCANDENS. Climbing branches. Or having climbing branches, as Cobæa scandens, which climb by adhesive tendrils of the branches.

SCANSORIALS, SCANSORES. Climbing birds, as the woodpeckers; they have two toes before and two behind on each foot.

SCAPE. A flower stem or peduncle rising from the ground, as in the hyacinth, flag, etc.

SCAPHOID. Shaped like a boat.

SCAPULA. The shoulder-blade.

SCAPULARS. The shoulder feathers which cover the sides of the back in birds.

SCAPUS. The stem of a feather. In architecture, a shaft.

SCARABÆIDANS. A family of lamellicorn beetles.

SCARCEMENT. A rebate, or set back in a wall, or bank of earth.

SCARFING. The union of two timbers, to answer as one.

SCARFSKIN. The epidermis, a delicate covering of the true skin.

SCELIDES. The posterior or lower extremities.

SCHEELES GREEN. Mineral green, arsenite of copper.

SCHIST. A coarse slate.

SCIATIC. Relating to the hip joint, as the sciatic nerve.

SCIENTIFIC AGRICULTURE. There is no such thing as a science of agriculture, and never will be in an exact sense, since the conditions present to-day are changed to-morrow, and the conditions, are ever varying, not only with the seasons, but from year to year, and from generation to generation. Hence, science in agriculture, must ever be more or less experimental, like medicine. Scientific agriculture, however, as is science in agriculture, are both important, and necessary studies, since the practical application of the facts elicited by scientific inquiry from generation to generation, have made up the sum of all agricultural knowledge. Until within the last few years, comparatively, agricultural science has been largely theoretical. It is so yet, to a considerable degree, and must in every instance be so since theory must always precede practical investigation. Yet inductive experiment, the only true plan, is being carried out more carefully year by year, by such organizations as agricultural colleges, boards of agriculture, agricultural congresses, and other bodies of a like nature. The province of every practical farmer, should be to foster such organizations, by every means in his power, and especially by assisting them in carrying forward simple experiments as may be designated, with a view of adding new facts carefully stated, which aggregated together and confirmed until a law is established, is really all there is in science in any of its departments. (See also article Agriculture.)

SCION. A bud, or buds on a branch. A stick of buds ready for grafting is called a scion. (See Grafting.)

SCIRRHUS. An indurated gland; it becomes a cancer when suppuration occurs.

SCIURINES. The squirrel family.

SCLEROTICA. The white membrane of the eye.

SCOLOPENDRÆ. The genus of centipedes.

SCOPIPEDS. A tribe of melliferous insects, some of which have the posterior feet furnished with a scopa, or little tuft of hair.

SCORE. Twenty pieces, or twenty pounds.

SCOTCH CATTLE. The Scotch breeds have been summarized by Youatt as follows: Scotland contains several distinct and valuable breeds of cattle, evidently belonging to our present division, The Middle Horns. The West Highlanders, whether we regard those that are found in the Hebrides, or the county of Argyle, seem to retain most of the aboriginal character. They have remained unchanged, or improved only by selection, for many generations; indeed from the earliest accounts that we possess of Scottish cattle. The North Highlanders are a smaller, coarser, and in every way inferior race, and owe the greater part of what is valuable about them to crosses from the Western breed. The North-eastern Cattle were derived from, and bear a strong resemblance to, the West Highlander, but are of considerably larger size. The Ayrshire breed is second to none for milking. The Galloways, which scarcely a century ago were middle-horned, and with difficulty distinguished from the West Highlanders, are now a polled breed—increased in size, with more striking resemblance to their kindred, the Devons—with all their aptitude to fatten, and with a great hardiness of constitution.

SCRUB CATTLE. This is a term applied to mixed cattle, that through the hardship incident to having to care pretty much for themselves, as in some thickly timbered regions of the country, have degenerated into dwarfed, scrawny stock, of no particular use, either for beef, labor or milk. (See Native Cattle.)

SCOURING. In colts and calves this is usually produced from some disability of the dam, or in the case of calves, from improper food. This must be remedied according to the nature of the case. Diarrhœa in horses is produced by a variety of causes, as indigestible or irritating food, disorder of the liver, or from constitutional tendency or weakness. It must be met according to the nature of the case. It is often an effort of nature to get rid of injurious matter in the system. If so, as soon as discovered, give a moderate dose of linseed oil, say from a half to one pint, but if the discharge has proceeded naturally for some time, such remedy would not be indicated. As a general remedy, two drachms of spirits of camphor, one drachm tincture chloride of iron, and one ounce of ether would be indicated. If the discharges are sour and fetid, take one ounce each of powdered chalk and bi-sulphite of soda, to be mixed in the food two or three times a day. If the diarrhœa is the result of over purging by medicine, give two ounces each of laudanum and powdered chalk, mixed in gruel of flour, every three hours until an effect is produced. For horses or cattle where a more astringent effect is required to counteract an irritable relaxed condition of the bowels, give the following in gruel or linseed tea: One drachm each of powdered kino, powdered opium, powdered gentian, and bi-carbonate of soda. Or it may be made up into a ball and given. For scouring in calves, give in milk or linseed tea, four drachms of calcined magnesia, twenty grains powdered opium, and two drachms of powdered rhubarb. Useful remedies are also strong teas of willow bark, with the addition of a little ginger or calamus root. For lambs troubled with diarrhœa, take one drachm of powdered opium, one-half ounce of powdered ginger, and two ounces of prepared chalk; mix these in a pint of calamus or mint tea, and give a tablespoonful twice a day until relieved. If this fails, to the foregoing add one ounce of powdered catechu, and give as before directed.

SCRATCHES. (See Grease.)

SCROFULA. A disease of the glands about the neck, followed by debility and skin diseases.

SCRUPLE. Twenty grains; the third of a drachm.

SCUFFLER. A light scarifier, or horse hoe.

SCUTATE. Protected by large scales.

SCUTELLIFORM. Of the figure of a shield; leaves having the foot-stalk terminating in the center of the lamina.

SCURVY GRASS. *Cochlearia officinalis.* A plant belonging to the same genus as the horse-radish.

SCUTCHING. Breaking flax or hemp. (See Flax.)

SEAM. In geology, a thin layer of a given rock between large masses. Also a measure of eight bushels, or a horse load of wood.

SEBACEOUS GLANDS. The minute glands of the skin, which excrete a fatty matter.

SEBACIC ACID. An acid produced during the destructive distillation of fats.

SECHIUM. A vegetable resembling a small squash in size, but different in flavor and structure, said to be from the *Sechium edulis*, a South American plant.

SECONDARY ROCKS. The formations lying above the coal and between it and the tertiary series. They are fossiliferous and stratified.

SECRETION. The separation from the blood or sap of certain products, by a glandular or other apparatus; the perspiration, urine, bile, saliva, etc., are secretions. They perform important offices in the economy, and can not be arrested without the occurrence of disease.

SECUNDINE. The second envelope of the ovule in plants. The word secundines also means the membranes which cover the animal fœtus.

SECURIFERS, SECURIFERI. The name of a tribe of *Terebrantia*, or boring hymenopterous insects, comprising those in which the females have a saw-shaped or hatchet-shaped terebra or appendage to the posterior part of the abdomen for the purpose of preparing a place to receive the eggs, and of depositing them therein.

SECURIPALPS, SECURIPALPI. The name of a family of coleopterous insects, comprehending those in which the maxillary palps terminate in a joint which is elongated and hatchet-shaped.

SEDATIVES. Medicines which produce sleep and diminish pain, as henbane, camphor, morphia, etc.

SEED. The seed is the perfected fruit of the plant, capable of again reproducing itself through germinations and growth. They may be divided into six principal classes: 1. Those of the cereal grains, beans, peas, etc., contained within dry coverings, and which are prepared directly for use. 2. Those contained in fleshy envelopes, as fruits, pumpkins, squashes, etc., the envelopes being the edible part. 3. The seeds of plants, the tubers, bulbs, leaves or foot stalks of which are eaten. 4. The seeds of plants used for flavoring. 5. The seeds of medicinal plants. 6. The seeds of plants cultivated for their foliage or flowers. In a more restricted sense the fruits of plants are not considered the seeds, the fruit being generally termed the edible portion. In the present article it will only be necessary to notice the seed in its relation to the improvement of the species, other questions having been discussed in the articles acclimation, foods, germination, etc., which see. The vitality of seeds is determined by the length of time required to disorganize them as kept under ordinary circumstances, with care as to dryness, and partial exemption from the effects of the oxygen of the air; seeds remain vital for twice or three times the number of years as ordinarily given in the table. Kept entirely from contact with air and moisture, there is practically no limit to the length of time they may be kept intact. As to the amount of cold which the seeds of plants will withstand without impairing their vitality, if dry, there is practically no limit. Prof. Wartman, of Geneva, Switzerland, more than twenty years ago, placed nine varieties of seed, some of them tropical, in hermetically sealed tubes, and submitted them to freezing as severe as science can produce. Some remained fifteen days in a mixture of salt and snow, others were plunged into a bath of liquid sulphuric acid, rendered as cold as possible by artificial means. They were then taken out and sown in pots in the open air and all germinated. Those which had been submitted to the severest cold germinated as kindly and made as good and healthy plants as those not submitted to this extreme test. Nevertheless, seeds as usually kept, like plants, have a limit beyond which they will not stand cold, or a degree of cold at which their cells are ruptured, provided always, however, they contain a sufficient amount of moisture for this purpose. In relation to the germination of seeds and tests of their quality, M. Charles Appelius, of Erfurt, in a memoir furnished the Imperial Society of Horticulture, France, says: The value of a sample of seeds is often determined solely by their specific weight and density. This method is no doubt good, but not infallible; besides, the weight of the same kind of seed may vary from year to year, according to the manner in which it is grown. It may even vary upon the same plant; it does so particularly in an ear of maize, the grains situated in the center of the ear of that plant having a greater specific gravity than those above or below. Now, the latest experiments of Dr. Hellriegel go to prove, first, that in accordance with the general opinion of cultivators the best formed seeds have the greatest specific gravity; and, in the second place, that the heaviest seeds produce the strongest plants. Every one knows that in order to ascertain the specific gravity of seeds quickly and easily it is the custom to throw them into water, and to collect as the best those which, from their greater weight, fall to the bottom, whilst those which float are rejected as bad. However, too much confidence must not be placed in this method of proving seed by water. It may frequently mislead, particularly in the case of seeds in which the specific gravity differs little from that of the fluid. For example, those of cucurbitaceous plants, which are produced during cold seasons, float upon the water, and nevertheless germinate very well. It is known, too, says M. Appelius, that the seeds of these plants bear more female flowers than younger plants; that is to say, the plants are more prolific than those raised from seeds gathered in a cold season and planted shortly after they have ripened. Good seeds of the melon and gourd lose weight as they grow old; at first they will sink in water, and by the sixth year half of them will float, without having become bad. We conclude, therefore, in this case, as in many others, that trial by water is not a sure test. In general the heaviest seeds are those which contain the most starch, such as those of cereals and leguminous plants, etc. The specific gravity of oily seed is often nearly the same as that of water, although in some cases they are heavier; as, for example, those of cabbages. The lightest seeds are those of umbelliferous plants, such as carrots, parsnips, chervil, aniseseed, etc., and of composites, such as lettuces, scorzoneras, etc. In the first of these families the lightness of the seeds arise from the presence of an oil in the case which encloses the seed, and of air in the last. With a few exceptions all shining seeds are heavier than water. Many cultivators, before buying seeds, test them by making them germinate upon damp blotting paper, at a temperature of 59° to 75°. This process is convenient and tolerably sure for the kinds which are quickly raised, such as clover, peas and cereals, but does not answer for those which require a long time to germinate. For these the best practical plan is to grow a sample in a pot. But even this will not always give a strictly correct indication of the germinating power of seeds, since the result depends, all other circumstances being equal, upon the care taken in sowing, the temperature of the air, the depth at which seed is sown and the time of the year, etc. Thus the pips of apples and pears almost always germinate badly and in very small quantities when trials are made of them in pots soon after they are ripe, whilst they answer perfectly if they are sown at the end of October or in March in beds in the open air. For this reason it often happens that a sample is pronounced bad when in reality it is excellent. This is the case with the generality of woody plants, the seed of which come up the first year, conifers excepted. The soil which is used to cover the trial seedlings also considerably affect the result. If, for example, the ryegrass seed (Lolium perenne) is sown in soil which retains moisture with average tenacity, and is buried one inch below the surface, seven-eighths of it grow in twelve days; if two inches, seven eighths also grow, but in eighteen days; if three inches, six-eighths in twenty days; if four inches, four-eighths germinate in twenty-one days; at five inches, three-eighths in twenty-two days; and at six inches, the proportion of the seeds which germinate is reduced to one-eighth in twenty-three days. On the other hand, when ryegrass is sown and simply harrowed in, it germinates, almost without exception, in five days. M. Appelius' memoir contains, in the form of a table, the length of time necessary to germinate the seeds of many plants at a temperature of 54° to 55° in the sun, and 54° to 64° in the open air. This table shows plainly, says the German author, that those seeds which are lighter than water require a longer time to germinate than those which are heavier. A tolerably large number of seeds come up slowly, and even with difficulty; they are generally those which have a thick, tough skin. In this case it is a good plan to soak the sample in hot water, from 167° to 185°, allowing it to cool naturally to 60° for four and twenty hours, and not to sow it until after it has been prepared in this manner. Their germination may be assisted by notching, a more delicate operation than the first, because care must be taken not to injure the embryo. Unless one or the other of these methods is adopted, it will generally be one or two years before such seeds come up. The seeds of palm trees usually grow very well placed on damp sawdust, the germinating end downwards, and kept in a damp, warm atmosphere. The spores of ferns and the seeds of orchids, which are very minute, come up rapidly, if they are scattered on pieces of peat placed in a pan with water. For hardy plants M. Appelius recommends, as by far the best plan, to sow them in lines. In his opinion, the reason of the frequent failure of seeds in gardens is that they are sown in earth too dry and buried too deep. Besides, if care is not taken to press the earth lightly together before sowing the seed, heavy rains falling directly after will force some of the seed deeper in, and so occasion greater inequality in germination. For perfectly hardy annuals, the best plan is to sow them late in the autumn, or, at least, very early in the spring; if the seeds are not in the ground before April you run the risk of seeing them flower very late and very badly. Seedlings which are obliged to be raised in hotbeds or under frames, cause much disappointment, and consequently complaint of the quality of the samples. M. Appelius does not hesitate to say, in that case, the want of success arises more often from bad management than from the badness of the seeds. In his opinion it is a mistake to sow many kinds of flowers in high bottom-heat, such as stocks, asters, phlox, heartsease, petunias, etc., which do far better in a very gentle hot-bed, and produce stronger plants, less likely to die off. On the other hand, it must not be forgotten that the dung with which a hot-bed is made, after it has given off its first heat, absorbs the moisture from the earth with which it is covered; that the surface of this earth under the frame generally slopes toward the south, and the greater part of the shower from the watering runs down this incline, the end of which is that the earth in which the seeds are embedded is often too dry, or, at least, it is so with that next to the back of the hot-bed. In this case, says M. Appelius, if you sow those seeds which germinate slowly and require constant damp, such as phlox and heartsease, at the bottom or in the front of the bed, and those which grow more readily at the top or back, the result will be good; but it will be quite the contrary if the reverse is done. Finally, the success of seedlings raised under frames depends principally upon the regulation of moisture. Another precaution, and one of the utmost importance in this case, is not to sow thick; a plant raised among a lot of crowded seedlings is very apt to die before it has made its fourth leaf. This seldom happens if, on the contrary, seeds are sown thin, and a little powdered charcoal mixed with the earth. Wheat, and the other cereal grains, if not injured by insects, or damp, retain their vitality perfectly three or four years, but seeds of the previous year's growth are best. Grass seeds should not be depended on for more than one year. The oily seeds unless kept quite dry and from contact with air soon deteriorate. The seeds of all the cucumber family, including melons, squashes, etc., are better after four years old. As to the time that seeds may ordinarily be kept intact, the following table of the seeds of vegetables and herbs will show:

Seeds.	Years.
Artichoke	5 to 6
Asparagus	2 to 3
Beans, all kinds	2 to 3
Beet	3 to 4
Broccoli	5 to 6
Carrot	2 to 3
Cress	3 to 4
Corn kept on the cob	2 to 3
Cucumber	8 to 10
Egg plant	1 to 2
Eudive	5 to 6
Leek	2 to 3
Cauliflower	5 to 6
Celery	2 to 3
Chervil	2 to 3
Corn salad	2 to 3
Onion	2 to 3
Parsley	2 to 3
Parsnip	2 to 3
Pea	5 to 6
Pumpkin	8 to 10
Rhubarb	3 to 4
Squash	8 to 10
Lettuce	3 to 4
Melon	8 to 10
Mustard	3 to 4
Okra	3 to 4
Spinach	3 to 4
Tomato	2 to 3
Turnip	5 to 6
Pepper	2 to 3
Radish	4 to 5
Salsify	2 to 3

HERBS.

Seeds.	Years.
Anise	3 to 4
Balm	2 to 3
Basil	2 to 3
Caraway	2
Coriander	1
Dill	2 to 3
Fennel	2 to 3
Hyssop	3 to 4
Lavender	2 to 3
Sweet marjoram	2 to 3
Summer savory	1 to 2
Sage	2 to 3
Thyme	2 to 3
Wormwood	2 to 3

In sowing seeds, a good rule for those not practically acquainted with the proper depth at which to sow seeds is to cover them four times their diameter. Very minute seeds should be simply pressed into the ground and kept moist until they sprout. Wheat, for instance, germinates best at a depth of three-quarters to one inch in depth. Below the depth of two inches it must partially exhaust itself in reaching the surface, and in throwing out its superficial roots. At the depth of six inches, it reaches the surface nearly or quite exhausted, if it indeed do not perish in the attempt. In light soils, however, seeds may be sown one-quarter deeper than in heavy, compact soils. The following tables of the time of sowing, the average seed or pounds sown per acre, the time of harvest and the best soil, gathered from a variety of sources will be found valuable. The table of averages of seeding and product in the different States, with the time of planting and harvesting, and prices of the various articles, is compiled from a number of returns in the different States; and in some instances, perhaps, eight or ten—in others, not more than four to six; and in one or two instances, perhaps, not more than two. The extremes are given, and the replies ranged from these; but in many instances there was almost an entire similarity in the judgments formed in the case of the prominent crops. In respect to some of the crops, also, regard must be paid to the different varieties cultivated. In the potato crop, both the common and sweet potato are embraced in the replies from certain States; and this fact deserves recollection when the disparity of seeding is mentioned. For a few of the States, as no returns were received there are no records made. The other tables, relating to estimates of the proportions of cultivated land to uncultivated, of corn stalk and straw fodder to the grain, the rotation of crops, and the cost of raising different crops, with amount of consumption, and the prices of various agricultural products and wages of labor, can of course be viewed only as the results of the conclusion of a few in each section of the country. Yet many of those who have furnished this information are among the prominent successful agriculturists, in their respective districts; or practical farmers, who show that, though the subject is new to them, they duly appreciate its importance, and have gladly lent their aid to promote the object. The replies, generally, relate to a county or district, though in a few instances, perhaps, they have been confined to a single town. The number of the returns were not sufficient to allow a condensation in a tabular statement, in respect to some of these subjects; and they have, therefore, simply been drawn out and entered in the order of the States. It is not claimed that the quantities of seed stated, or, the land adapted to the cultivation of the crops are a sure guide except in a general sense. Yet approximately they are correct. Allowance must be made for climate. For instance, a crop doing well in a cool and rather stiff soil in the South might require a warm and rather light soil in the North, and *vice versa.* So in the quantity of seed different soils and localities require different quantities of seed. Though defective in many respects, yet at the same time they are of value, in a general sense, especially in relation to costs, quantities sown and time of harvesting.

WHEAT.

States.	Time of sowing or planting.	Average bushels or pounds of seed per acre.	Time of harvest.	Best soil.
Maine	May 15 to June	1½ bush	August 20 to 30	Sward corn stubble; high ridges; dry pasture.
New Hampshire	April to May 20	1½ to 2 bush	August 1 to 20	Clay loam; new upland; diluvial; black loam.
Massachusetts	April 10 to 25	1¼ to 2 bush	June 25 to Aug. 10	
Vermont	May 1 to September	2 to 2½ bush	Last Aug. to Sept. 1.	Loam clay; clay loam
New York	May 10 to September 1.	1¼ to 2 bush	July 2 to Aug. 10	Sandy loam; clay loam; loam mixed with gravel.
New Jersey	Sept. 1 to October 15	1⅓ to 2 bush	June 28 to July 7	Friable loam; loam; clay loam; sandy loam, rather stiff.
Pennsylvania	Sept. 1 to October 15	1¼ to 2 bush	June 15 to July 15	Light sandy; clay soil; sandy loam; limestone; do. clay, mixed with gravel; clay; do.; clay and gravel.
Delaware		1 1-6 to 2 bush		
Maryland	October	1½ bush	June	Rich loam; clay.
Virginia	Sept 15 to Nov. 30	1 to 2 bush	June 15 to July 15	Clay; do. do.; clay and lime.
South Carolina	October and Nov	50 lbs	June 1	Clay.
Georgia	September 15 to Nov	¾ to 1 bush	June 1	Red mulatto.
Alabama	September to Dec	½ to 2 bush	June to July	Loam; oak and hickory.
Tennessee	October 12	1 to 1½ bush	June 15	Dark loam; all kinds.
Kentucky	September and Oct	75 lbs	July	Clay.
Ohio	Sept. 1 to Oct. 25	1 to 1½ bush	June 28 to July 20	Oak and maple land; clay; do.; very warm; limestone; clay loam; yellow clay; clay; sandy.
Indiana	September to October.	1 to 2 bush	June 15 to July 20	Sand and loam; clay loam; clay; improved clay; loam do.; clay; sandy loam.
Illinois	August to Sept. 30	1 to 1½ bush	May to July 1	Sandy loam; clay; oat or clover stubble; clover; rich loam.
Michigan	Sept. 3 to Oct. 1	1¼ to 1½ bush	June to July 30	Marl Clay; clay and sand; oak; clay loam.
Iowa	August 20 to Sept. 15	90 lbs. to 1½ bu.	July 5 to 20	
Texas	October 1 to Dec. 15	¾ bush	May 1 to June 10	Lime soil.

BARLEY.

Maine	Last of May	2 bushels		
New Hampshire	April; May	2½ to 4 bush	August	Black loam.
Massachusetts	May	2½ to 3 bush	July 30	High, warm land.
Vermont	July 1	2 bushels	August 1	Dry.
New York	April 10 to May 10	2 to 3 bush	July 1 to August	Loam; warm loam; loam and muck; sandy loam; black sandy loam.
Pennsylvania	March 15	1½ to 2 bush	June and July	Heavy clay; sandy loam.
South Carolina	September	2 bushels	May	Clay.
Tennessee	March 1	1 bushel	July 1	
Ohio	April 1 to May 1	1½ to 2 bush	July 1 to 25	Clay, mixed with sand; clay loam; loose do.
Indiana	April to September	1¼ to 2½ bush	June 25 to August	Clay; do. loam; dry, sandy loam.
Michigan	April 15 to May 1	½ to 2 bush	July 7 to August 1	Sandy loam; rich loam.
Iowa	March to April 1	1¼ bushel	July 1	

OATS.

Maine	April to May	2½ to 3 bush	August 10 to 30	Dry; gravelly.
New Hampshire	April and May	3 to 4 bush	August 1	Clay; sandy; free.
Massachusetts	April 10 to May 10	2½ to 3 bush	July 15 to August 20.	High, warm land.
Vermont	April to May 15	3 bushels	August	Light; sandy.
New York	March 15 to May 25	1½ to 3 bush	July 10 to August 15.	Loam and muck; loam; deep, black muck; rich, sandy loam.
New Jersey	April 1 to 15	2 to 2½ bush	July 20 to August 1.	Sandy loam; clay.
Pennsylvania	March 15 to April 15	1 to 3 bush	July 10 to August 1.	Sandy loam; light; sandy; sandy loam; limestone; do.
Delaware				Rich; moist.
Maryland	April	2 bushels	July	Dry loam; clay and lime; sandy loam; do.; do.
Virginia	February to April 1	1½ to 2½ bush	July 10 to August 10.	
South Carolina	Dec. to February	1 bushel	June 1 to last June.	Moist; sandy.
Georgia	January to March 1	1 to 1½ bush	June to July 1	Slate loam.
Alabama	November to April	¾ to 1 bush	May and June	Sandy loam.
Mississippi	October to February	1 bushel	July	Light do.; clay.
Tennessee	Feb. 15 to March	1½ bushels	July 10	Black loam, thin.
Kentucky	March and April	48 pounds	July	
Ohio	March and April	2 bushels	June to August 1	Loose loam; do. do.; clay loam; sandy loam; oak and hickory loam.
Indiana	March to May 1	1¼ to 2 bush	July 1 to August	Sandy loam; loam; clay; do.; do.; do.; sandy.
Illinois	March 20 to April 4	1½ to 2 bush	June to August 1	Sandy loam; light loam; sandy do.
Michigan	April 10 to 30	2 to 3 bush	July 7 to August 1	Clay or sand; rich loam; sandy.
Iowa	April	2 to 4 bush	July 15 to August	
Texas	February	1 bushel	May	

RYE.

States.	Time of sowing or planting.	Average bushels or pounds of seed per acre.	Time of harvest.	Best soil.
Maine	Fall and Spring	1¼ bush		New, burnt land.
New Hampshire	September and April	1 to 2 bush	July and August	Sandy; silicious; newly cleared land.
Massachusetts	August to September	1 to 1½ bush		High, warm, light land.
Vermont	September	1¼ to 1½ bush	Last July to August	Light.
New York	September 1 to Nov.	1 to 2 bush	July 10 to 25	Sandy and slate; sand; sandy loam, or gravel; gravelly loam.
New Jersey	September 1	1 bushel	July 1	Light, sandy loam.
Pennsylvania	September 1 to 15	1 to 1½ bush	Last June to July	Gravel; serpentine; stubble.
Maryland	October	1 bushel	June	Light.
South Carolina	October	⅝ bushel	June	Gray land.
Georgia	September	¾ bushel	July	Mulatto.
Alabama	October	½ bushel	May	Light.
Mississippi	September	½ bushel	May and June	Rich loam.
Tennessee	September 1	1 bushel	June 15 to July	Black, thin loam.
Ohio	September and Oct.	1 to 1½ bush	June to July	Clay; clay, light; sandy and warm oak and hickory clay.
Indiana	September to Oct.	1 to 1¼ bush	June 20 to July	Dry; just cleared.
Illinois	October and Nov.	2 to 2½ bush	June 20 to July	Clay; or sandy loam.
Michigan	October 10	1½ bush	July 15th	Clay or loam.
Iowa	September	2 bushels	July	

BUCKWHEAT.

Maine	Middle of June	½ bush		
New Hampshire	June	½ bushel	August; September.	Silicious.
Vermont	July 1	¼ to ½ bush	September	
New York	June 10 to July 20	½ to 1 bush	September 15 to Nov.	Rich, sandy loam; sand and loam; deep black muck; light sandy.
New Jersey	July 13 to last of June	½ to 1 bush	September 15	Sandy.
Pennsylvania	June 1 to last July	¼ to 1 bush	Sept. 1 to Oct. 15	Slate; sandy loam; gravel or slate.
Tennessee	May 20	1 bushel	October 15	Mountain.
Kentucky				
Ohio	Middle June to July 1.	¼ to 1 bush	Sept. 20 to Oct. 1	Loose loam; sandy; black, thin and compact loam.
Indiana	July 1 to August 1	½ to 1 bush	September to Oct. 1.	Clay; black loam.
Illinois	June to July 1	15 to 25 lbs	September	Sandy loam; wheat stubble; black muck.
Michigan	June 15 to July 5	½ to 2 bush	Aug. 10 to Oct. 10	Light loam; light sandy do.
Iowa	June 20	½ to 1½ bush	September 20	

INDIAN CORN.

Maine	May 20 to June 6		September	Dry, warm, deep, clay loam; gravelly.
New Hampshire.	May 20	¼ bushel	September and Oct.	Warm, rich, silicious; any except clay.
Massachusetts	Last April to May 20		Last of Sept. to Oct.	
Vermont	May 10 to 20	6 to 8 quarts	September and Oct.	Sandy loam; dry loam; black slate.
New York	May 1 to June 10	4 to 12 quarts	September to Nov.	Gravelly loam; sand and loam; clay loam; black, gravelly; warm loam; gravelly; sandy loam; gravelly loam: do. with sand
New Jersey	May 2 to 10	4 to 6 quarts	Sept. 20 to Oct. 15	Sandy loam; do.
Pennsylvania	April 15 to May 15	⅛ to ¼ bush	Sept. 15 to Nov.	Sandy loam; sand and slate; limestone; sandy: do.; do.; loam: light; sandy; shale.
Delaware				
Virginia	March 25 to May 15	⅛ to ¼ bush	September and Nov.	Low bottom and sandy loam; sandy loam; do.
South Carolina	March and April	1-10 bushel	October	Clay sub-soil grounds and bottom lands.
Georgia	March 15 to May 1	⅛ bushel	October	Red Hickory land; red, black loam.
Alabama	February to May 1	1-10 to 1 peck	September and Oct.	Alluvial; light.
Mississippi	February to May		October	Rich bottom.
Tennessee	March to April	1-10 bushel	October and Nov	Black loam; best.
Kentucky	April and May		October and Nov	
Ohio	April and May	1-9 to ½ bush	October and Nov	Alluvium; do.; bottom land; do.; black ground; loam; sandy; black loam; loose land.
Indiana	April 1 to May 1	5⅓ qts. to 1¼ bu.	Oct. 1 to Nov. 30	Rich, black loam; black loam; sandy bottom.
Illinois	March to May 25	6 to 10 lbs	October to Dec	Sandy loams; do.; alluvial bottoms; bottoms.
Michigan	May 1 to 20	4 to 5 quarts	Sept. 20 to Oct. 15	Warm, sandy; intervale loam.
Iowa	April and May	4 qts. to ⅛ bush.	September to Nov	
Texas	February and March	1-10 bushel	Early in Aug. to Sept.	

POTATOES.

States.	Time of sowing or planting.	Average bushels or pounds of seed per acre.	Time of harvest.	Best Soil.
Maine	April to June	10 bush	September	Dry.
New Hampshire	May to June 1	10 to 15 bush	September and Oct.	Gravelly; old pasture land, without manure.
Massachusetts	April and May	10 to 20 bush	September and Oct.	Dry.
Connecticut	April and May	10 bush	September and Oct.	
Vermont	April 16 to June 30	10 to 20 bush	September	Loamy, if manured; sandy. with plaster; marl.
New York	April 15 to June	8 to 15 bush	Last May to Nov. 1	Black, gravelly; sandy loam; loam; dry, sandy loam and muck.
New Jersey	Last week in March to June 10	2½ to 10 bush	July 1 to Oct. 30	Sand; loose sandy loam; loam.
Pennsylvania	April and May	2½ to 10 bush	August to October	Sandy loam; do.; light loam; light; common; sandy; do.
Maryland	May	10 bush	September	
Virginia	February to June 20	2 to 10 bush	July to November	Sand and loam; do.; calcareous loam.
South Carolina	February to April	3 to 5 bush	September to Dec.	Fresh light; grey moist.
Georgia	February to May	3 to 5 bush	Sweet, Oct. 15; common, October	Sandy; grey.
Alabama	Sweet, April		October	Light.
Mississippi	Sweet, April; common, January	Sweet, 10 to 15; common, 4 bu.	November	Sandy loam.
Tennessee	April and May	3 to 4 bush	October 15	Clay; sandy; rich.
Kentucky	April and June			
Ohio	April to June 1	8 to 20 bush	Sept. 15 to Oct. 30	Bottom; loam; sandy; stiff; rich; alluvial.
Indiana	May 1 to June 20	3 to 20 bush	July 1 to last Sept	Rich, dry, sandy loam; sandy; black loam; light, sandy; black loam.
Illinois	March and June	Common, 8 to 12; sweet, ¼ to ½ bushel	July and October	Wet clay; new and alluvial; sandy.
Michigan	May 1 to June	5 bushels	October 10	Intervale; muck or loam.
Iowa	April and May		Sept. to Nov. 1	
Texas	February 1 to 20			

HAY.

Maine			July 15 to Aug. 15	
New Hampshire		¼ bushel	July and August	Diluvial and moist; clay; moist.
Massachusetts	April and May	10 lbs. clover; 1 peck timothy	July and August	Cultivated meadows.
Vermont			July and August	Wet.
New York		½ bushel	June 25 to Aug. 20	Deep, black muck; clay loam; moist alluvial.
New Jersey	March 1	¼ bushel	June and July	Meadow; sandy loam.
Pennsylvania		⅛ bushel	June and August	Limestone; light loam; sandy loam; clay for timothy; loam for clover.
Maryland			July	
Virginia	In the fall	6 lbs. clover; 4 lbs. timothy	June to August 15	Sandy loam for timothy; clay for clover; sand and loam; limestone.
Tennessee	August 10	1 bushel	June and July	Low swamp for herds grass; rich clay for clover.
Kentucky				
Ohio	September or March	1-10 to ½ bush	Last June to Aug. 1	Loose land; bottom; black swamp; clay loam; clay; do.; limestone.
Indiana	September to Feb. 1	4 to 10 quarts	June to August 1	Sandy; stiff table land; clay; damp clay; clay; do
Illinois	February	10 quarts	June and August	Wet clay; sandy.
Michigan			July 1 to October 10.	Clay; do.
Iowa		6 lbs.	June 1 to July 1	

HEMP OR FLAX.

Vermont	May	½ bushel	July	
New York	April	½ to 1 bush	July and August	Clay sand; alluvial.
Tennessee	April 4	2 bushels	May 20	
Ohio	April to May 1	1 to 2 bush	Last July to August.	Sandy
Indiana	April 1	½ to 1 bush	July 1	Loam; clay.
Michigan	April 15 to May 20		September 1	

TOBACCO.

Maryland	May to August		September	Sandy loam.
Virginia	May to June			
Tennessee	February 20		August 1 to Sept. 20.	Rich.
Ohio	April	1 bushel	August	Hickory and white oak.
Indiana	June		September	Loam.
Illinois	February		September	Manured lots.

COTTON.

States.	Time of sowing or planting.	Average bushels or pounds of seed per acre.	Time of harvest.	Best soil.
Virginia	May 1	2 bushels	October 1 to Dec. 15.	
South Carolina	April	75 pounds	Sept 1 to end Dec	Dry and light.
Georgia	April 1	2½ bushels	Fall	Sandy; do.
Alabama	March and April	1 to 4 bush	Fall and winter	Grey.
Mississippi	March 15 to April 15	3 bushels	August till March	Black loam.
Tennessee	April 20 to May 1	2 bushels	October	Clay, light.
Texas	March and April	Not material, if plenty	August 1	

RICE.

South Carolina		100 pounds	September	
Alabama	March	½ bushel	September	Branch lands.
Tennessee	April 20	2 bushels	August	Swamp.

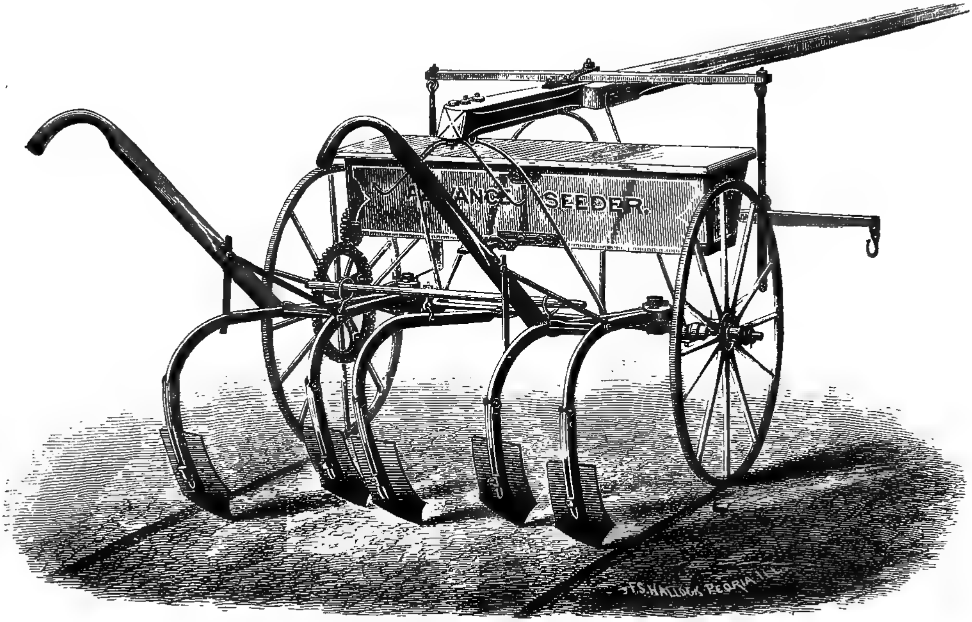
One of the mistakes in sending seeds long distances, except it be in the case of regular seedsmen, who understand their business, is, they are packed nearly air tight, and often in a damp state. The same is often true of seeds kept for sowing or planting. The consequence is they mold and even rot. The proper rule to be kept in view in the saving of all seeds for great lengths of time is, first, perfect dryness, at a temperature of not less than 100°, nor more than 130°, then packed in paper bags, enclosed in canvas sacks, and kept as near the freezing point as possible, and at the same time in a dry atmosphere. Hermetically sealing, and other methods of excluding the air, are not only useless but positively injurious. The following table of weights per bushel, time of sowing in the North, and quantity per acre, will be found valuable, and correct. The letter *a* signifies the months when they may be sown:

Weight per bushel.	Seed.	March.	April.	May.	June.	July.	August.	September.	October.	Quantity per acre.
60	Red clover	a	a							8 to 10 pounds.
45	Timothy	a	a				a	a		¼ to ½ bushel.
14	Red top		a	a			a	a		½ to 1 "
14	Ky. blue grass		a	a		a	a			1½ to 2½ "
50	Hung. grass			a	a					¼ to ½ "
50	Millet			a	a					¼ to ¾ "
45	Sorghum seed			a	a					2 quarts.
56	Flax seed		a	a	a					1 to 3 bushels.
56	Corn		a	a	a					4 to 6 quarts.
56	Rye	a	a					a	a	1 to 2 bushels.
60	Wheat	a	a				a	a		1 to 2 "
48	Barley	a	a	a			a	a		1½ to 2 "
32	Oats	a	a	a						2 to 3 "
52	Buckwheat				a	a				½ to ¾ "
60	Potatoes	a	a	a	a	a				10 to 15 "
55	S. Potatoes			a	a					Transplant.
	Beets		a	a	a					4 to 10 pounds.
..	Carrots		a	a	a					2 to 3 "
55	Turnips	a	a	a			a	a		½ to 1 "
	Parsnips	a	a	a	a					2 to 3 "
..	Onions	a	a							4 to 6 "
60	White beans			a	a					½ to 1 bushel.
60	Peas	a	a							1½ to 2½ "

The larger quantity of flax should only be sown when the lint exclusively is wanted, and then only on exceedingly rich and mellow land. Sweet potatoes, if in hills three feet each way, will require per acre 4,840 plants. If in ridges four feet apart by sixteen inches in the row, it will take 8,166 plants. Beets, carrots, and parsnips should not be planted in June, except for the purpose of getting small and tender roots for family use. The greater number of pounds per acre is used only in field culture where many plants are necessarily lost. The quantity of peas is, for sowing broadcast, when drilled, from one to one and a half bushels only will be required. Potatoes should not be planted in June and July, except early maturing sorts. These will usually produce excellent crops after the nights become cool in the fall. It is better to plant any potatoes in March and April, than in May—except in very high latitudes. As a rule, the earlier we seasonably plant our crops in the West, the better the crops will be, except turnips, buckwheat, etc., which require cool weather to mature in. The later these are sown, having time to mature, the better the crop. The following table explains itself, and will, as well as the others given, be found valuable for reference:

	Seeds, per oz.	Length of Drill, per oz.	Vitality. Years.
Asparagus	1,000 to 1,200	50 feet.	4 to 6
Beet	1,200 to 1,500	100 "	6 to 8
Carrot	20,000 to 24,000	200 "	1 to 3
Cabbage Cauliflower	8,000 to 12,000	Transplant.	4 to 6
Celery	50,000 to 60 000	Transplant.	3 to 5
Egg plant	5,000 to 6,000	Transplant.	5 to 6
Endive	20,000 to 24,000	Transplant.	8 to 10
Lettuce	25,000 to 30,000	400 feet.	5 to 6
Okra	500 to 600	50 "	5 to 6
Onion	7,000 to 8,000	200 "	1 to 2
Parsnip	5,000 to 6,000	200 "	1 to 2
Radish	3,000 to 4,000	100 "	4 to 5
Salsify	2 500 to 3,000	100 "	4 to 5
Spinach	2.000 to 3 000	100 "	4 to 5
Tomato	About 20,000	Transplant.	4 to 5
Turnip	8 000 to 12,000	200 feet.	6 to 7

Dwarf beans will run from 1,200 to 4,000 seeds per quart, according to the variety; Lima, Scarlet runners and other large pole varieties are much larger. The seed required per acre is from thirty-six to fifty quarts. Pease will run from 1,200 to 2,000 seeds per acre, the large marrows giving the lesser and the dwarf varieties the greater number. The seed required per acre is from thirty-six to fifty quarts of garden seed, the quantities per acre given above are more than are required to mature, but enough must be planted to insure a crop. Of potatoes, eight bushels will plant an acre in hills three feet apart each way—two pieces in each hill—if cut small, but fifteen bushels will be used in drills three feet apart, by about fifteen inches in the drill, if cut to two to three eyes. The seeds of vegetables should be attended to as they ripen, and be carefully taken care of. Thus peas, when ripe, should be pulled, and after becoming dry in the sun, ought to be immediately threshed and spread in some airy place to season. The same rule will apply to beans. Top onions may be cut and hung up, or laid in rows to cure. Shallots, black seed, and potato onions should be pulled when the tops are generally dry, but not yet withered, and placed in windrows to mature. Garlic should be tied in bunches, and hung up to dry in the shade. Lettuce, parsnip, oyster-plant, etc., should be cut and dried in the shade. If possible do not wait until the seeds are all ripe. If you do, many of the best seeds will be lost. Corn should be plucked as soon as the husk begins to dry and hung up in the air to ripen. Tomatoes and other pulpy fruits should be allowed to become entirely ripe and then broken, and macerated in water to separate the seeds. Cucumber seeds should be washed in this way. Do not allow undue fermentation, however, as it blackens the seeds. In cleaning wheat, oats, barley, and other small grain, save only the best for seed. The time to save the seed is when you are marketing your grain. Pot herbs should be cut while green, carefully and thoroughly dried in the shade, and then laid away in paper bags for future use. It will pay every farmer to grow vegetables, and also to save some of the more important seeds thereof.



COMBINED SEEDER AND CULTIVATOR.

SEEDING. One of the most important operations of the farm, is the equal distribution of the seed over the land, whether in drills or broadcast, so there shall be no bare spots, and that each plant may have equal room, measurably at least. In the old way of seeding by hand this was a difficult matter, even by the most practiced sowers, either from an inequality of the several casts, and especially from the contingencies of wind, and other causes beyond the control of the operator. In this direction, agricultural ingenuity has fully kept pace with invention in other directions, relating to the farm. We have now machines adapted to sowing the finest grass seeds in accurate proportions per acre, or the most bulky grains and seeds, either in drills or broadcast, and at any given depth, and in the case of drills, from the most minute garden seeds, one drill at a time to the young field seeder, which will finish twelve acres a day, leaving the seed covered at any required depth, and the drills exactly equi-distant one from another. Above we give a cut of a combined seeder and cultivator. In the planting of seeds in hills or check-rows, there would seem to be little desired, the better class of check-row attachments doing away with all marking of spaces previous to planting.

SEED LIP. A sowing basket.

SEED LOBES. The fleshy substance of the seed, the *cotyledons;* there are two in dicotyledonous or exogenous plants, but one in endogens, such as grasses, cerealia, palms, etc.

SEDGES. Plants of the genus *Carex*, perennial; coarse, false grasses, growing generally in marshes and wet places.

SEGMENT. A slice, a portion cut from a solid by a line or plane

SELECTION OF SEED. (See Seed.)

SELENITE. Crystallized sulphate of lime.

SELENIUM. An elementary body closely resembling sulphur. Selenic acid is isomorphous with sulphuric acid; it is very rare.

SEMEIOTIC. Relating to the signs or symptoms of diseases.

SENECA SNAKEROOT. *Polygala senega.* A perennial-rooted, common plant, especially in the South, the roots of which are used as an expectorant.

SENNA. *Cassia senna.* A small leguminous shrub of Africa and Arabia, the leaves of which are much employed in decoction as a purge.

SENSIBLE FROG. The part of a horse's hoof immediately above the bony covering; the fleshy sole.

SENSITIVE PLANT. Plants or shrubs of the genus *Mimosa,* whose leaves fold when touched, or shaded from the sun.

SEPALS. The leaflets of the calyx.

SEPTARIA. Large nodules or masses of a marly clay found in some geological formations; when burned they form Roman cement which has the property of hardening under water.

SEPTIC. Substances or causes which hasten putrefaction.

SEPTUM, SEPTA. A partition, especially in a seed vessel.

SEQUOIA. A genus of plants to which the giant trees of California, *S. gigantia,* and the redwood, *S. Sempervirens,* belong. They are difficult to transplant, and not hardy in the North, and neither of them will probably be valuable for cultivation in the United States outside their native habitat.

SERICEUS. Silky, covered with short, soft hairs.

SERICIC or MYRISTIC ACID. An oily acid obtained from the butter of nutmegs.

SEROSITY, SEROUS FLUID. (See Serum.)

SERRICORNS. A coleopterous family, many of which have serrated antennæ.

SERUM. The fluid portion of the blood; it consists of a solution of albumen in soda, with salts, and contains seven per cent. solid matter.

SESAMOID. Small bones not larger than a pea, found at the joints of the toes and fingers.

SESQUI. One and a half. *Sesquioxide.* An oxide containing three equivalents of oxygen, and two of metal.

SESSILE. Without stalk, sitting on the stem.

SETA. A term used by botanists in various senses. It is the stalk that supports the theca, capsule, or sporangium of mosses; the awn or beard of grasses, when it proceeds from the extreme point of a palea or glume; sometimes the glandular prickles of roses, and also the abortive stamens or rudimentary perianth of cyperaceous plants.

SETACEOUS. Bristle-like. *Setose,* bristly.

SETONS. These are generally made of tapes, though sometimes fine wire or strong thread is used. Their object is to produce a running sore and constant irritation, to cure bone disease, strained sinews, or in healing fistulas. They are inserted by means of a seton needle, and are to be smeared daily with some irritating ointment, and also moved forward at the same time. The ends, of course, must be knotted together to prevent their dropping out. A good ointment is made by taking one part each of oil of turpentine, and powdered cantharides, and digesting them together in a closed vessel, and then adding eight parts of Canada balsam; or the seton tape may be smeared with either oil of turpentine, or citrine ointment, according as a mild or sharp irritant is desired, or they may be mixed in the proportion of one part of turpentine to three of citrine ointment.

SEXES. In plants, the stamens and pistils; the former being called the male, and the latter the female organs, from a fanciful analogy.

SHADDOCK. An inferior but very large orange; the fruit of the *Citrus decumaria.*

SHAFT. The trunk of a column, the entrance or downward excavation of a mine; a handle.

SHAKES IN TREES. Fissures, clefts, rents, or black and rough places in trees or timber.

SHALE. A loose, rotten, or crumbling slate.

SHALLOT. *Allium ascalonicum.* A species of onion, the bulbs of which are of small size, of mild flavor, something resembling the leek, which are cultivated by planting the small sets in precisely the same manner as onion sets. They are but little cultivated.

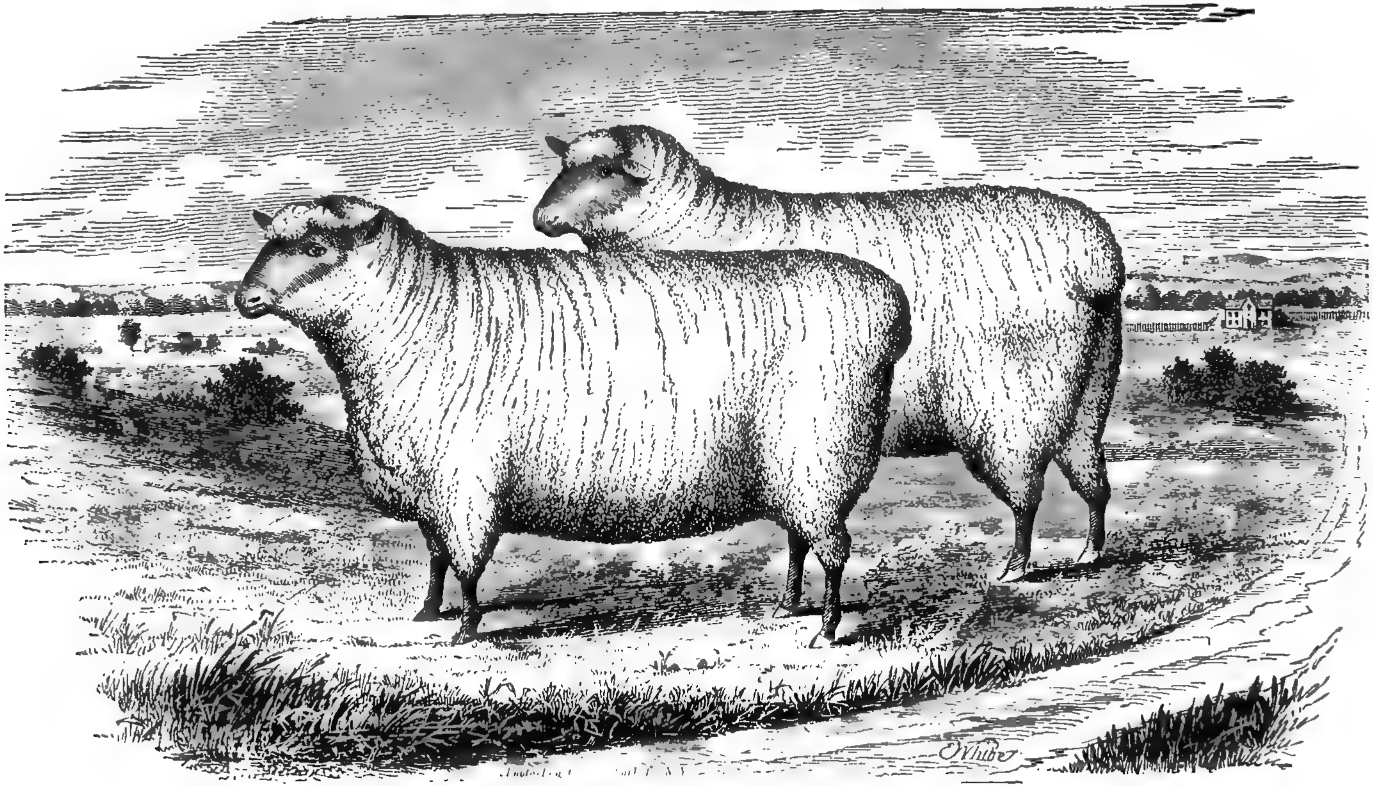
SHANK BONE. The femur.

SHARE OF A PLOW. The point.

SHARP-SHINNED HAWK. (See Buzzard.)

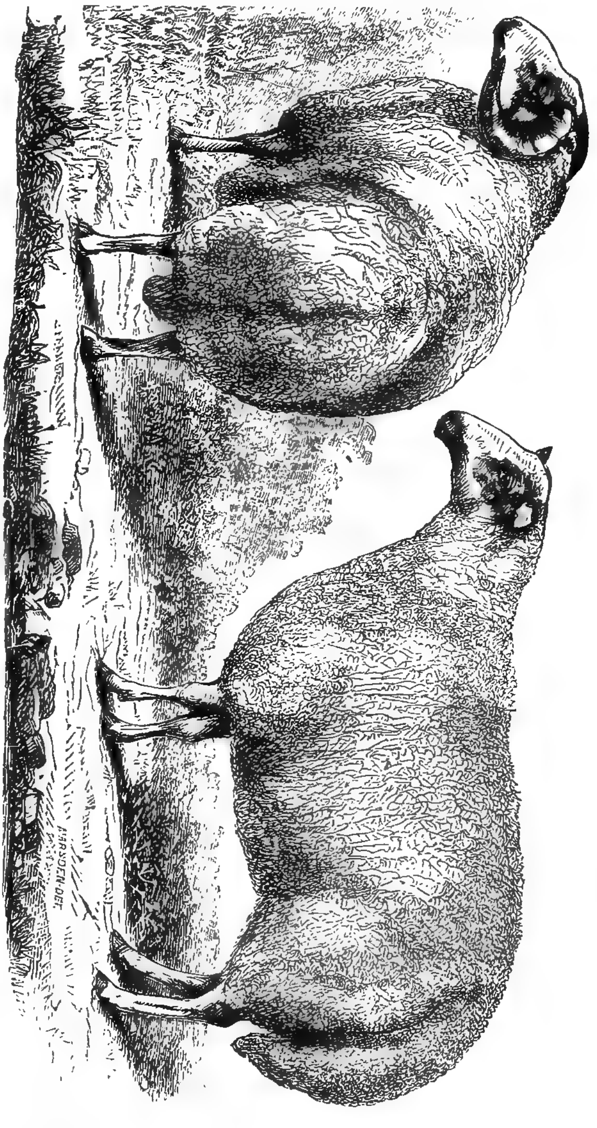
SHEARLING. A sheep once shorn.

SHEEP. The antiquity of sheep, as kept for their flesh and wool, is coeval with the first dawn of civilization of mankind. The original wild type is lost in obscurity, and naturalists have conjectured in vain as to when the original race was indigenous, and from what race or races domestic sheep have sprung; some asserting the mufflon (*Ovis musmon*) of Barbary, Crete, Corsica, Sardinia, and the islands of the Grecian Archipelago to be its origin; others, the argali (*Ovis ammon*) of Siberia; while others again, consider it likely that more than one wild species have commingled to form the numerous domestic breeds. Whatever may have been the type of our common sheep, there can be no doubt that they are naturally mountainous animals. For, if left to themselves, it is always observed that they prefer hill-sides and rocky mountains to valleys and low plains; and, in the former situations, they thrive better, although they acquire less flesh than on more luxuriant soils. The domesticated sheep is pre-eminently a wool-bearing animal; yet many races seem to be destitute of this covering, particularly in tropical climates, and to be clothed with wool, so closely resembling hair as not to be distinguishable from it unless by means of a powerful lens. The mufflons and argali, that is, the wild species, are covered with a harsh kind of hair, having beneath it, at its roots, a short, spiral wool, which, in winter, becomes longer and more full. Mr. Bell, an English writer, considered the harsh hair as essentially wool in its structure, presenting the imbrications which the microscope shows to be the characteristic of wool, and on which its felting property depends; and he regards the short under-coat as composed of hair, and not of wool. Mr. Youatt makes the contrary statement, and, notwithstanding the appearances noticed by Mr. Bell, one might be inclined to the opinion of the former; for, as is well known, in the Cashmere and Angora goats, the long outer covering is hair; the under-coat exquisitely fine down, or wool. In other down or wool-bearing animals, as the beaver and otter, a similar arrangement prevails; and we know, moreover, that, in some neglected breeds of the domesticated sheep, the wool becomes mixed with long, coarse hairs, by which it is more or less obscured. Both in its natural and domesticated state, the sheep is a gregarious animal, collecting in flocks of greater or fewer numbers, according to the nature of the district it frequents, and the abundance of pasture. The more the sheep is neglected, and the less its range of pasture is circumscribed, the more will it acquire habits of independence, and the more will its instincts be drawn forth and put into exercise. In wild and mountainous districts, it has been remarked that sheep unite in self-defense, and form themselves into a phalanx in opposition to a strange dog, or a prowling fox, the rams heading the array, and presenting a formidable front to the foe, while the ewes and lambs crowd together in the rear. Should the intruder venture within a certain distance, they rush upon him and commence a violent assault. On the mountains, they display considerable boldness and agility in leaping from crag to crag, and frequently climbing about the whole surface of the almost perpendicular sides of the precipitous rocks, by treading upon the narrow ledges and projections, which scarcely afford them room to stand. In these apparently dangerous situations, sometimes at a height of several hundred feet, and with the billows of the ocean roaring beneath them, they show that they are not such cowardly and stupid beings as they have been described. They exhibit great intrepidity, and a full confidence in their skill, vieing with the goat in sureness of step and strength of spring, when they are ascending to the summit by repeated bounds. With regard to the courage of sheep may be instanced the boldness with which the ewe not unfrequently defends her offspring from danger, and the desperate combats often occurring between the rams, actuated by a feeling of mutual jealousy; for, as soon as they come together, they rush headlong at each other with immense force, the concussion of their heads being audible at a very considerable distance. The skin of sheep is composed of three textures. Externally is the cuticle or scarf-skin, which is thin, tough, devoid of feeling, and pierced by innumerable minute holes, through which pass the fibers of the wool and the insensible perspiration. It seems to be of a scaly texture. This is plain to be seen when the sheep have the scab. Below this is the *rete mucosum*, a soft structure, its fibers having scarcely more consistence than mucilage, and being with great difficulty separated from the skin beneath. This seems to be placed as a defense to the terminations of the blood-vessels and nerves of the skin, and these are in a manner enveloped and covered by it. Beneath is the cutis or true skin, composed of innumerable minute fibers crossing each other in every direction, highly elastic, in order to fit closely to the parts beneath, and to yield to the various motions of the body. Judging from the mixture of wool and hair in the coat of most animals, it is thought by some that the primitive sheep had a hairy covering. It is said that there are, at the present day, varieties of sheep that are clothed outwardly with hair of different degrees of fineness, and underneath the external coat is a softer, shorter, and closer one that answers to the description of fur, but which really possesses all the characteristics of wool. It is, therefore, highly improbable that the sheep, which has now become, by cultivation, the wool-bearing animal, should, in any country, have ever been entirely destitute of wool. Sheep of almost every variety have at times been in the gardens of the Zoological Society of London, but there has not been one on which a portion of crisped wool, although exceedingly small, has not been found at the bottom of the hair The filament of the wool has scarcely pushed itself through the pores of the skin, when it has to penetrate through another and singular substance, which, from its adhesiveness and color, is called the yolk. It is found in greatest quantity about the breast and shoulders, the very parts that produce the best and most abundant wool, and in proportion as it extends to any considerable degree over other parts, the wool is then improved. It differs in quantity in different breeds; it is very abundant in the Merino. The yolk being a true soap, soluble in water, accounts for the comparative ease with which the sheep, that have the natural proportion of it, are washed in a running stream. The fiber of the wool having penetrated the skin and escaped from the yolk, is of a circular form, generally larger toward the extremity and also toward to root, and in some instances very considerably so. When the animal is in good condition, and the fleece healthy, the appearance of the fiber is brilliant, but when the state of the constitution is bad the fiber has a dull appearance, and either a wan, pale light, or sometimes scarcely any, is reflected. The age of the sheep is generally determined by their teeth. When they are about one year and a half old, they shed their two center teeth of the incisors, and two wide ones grow out and take their place. The next year the next two are shed, and when the sheep is three years old the four central teeth are fully grown. At four years they have six teeth, and at five years the teeth are perfectly developed. This is one year before the horse or ox can be said to be fully mouthed. This rule for the age of sheep will hardly ever fail in ewes, but sometimes will in the case of rams. If not too old, their age may be determined by the growth of their horns each year. The difference caused in the shedding of their teeth may be by the manner in which the sheep are cared for. If well fed and kept in a thriving condition, they will shed them faster, and *vice versa.* Some sheep with the full mouth will hold their teeth much longer than others. The natural age of sheep is about ten years, to which time they will thrive and breed well if in good health. Sheep husbandry was early undertaken in the United States, but has been subjected to great vicissitudes. Sheep were imported into the colony of Virginia as early as 1609, and they increased by 1648 to three thousand. The Dutch West India Company introduced them about the year 1625, but they proved to be too much of a temptation for dogs and wolves, for it is recorded that in 1643 there were but sixteen in that whole colony. They were kept upon the islands in Boston Harbor as early as 1633, and two years after there were ninety-two in the vicinity of Portsmouth, N. H. It became the universal practice in the good old days of homespun for the farmer to keep a number sufficient to clothe his family. The old native sheep was a coarse, long-legged, and unprofitable animal, and there was no improvement made in the breeding till toward the close of the last century, when, in 1793, the first merinoes, or fine-wooled sheep, were imported by William Foster, of Boston. They were wholly unappreciated, were given to a gentleman to keep, and he, knowing nothing of their value, simply ate them, and a few years after was buying the same class of sheep at $1,000 per head. The embargo of 1808 induced many to turn their attention to fine-wooled sheep, and soon very large numbers of merino sheep were imported and distributed throughout the United States, and our modern sheep-husbandry, now grown up to its proportional importance, may be said to date from these importations. The finest wooled sheep are now most extensively produced in the United States and in Australia. Next comes France, and then Spain. Mutton sheep have been carried to great perfection in England, and of late years, this industry has been a constantly increasing one through the importation of the best representatives of the middle and long-wooled breeds. Of the English breeds, the report to the Government of the United States, following the Vienna Exhibition, states the characteristics of prominent English breeds as follows: The British breeds are most naturally divided according to altitudes and fertility of their habitat. The large breeds, white, hornless, and bearing long wool with small felting property, occupy the rich alluvial districts, the lands reclaimed from the sea, and the highly cultivated and very productive farm-areas. These are the Leicester, Lincoln, Romney-Marsh, Cotswold, the few remaining of the Devonshire Notts, the Roscommon, and similar Irish sheep. Next should be classed the sheep of the chalk-downs, the commons, and forests, suited to a dry and temperate climate. There are the Downs of several families, perhaps now to be taken as breeds, the Dorsets and their congeners, the pink-nosed Somersets. They produce a short, felting-wool, suited to inferior grades of goods. The Ryeland, formerly found in the western counties, and esteemed for producing the finest cloth-wool of England, is now almost extinct. The third general division comprises the mountain breeds, first the Cheviots of the hills of the North of England and borders of Scotland; the Black-face of the central chain of mountains and moors northward from Derbyshire to the mountains of Scotland; and two varieties of Welsh mountain-sheep, and the Kerry and other mountain-breeds of Ireland. There are many local remnants of the ancient stock allied to the above, but there are none worthy of special mention. The weight of fleece of British sheep averages about five pounds. The Lincolns may be placed at eight pounds, the Cotswolds nearly the same, the Leicesters at seven, the Downs at four, the Cheviots at three, the Black-faces at two and one-half, and the Welsh at two. The Leicesters are most numerous, exceeding one-third of all; the Downs one-sixth, the Black-faces nearly as many, Cheviots one-eighth, leaving about one-fifth for other breeds. The heavy breeds of eighty years ago, modified mainly by the Leicester, now furnish lighter fleeces. For instance, the Lincoln, as reported by Hon. Robert R. Livingston, then yielded eleven pounds; the Teeswater and Cotswold, nine pounds. These are, of course, average weights, as rams as well as pampered ewes and wethers, greatly exceed the average. The weight of carcase exceeds by twenty per cent. the weight of imported mutton, and averages sixty pounds; by some estimates, sixty-five pounds. A brief reference to this improvement, with the characteristic points and present status of the principal breeds, will indicate more fully the progress of the century in sheep-husbandry. Leicesters.—The Leicestershire sheep, in the beginning of the Bakewell era of improvement, were known by their names, the old Leicesters, the new Leicesters, or Dishleys, (the latter from Bakewell's place of residence,) and the forest-sheep. The Dishley experiment commenced in 1755, and was continued so successfully that the rams of this famous flock ultimately commanded $15,000 as hire for the season, giving an impetus to the improvement which was perpetuated by the permanence and desirability of the results achieved, until the breed assumed a position which has been maintained to the present time. The original Leicester upon which Bakewell commenced his experiment was an animal of large frame, with heavy bone and course-grained meat, a flat-sided carcase, and legs large and rough. It was a slow feeder and necessarily late in reaching maturity, weighing at two or three years old 100 to 120 pounds. Seeing the necessity of obtaining, in addition to the fleece, the largest possible increase of flesh in proportion to the food consumed, in the shortest period of time, he bred by selection most persistently and skillfully for these objects. With these aims always in view, he chose with rare judgment, yet with a broad latitude as to breed or family, such animals as would approximate his ideal of compactness and symmetry, refinement of bone, a reduction of the proportion of unprofitable parts, and higher capacity for rapid conversion of food to flesh. After securing this result by animals of characteristics so widely differing from those of the original stock, he found necessary a rigid adhesion to the practice of in and in breeding to keep the advantage gained, until a fixedness of type had been secured which should impress itself surely and indelibly upon any race which might be selected for improvement. In accomplishing results of such practical value, with all possible care to retain the sound constitution and great hardiness of the old stock, there was perhaps inevitably induced a comparative delicacy, a reduction in size, a decrease in prolificness and excellence as nurses. These defects have indeed demanded the wisest judgment in the infusion of fresh strains of blood, by which the stamina of the race has been fortified, and its popularity maintained until the present day, to such a degree that the Leicester blood is far more widely diffused than that of any other breed, even modifying essentially all the long-wool races, and to some extent the mountain breeds, and some families of the short-wool Downs. The true type of this breed, as understood by Youatt, is thus described: The head should be hornless, long, small, tapering toward the muzzle, and projecting horizontally forward. The eyes prominent, but with a quiet expression. The ears thin, rather long, and directed backward. The neck full and broad at its base, where it proceeds from the chest, so that there is, with the slightest possible elevation, one continued horizontal line from the rump to the



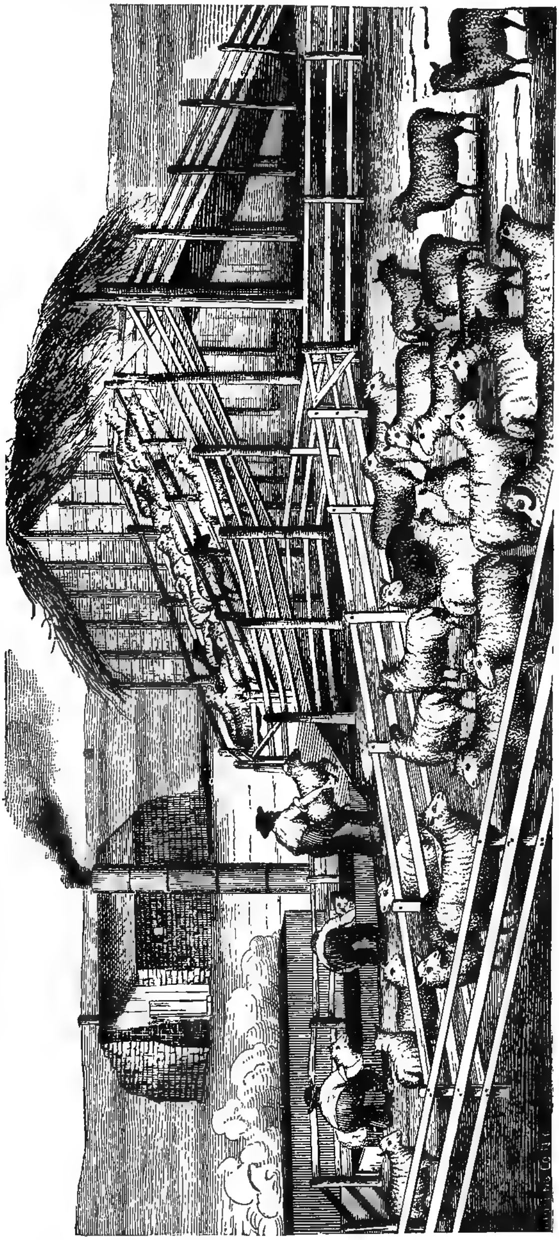
HAMPSHIRE DOWN EWES.

poll. The breast broad and round, and no uneven or angular formation where the shoulders join either neck or the back; particularly no rising of the withers or hollow behind the situation of these bones. The arm fleshy through its whole extent, and even down to the knee. The bones of the leg small, standing wide apart; no looseness of skin about them, and comparatively bare of wool. The chest and barrel at once deep and round, the ribs forming a considerable arch from the spine, so as in some cases, and especially when the animal is in good condition, to make the apparent width of the chest even greater than the depth. The barrel ribbed well home; no irregularity of line on the back or belly, but on the sides; the carcase very gradually diminishing in width toward the rump. The quarters long and full, and, as with the fore legs, the muscles extending down to the hock; the thighs also wide and full. The legs of a moderate length; the pelt also moderately thin, but soft and elastic, and covered with a good quantity of white wool. The Leicester requires less food in proportion to weight than any other race. They are mostly sold early in the summer or early autumn after their first year, many wethers at twelve to fifteen months weighing twenty to twenty-five pounds per quarter; and at two years they attain the weight of thirty to thirty seven pounds. The fleeces are valuable as fine combing-wool, and, if well grown, weigh from seven to eight pounds each. The earliest record of this breed in the United States is a mention by Custis of the Bakewell ewes on the estate of Washington, from which, through a cross by a Persian ram, was derived the somewhat famous Arlington long-wooled sheep. The influence of this and other long-wool flocks of Virginia gave a popularity to the English races which has continued to the present day, though the preference at present appears to be given to the Merinoes, especially since the war and its accompanying destitution and lack of thrift. Kentucky also gives a preference to the Leicester, as a fit companion to the short-horn bullock upon the blue-grass pastures. They are to be found in small numbers in the Middle and Ohio Valley States, generally in a semi-degenerate state, not bred up to the modern standard of the perfect Leicester in his English home. The mutton of Leicesters is too fat to suit American taste, yet that of grades is quite palatable, though coarse-grained, with too much outside fat. Even in England meat of animals two years old is less valuable than that of lambs or shearings; and the price is always materially lower than mutton of Southdowns and the mountain races. Border Leicesters.—More than a century ago some of the sheep-folds of the border were reinforced by Leicestershire sheep of established repute. Early in the present century representatives of the Dishley stud began a contribution to the improvement, which has been continued until they have won a distinct position in the show-yard and in popular esteem. The characteristics of this breed, as given by Mr. John Wilson, are extraordinary aptitude to fatten and early maturity. He says: The most marked feature in their structure is the smallness of their heads and of their bones generally, as contrasted with their weight of carcase. They are clean in the jaws, with a full eye, thin ears, and placid countenance. Their backs are straight, broad, and flat; the ribs arched, the belly carried very light, so that they present nearly as straight a line below as above; the chest is wide, the skin very mellow, and covered with a beautiful fleece of long, soft wool, which weighs, on the average, from six to seven pounds. On good soils, and under careful treatment, these sheep are currently brought to weigh from eighteen to twenty pounds a quarter at fourteen months old, at which age they are now generally slaughtered. At this age their flesh is tender and juicy, but when carried on until they are older and heavier, fat accumulates so unduly in proportion to the lean meat as to detract from its palatableness and market value. Cotswolds.—This is one of the largest English breeds, though the improved race is smaller than the originals, on account of the influence of the Leicester element in its amelioration. As a breed it is of great antiquity. It has gained in fleece and form, and comes to maturity earlier; is more prolific than the Leicester, and has greater strength of constitution; is often fattened at fourteen months, yielding fifteen to twenty pounds per quarter, and twenty to thirty if kept till two years old. The fleece is six to eight inches in length, and sometimes much longer; is strong, somewhat coarse, of good color, and yields a heavy fleece. The mutton is superior to that of the Leicester, with a smaller proportion of fat, and the sheep are also superior to that popular breed in weight of wool, size, hardiness, and vitality. They are possessed of good figure, have a large head, well set on, a broad chest, a well-rounded barrel, and a straight back. They are often used for crossing upon other breeds, and for obtaining earlier market-lambs, both in this country and in Europe. They are more widely disseminated in this country than any other long-wool, and preserve well the popularity which they have attained here. Some imported sheep of this breed have borne fleeces in this country of eighteen pounds. Lincolns.—The old Lincolns, of the fertile meadows of Lower Lincolnshire, were remarkable beyond any contemporary breed for coarse and heavy forms and length of wool, the fleeces weighing ten to twelve pounds. They were hornless, with large limbs, hollow flanks, and flat sides. They shared with the Romney-Marsh sheep the alluvial and fen districts, consumed largely their rank pasturage and fattened slowly. When the fame of Bakewell at Dishley was rising to its zenith, recourse was had to his improved Leicesters for improvement in the flesh-taking property, and this course of crossing was pursued to the close of the eighteenth century, and indeed to the present time, as found necessary, for the purpose of securing a better form and earlier maturity without losing wholly their peculiarities of size and length of fiber. For at least a quarter of a century a sharp contest was waged between the supporters of the old and the new, the former fearing the loss of hardiness and local adaptation, as well as its unrivaled peculiarities of fleece, while the latter were quite willing to risk any or all of these results in the belief that more mutton and wool and money could be realized upon each acre of area than with the modified Lincolns. And the latter ultimately prevailed, and verified the correctness of their theory. The effect of this change upon the wool has been to make it shorter and finer, and to diminish somewhat its softness of fiber. It is a question whether the peculiar quality of the wool could have been retained in larger degree without essential injury to its mutton producing quality. This district of country still continues to produce the largest sheep of Great Britain, with fleeces superior in weight and value to any other. They are not equal in earliness of maturity to the Leicesters, but they are profitable, and suitable to the rich lands they occupy, wethers frequently attaining the enormous weight of fifty to sixty pounds per quarter. Romney-Marsh —There is another breed of English sheep inhabiting the rich alluvial soil of Kent, known as the Romney-Marsh sheep, which pertinaciously retains its distinctive features, though modified and improved by recent breeding. It is a large sheep, not very symmetrical in form, having narrow forequarters and flat sides, and coarse bone and muscle. It has a white face, a long and thick head, and a tuft of wool on the forehead. The wool is of more value than the mutton, perhaps, (but would not be profitable without it,) being long, fine and lustrous, and in demand at good prices for export to Flanders and to France, for the manufacture of cloth of gold and similar fabrics. Other breeds have been introduced upon the marshes, but can not maintain themselves in competition with the Romneys. The country is flat, open to the east, and very bleak, yet these sheep live through the winter in the open fields, and have little protection or supplied food. The ewes are comparatively prolific, about thirty per cent. of doubles being expected in reproduction. The lambs come late, after the severity of the winter is over. With a good course of turnip feeding after the first wintering they can be brought to seventeen pounds, sometimes to eighteen pounds, per quarter, yet they are more frequently kept over a second winter. They are not very early in maturing, and grass is the main reliance for growth if not for fattening. There are cattle on the farms, but sheep greatly predominate and furnish the principal profits. The pasture lands of the marsh differ greatly in productiveness. There are feeding lands, keeping two or three ewes in winter and twice as many in summer; and the fattening lands keep four or five sheep per acre. The original Sussex or Southdowns have probably the purest blood, free from admixture during the long period which covers the rise and development of the British wool-manufacture and the increase of meat production, of any race of British sheep. Their improvement has been long-continued and is still continuing, apparently without the necessity of recurrence to any foreign blood for amelioration of a single objectionable point. While they have been greatly improved, progress has invariably been in the direction indicated in the distant past, and not by radical and violent changes. It has been carried on, there is little reason to doubt, solely by selection, there being little, if any positive evidence that the Leicester or other blood has aided in the amelioration. In the production of Hampshire and Shropshire and other breeds bearing the Down name, it is well known that other blood has been effectively used; but it should be remembered that these families, or rather breeds, are not really improved Downs, but have come from selected individuals of other hardy, primitive breeds, molded into a modification of the Southdown type by large and repeated infusion of that blood, with occasional dashes of Leicester to give greater size and aptitude for fattening. The changes effected in the true South (or Sussex) Downs have been mainly these: Speckled faces have been changed to a uniform tint of brown or fawn color, sometimes almost a gray; the forehead and cheeks have been partially covered with wool; a greater symmetry of form has been obtained; a larger size and greater fattening aptitude. The flock of Lord Walsingham exhibits some deviation from the Sussex type, having somewhat greater length and a decided development of the forequarter, giving greater weight at the expense of somewhat reduced value to the butcher. They are splendid animals, and have been largely sought by continental purchasers, though disapproved by many breeders of pure Southdowns. By reason of its purity the Southdown, perhaps, has stamped its peculiarities upon its cross-bred offspring more certainly and strongly than any other of the English breeds; and for this reason, together with its hardiness and the unsurpassed quality of its mutton, it is deemed of greater practical value in its crosses than in its pure-bred flocks. But for the fact that quantity and quickness in lamb production are of more pecuniary value than superior quality, it would far surpass the Leicester in its prevalent use for cross-bred early lambs. It is now considerably more than one hundred years since Mr. Ellman, of Glynde, Sussex, sought a more symmetrical and profitable form, and a superior flesh and fat producing habit, without injury to constitution or fecundity; and he pursued his object slowly, cautiously, with a judgment, patience, zeal, and intelligent liberality that insured success. The light forequarters, narrow chests, and long necks and limbs were totally changed This is the description given by Mr. Ellman, himself, to his improved sheep: The head small and hornless; the face speckled or gray and neither too long nor too short; the lips thin, and the space between the nose and the eyes narrow; the under jaw, or chop, fine and thin; the ears tolerably wide and well covered with wool, and the forehead also, and the whole space between the ears well protected by it as a defense against the fly: the eye full and bright, but not prominent; the neck of medium length, thin toward the head, but enlarging toward the shoulders, where it should be broad and high, and straight in its whole course above and below. The breast should be wide, deep, and projecting forward between the fore legs, indicating a good constitution, and a disposition to thrive. Corresponding with this, the shoulders should be on a level with the back, and not too wide above; they should bow outward from the top to the breast, indicating a springing rib beneath and leaving room for it, the ribs coming out horizontally from the spine, and extending far backward, and the last rib projecting more than the others; the back flat from the shoulders to the setting on of the tail; the loin broad and flat; the rump long and broad, and the tail set on high, and nearly on a level with the spine; the hips wide, and the space between them and the last rib on either side as narrow as possible, and the ribs, generally speaking, presenting a circular form like a barrel; the belly as straight as the back; the legs neither too long nor too short; the forelegs straight from the breast to the foot, not bending inward at the knee, and standing far apart both before and behind; the hocks having a direction rather outward, and the twist, or the meeting of the thighs behind, being particularly full; the bones fine, yet having no appearance of weakness, and of a speckled or dark color. The belly well defended with wool, and the wool coming down before and behind to the knee and to the hock; the wool short, close, curled, and fine, and free from spiry projecting fibers. The Dorsets.—A very ancient race of sheep is found in the county of Dorset, which formerly included a large tract of country. It has some resemblance to the Merino in form, but none in other respects. In 1749 they were described by Ellis as having white fleeces, white and short legs, broad loins, and fine curled wool. They still have white legs and faces, and show some increase in length of limb and in weight of fleece, which averages about four pounds of fine wool without sufficient softness for goods of first quality. Its great distinguishing peculiarities, which prevent its extinction as a breed, are its early breeding and fecundity, rendering it popular for early lambs, dropped in October, and fit for table at Christmas. There is a paying demand for them raised as house-lambs for the London market. Either Leicester or Southdown rams, preferably the latter, are generally employed, making the lambs a Dorset cross. Some have attributed their peculiarities to an origin in a warm climate; others to the comparative mildness of climate, a calcareous soil, and to the abundance of thyme and aromatic plants in the herbage. These sheep are hardy, fold well, subsist on scanty pasturage, and wethers at three years old furnish mutton weighing eighteen pounds per quarter. While their range has been reduced by the predominance of the modern Leicesters and Southdowns, they maintain a better footing in the county of Somerset than in Dorset itself, exhibiting here slight difference in type, especially showing a pink-colored nose like the Merino, and often called the pink-nosed Somerset. They have also somewhat greater length of wool, larger lambs, and mutton heavier per quarter. Other varieties of the Dorset group, inhabiting the older commons of the south and west of England, are nearly extinct, though traces of them may still be found. One variety, inhabiting the isle of Portland, still exists in a state of purity. They are small, gentle, of good form, with a tinge of dun on the face and legs. Their wool is of medium fineness, weighing two pounds per fleece. The wethers often produce mutton weighing ten pounds per quarter. Welsh mountain-sheep.—The Welsh is another mountain-breed, indigenous, and still unmodified in the higher elevations, while they are the basis of the more cultivated flocks inhabiting the more productive valleys. They are small, weighing as store-sheep about seven pounds per quarter. The head is small and well set up, the poll clean, except sometimes a tuft upon the forehead; the females generally hornless; the faces unusually white, with occasional instances of gray, speckled, or rusty brown. They are narrow-chested, low-shouldered, high-rumped, long-tailed, active in movement, having little regard for fences or hedges, hardy and thrifty on scanty herbage. The wool is fine, though not very even in quality; fleeces weighing about two pounds. They are not prolific, as one lamb is enough for a mother to care for in mountain pastures, but are good nurses, and are sought for on that account for breeding fat lambs from Leicester or Down crosses. In the winter, just before the lambing-season, the ewes are brought down from the mountain-wilds and supplied with small quantities of hay or oats; if the latter, sheaf-oats are used, as the little Welsh sheep would not know what to do with clear grain. Lambs kept in the flock are shorn in July or August; and after weaning, the mothers are milked for a month or two, and butter is made, or the milk is used to improve skim-cheese. They are too wild for ordinary farm economy of the lowlands, a new lot brought home disappearing in all directions if allowed the opportunity to scatter, and sometimes found on the roofs of neighboring cottages. Cheviots or other breeds do not thrive in their mountain-home, rendering it probable that they will not be superseded, though they may be modified. Cheviots.—As the Black-faces monopolize the higher mountain-lands, the Cheviots occupy the lower elevations, the hills of the border counties between England and Scotland. They have been systematically improved by the use of carefully selected rams of Lincolnshire, before the day of the improved Lincoln race. It has been claimed that the Leicester blood produced the improvement, but the hardiness of the breed and the testimony of the breeders tend to invalidate the opinion. They were formerly light in bone and wool, of scraggy frame, but with a constitution wonderfully hardy. Draining of lands, provision of shelter, and a greater abundance, both of summer and winter food, have aided the efforts of the breeder, and the result has been one of the most useful and profitable of known breeds of sheep. No animal has contributed so much to the prosperity of the Scottish border and hill farms as the Cheviot sheep. Their mutton ranks very high in Smithfield market, and some people give it a preference over the game-flavored mutton of the Black-face. These sheep obtain their name from a range of hills running through the border counties of England and Scotland. The original improver of greatest repute is William Robson, of Bilford, who commenced his operations a century ago, and his flock became the nucleus of the ram-supply of all that region for many years. They are considered very useful for crossing with border Leicesters. Roscommons.—Connaught has been for a long period the principal sheep-breeding section of Ireland, and the source of supplies furnished to the great Ballinasloe fair for the graziers of all other parts of the green isle. Culley described the original stock of Connaught as the most awkward and ungainly sheep to be found in the kingdom, with nothing to recommend them but their size. These sheep are supported by very long, thick, crooked, gray legs; their heads long and ugly, with large, flagging ears, gray faces, and sunken eyes; necks long, and set on below the shoulders; breasts narrow and short, hollow before and behind the shoulders; flat-sided, with high, narrow, herring-backs, hind quarters drooping, and tail set low; in short they are almost in every respect contrary to what he apprehended a well-formed sheep should be; and it is to be lamented that more attention has not been paid to the breeding of useful stock in an island so fruitful in pasturage as Ireland. The spirit of improvement reached this district; the smuggling of English animals, the importation of which was strictly prohibited, begat a desire for superior style and more satisfactory returns. At length the restriction was removed, and their improvement was very vigorously conducted, the first means employed being a Leicester cross, by which the form was improved and the wool lost much of its coarseness. When it assumed the distinctive and fixed peculiarities of a new breed, it took the name of the Roscommon sheep. The breeders manifested much judgment in perfecting its points and skill in selecting the individuals by which it was accomplished. For the past generation the progress made has been remarkable, compelling the Royal Agricultural Society and the Royal Dublin Society, which for a long time admitted them in a mixed class to their shows, to recognize them as a distinct breed of long-wools. The following statement of their present status is given by the editor of the *Irish Farmer's Gazette:* The old Connaught breed of sheep were never fattened until they were three or four years old, when they made great weights, but the mutton was coarse. In consequence of the improvement which has been made in the breed, shearling-wedders, are now often sold fat to the butcher, making from twenty-five pounds to over thirty pounds per quarter; but, as a general rule, the Roscommon graziers hold them over until they are thirty months old, at which age they are generally sold in Ballinasloe fair, at prices varying from three to four guineas each, to Leinster graziers, by whom the sheep are kept until they are about three years old, when, they make from thirty-six pounds and upward per quarter. Draft ewes, fed after being cast for breeding, weigh from thirty-four pounds to forty pounds per quarter, and the quality of the mutton is unexceptionable. It must be understood that the Roscommon sheep are, in general, reared entirely upon grass, with the help of some hay during winter. Turnip-feeding does not, as in Great Britain, form a material point in sheep-farming as conducted in Roscommon, there being only one acre of turnips grown in that country to each 109 acres of area. These sheep, from first to last, are for the most part reared and fattened without seeing a turnip. In all cases where turnip-feeding is pursued, the Roscommon sheep prove that early maturity, along with heavy weights, has become one of their characteristics; so that if turnip-growing were extended in the west of Ireland, it is only reasonable to believe that Connaught would produce much larger supplies of sheep. A breed of sheep has long been known with enlarged and very fat tails, and were at one time regarded with considerable favor. They are now extremely rare, being unprofitable in both flesh and wool. The American Merino is acknowledged to be the best fine-wooled sheep in America, if indeed it now has a superior in the world. It has been disseminated into every State and Territory of the United States and Canada, and has been largely exported to every country in the world, where the raising of fine wool is made a leading industry. The introduction of fine wooled sheep into the United States, and the establishment of the American Merino was principally brought about by the introduction of Spanish blood. The history of their introduction is as follows: Wm. Foster, of Boston, Mass., imported three Merino sheep



FAT-TAILED SHEEP.

from Spain into that city in 1793. They were given to a friend, who killed them for mutton! In 1801 M. Dupont de Nemours, and a French banker named Delessert, sent four ram lambs to the United States. All perished on the passage but one, which was used for several years in New York, and subsequently founded some excellent grade flocks for his owner, E. I. Dupont, near Wilmington Del. The same year, Seth Adams, of Zanesville, O., imported into Boston a pair of Spanish sheep which had been brought from Spain into France. In 1802, Mr. Livingston, American Minister in France, sent home two pairs of French Merinos, purchased from the Government flock at Chalons. In 1809 and 1810, Mr. Jarvis, American Consul at Lisbon, bought and shipped to the United States about 3,850 sheep. Of these, 300 were Aqueirres, 200 Escuriels, and 200 Montarcos, the rest Paulars and Negrettis. French Merinos, and also Saxon Merinos, were also introduced. These crosses, however, worked damage wherever introduced. The incomparable American Merinos that have shown themselves so well adapted to a great range of climate and conditions, have been the result of careful crossing of selected animals with reference to weight and fineness of wool, perpetuated for the last fifty years by careful selection. Thus, as at present constituted, they would suffer by crossing upon any other breed, and they will hold their own with the best flocks of any country, all things considered. In relation to the general management of sheep, the following extracts from a carefully written article by Mr. T. M. Younglove to the Department of Agriculture will be found to carefully cover all the essential points. He says: I know of no more definite way of arriving at the profits of wool-growing than to refer to the common custom of letting sheep. Occasionally a flock of ewes are let to double in three years. This is an annual interest of thirty-three and one-third per cent. The more common practice is to let them for two pounds of wool per head annually, returning the original number. Assuming the ewe to be worth three dollars per head, and the wool an average of forty cents per pound, it gives eighty cents for the use of one sheep, or twenty-six and two-thirds per cent. This is certainly a very good interest for the owner of the sheep. Now let us see what the taker has for his care and trouble. With reasonable care he can count upon raising three lambs from every four ewes, or seventy-five per cent. increase; which, if they be worth $1.50 per head, would be over $1.12 cents per head for the increase of each ewe. This, added to the wool left after paying the two pounds to the owner, (assuming that they would shear four pounds,) is eighty cents—making one dollar and ninety-two and one-half cents for his portion. The cost of keeping a single sheep for the entire year is variously estimated at from one dollar to one dollar and fifty cents per head. Taking the highest figure, it still leaves over forty cents clear profit, after paying the owner over twenty-six per cent. annual interest. But this is only upon a flock of breeding ewes, which may be set down as about two-fifths of each flock. The other three-fifths will only a little more than pay for their keeping. Allowing them to shear four pounds, at forty cents, gives one dollar and sixty cents. But this portion of the flock will shear more in proportion to their weight of carcase, and require much less care and attention than the breeding ewes. Upon this branch of wool-growing very much depends. Upon the form of the carcase depend not only the powers of endurance, but the capability to produce the greatest possible amount of wool to the least weight of carcase. It is quite as impossible to put a strong and healthy constitution as it is to put a heavy fleece upon a sheep with long, slender legs and neck, and a thin, lathy, loose body. In order to secure the many desirable good qualities which go to make up a first-class flock of sheep, great care is taken in the selection of a buck with reference to the particular flock of ewes with which he is to be put. As one buck is sufficient to serve from one to two hundred ewes, very much depends upon him, as he is to impart, in a great measure, his qualities to the entire flock. Some bucks, although possessing all the desired qualities of form and fleece, yet fail to infuse into their stock their many good qualities, and are, therefore, rejected as not good stock bucks. But when one is found that seems to impart all the valuable qualities of the sire to the entire stock, he is very properly termed a decided stock-getter, and is prized accordingly. One hundred dollars is not deemed an excessive price for a good stock buck. In some cases fancy prices even beyond this have been paid. It is not uncommon for a buck in prime of life, weighing from one hundred and twenty-five to one hundred and fifty pounds, to shear twenty pounds annually of unwashed wool. Bucks that are valued highly are not risked the exposure of a cold bath for the purpose of washing the wool upon the sheep. Constitutional defects of body or fleece in a flock of ewes can easily be corrected by using a buck that shows strength where the other is weak. A common custom is to turn the buck loose with the flock of ewes which he is desired to serve, and to give them no further attention. This will do very well where only a few ewes are to be served by one buck; but when it is desired to have one buck serve a large number, it may be done much more effectually by keeping the buck up, and ewes only taken to him when in heat, such being selected from the flock, by the aid of a buck, with an apron called a teaser. Some allow the buck to run with the flock during the daytime, and keep him up through the night. From observation of the different modes, I think the better way is to allow the buck to run with the ewes from the time the flock is brought to the yard at night until they are turned away in the morning, and so keep the buck in the stable during the day. This gives the buck an opportunity to go through the flock before they lie down at night and again in the morning, and not only the buck, but the whole flock of ewes are allowed to feed at their leisure through the day. There are few males in the whole of the animal race more cruel or abusive to the female than the buck, for he will follow and butt or hook until both are worried down. From this practice an observing breeder will readily see that extraordinary exertion of the ewe brings her readily to the wants of the buck. In case it is desired to have the ewe ready for the buck when put together, it can easily be effected by driving the flock of ewes briskly for a half or a whole mile before being brought to the yard. They will then be found in a particularly pleasant mood. If the buck is stabled, and the ewes brought to him in this manner, he is saved much labor, and will consequently serve more ewes in a given time, without fatigue or exhaustion of the system, than if allowed to run with the flock. A buck treated in this manner will serve one hundred ewes without materially impairing his condition or the offspring, and will be as strong and healthy at the close of lambing as at the beginning. Lambs should be dropped at the particular season when the ewe first obtains a scanty supply of grass, and consequently must be varied in different localities. If allowed to drop earlier, the ewe gives but a poor supply of milk, many of the young ones, and those in low condition, none at all. In this case many of the ewes that have no milk will refuse to own the lamb, and many of the lambs get a stunt, of which they recover, if at all, but slowly, and the flock will be of all sizes. If allowed to drop later in the season, when the ewe has obtained sufficient grass to enable her to give a flow of milk, and the whole system becomes invigorated by it,, the offspring too often attains an over growth, so that even the services of the most skillful midwife are not sufficient, and frequently both mother and lamb die from this cause. Another serious difficulty of late lambing is, that unless the lamb draws both teats soon after its birth, the ewe suffers from an over abundance of milk, and frequently inflammation follows. The lamb should be castrated at from one to three days old. The lamb should be held by an assistant, who should set the lamb upon his back just back of the hips, taking the fore and hind legs of each in each hand, putting the fore legs outside of the hind, and hold them firmly just above the knee joints. The operator takes hold of the pouch and pulls it gently, so as to get as much as possible of it, and then with a sharp knife at a single stroke takes off the pouch pretty close to the testicle. Then take a firm hold of each testicle separately between the fore finger and thumb of the right hand, and pull it out with all the cord that adheres to it. This completes the operation. The reason for cutting off all the pouch that can be easily pulled beyond the testicle is, that it leaves a much evener surface for shearing than if only a little is taken off. This operation should be performed in the morning, and the lambs then turned out to move about, which will, in a great measure, prevent any disposition of swelling or stiffening of the parts, which is frequently the case if they are allowed to lie still for a time afterward. Docking should be done as soon as they are well of the castration, generally about three days afterward. This operation should be performed with a single stroke of a sharp knife, and in the evening, allowing the flock to lie down and keep quiet and still, so that they may lose the least possible amount of blood. By morning the wound will be sufficiently dried that no fear of bleeding need be entertained, unless by accident. In no case should they be driven or put to any extra exertion immediately after being docked, for if so, many will bleed to death. If these hints, which are simple and easily put in practice, are carefully heeded, not one lamb in a hundred need be lost by both operations. At from ten to fifteen days old he should be entirely well of both, and will go on thriving. At about three months old the lamb should be taken from the ewe. The flock should be brought to the yard in the forepart of the day and turned away just at evening, while they are hungry. Much anxiety of both is avoided by this simple practice, for both flocks will go quietly to feeding, and finally lie down satisfied, which they would not otherwise do. The lambs should be picked from amongst the ewes and allowed the liberty of a larger yard, while the ewes are kept more closely confined during the latter part of the day, the two flocks separated by a sheep rack, or open fence. The lambs' yard should be furnished with a feeding trough, supplied with a mixture of salt and bran. This is very palatable, and they will learn to eat from a trough the same day their supply of milk is taken from them. This yard and trough should be convenient for the flock of lambs to run to, and should, as often as twice a week be supplied with something palatable, which learns them to eat from a trough, and goes far towards taming and attaching them to the shepherd. If the yard is not contiguous to the pasture, the trough may and should be moved to the pasture where the lambs are to make their future home. As the season advances and the nights become frosty, or during heavy storms, the flock of lambs should be herded, and the yards supplied with racks and troughs sufficient for them to feed without crowding too much. Occasionally a little hay, or oats in the sheaf, should be put in the racks. This teaches them to use the yard and and rack ere it is needed; and when the first severe storm of winter covers the ground, as only a cold winter storm can do, they will take hold with a keen relish. If they are left in the field until the winter sets in and makes it necessary to fodder, they are brought to the yard strangers alike to the arrangements and the food they are to use. Many will become discouraged and stand with drooping head and ears, and will only eat when reduced to a reeling skeleton. They thus begin the winter under serious disadvantages and frequently never regain it, but drag along a miserable winter, toppling over every obstacle, to be lifted to their legs, and finally die, as the first warm days of spring take from them the miserable remnant of appetite which idly lingered about them. This negligence in the early education of the sheep is like neglecting the education until the tender and pliant years of childhood are past. When the fully-matured man acquires a business that must be done, he sets about learning to do it. There is however, this difference; the man can get a competent person to do it for him, but the unlearned sheep can get none to eat for him that will supply the wants of nature. When the lambs are fairly in their winter quarters, their education may be considered complete, as their treatment in the after part of the winter may be in every respect like older sheep only a little more care and attention; and like older ones grain is not lost upon them, although too high feeding is not recommended. During the winter, care should be taken not to allow too many to run in one flock, for the stronger continually overrun the weaker, picking out the most delicate portions of the food, and leaving that less palatable and of inferior quality to those which should have the best. The usual mode is to allow from one hundred to one hundred and



SHEEP DIPPING IN KANSAS AND COLORADO.

fifty in a flock. While some keep them in close yards and water and feed them, others allow them to roam over the fields during the day and bring them to the yard at night. Such as are allowed a free range usually pick quite a portion of their winter living, but it is of an inferior quality, and a flock allowed to roam will not usually keep in as good condition as when they are carefully yarded, housed, and properly fed. If sheep are divided into small flocks of about twenty-five, and are selected with reference to size and strength, and kept in close confinement through the winter, giving them only room enough to move about, they will require less food than if allowed more liberty, and allowed to run in larger flocks; but whether the increased amount of labor will offset against the difference in the supply of food can only be determined by the circumstances and conveniences of the grower. Before the sheep are changed from hay to grass in the spring they should be carefully looked over, and all horns and hoofs that threaten to be troublesome carefully removed. The hoofs can be taken off with pruning shears, but a fine saw is needed for horns. The sheep is then laid upon his back in a kind of saw-buck, with a board nailed to each side, forming an easy place for the sheep to lie, and convenient for the operator. It should be high enough for the sheep to run under without oversetting it. A basket is then placed at the end to receive the tag locks as they are taken off. A portion of the wool should then be taken from the stern of each sheep in such a manner as to allow the manure to drop free without finding any stray locks or loose raw edges of wool to obstruct it in its passage. The wethers should have a small portion of wool removed from the belly, to allow the urine a free passage. This is quite as important as any part of the tagging, and yet is neglected by many. When the entire flock have received this attention, they are ready to be changed from the yard to the pasture. A ewe should not be required to move about much for a few hours after lambing. If her teats are closed against the efforts of the lamb, squeeze them out with the wetted fingers. If they have been cut off in shearing and are grown up, reopen them with a delicate blade, inserting it no further than is necessary. The sucking of the lamb will generally keep them open; but if they become inflamed, the ewe must be held for the lamb to suck, and some cooling lotion applied to the part. If the udder is hard and hot, it should be fomented by frequently and continuously applying to it a cloth dipped in hot water. Repeated washings with cold water produce the same effect, but more slowly, and with a greater tendency to dry up the milk. If the lamb is dead, and there are indurated tumors in the udder, apply iodine ointment. A ewe which disowns her lamb, or one which is required to adopt another should be confined alone with it in a dark place, and out of hearing of other sheep, and she should be held several times a day for it to suck. Frightening a ewe when with her lamb, by showing her a strange dog, or a child wearing a bright colored mantle, sometimes arouses her dormant maternal instincts. If a ewe's dead lamb is skinned, and the skin tied on a living lamb, she will generally readily adopt it. If she hesitates, rubbing some odor on her nose and also on the lamb will facilitate the process. Docking and castration should be performed when the lamb is not more than two or three weeks old, and before warm weather comes on; and it is an excellent plan to smear the wounds with a compound of tar, butter, and turpentine. The tail should be cut off so that no part of the bone is left uncovered. Castration is an operation sufficiently familiar to most farmers. It is generally held by those who have tried it that early shearing is preferable for sheep, if they can be subsequently housed in case of severe storms or unusually cold nights. As early washing is improper in cold climates, it is urged that sheep should be shorn unwashed. This is a question on which the wool-grower should be allowed to exercise his own judgment; nor should any buyer attempt to compel washing, or to take advantage of its omission by insisting on a particular and fixed rate of shrinkage on unwashed wools. The shrinkage on every lot should be proportioned to its actual condition, as deduction is made on wheat, other products, or foreign wools which contain impurities. The mode of washing sheep does not require to be here described. Merino sheep generally require to have their feet trimmed at least once a year. Some do this at washing, when the feet are clean and soaked soft; others immediately after shearing.

SHEEP DIPPING. Dipping is a term used for immersing sheep, after shearing, to free them from vermin, and used also as a means of curing them from the scab or mange insect. When but few sheep are kept, the cure is accomplished generally by anointing them with any of the preparations in common use for this purpose. For those who prefer ointments, the following will be found good: One pound mercurial ointment, one-half pint oil of turpentine, one pound resin, and six pounds of lard. Dissolve the resin in the turpentine; dissolve the lard by gentle heat, mix the mercurial ointment thoroughly with it, and when cold rub both preparations well together. In applying this, the wool must be parted well down to the skin from between the ears to the tail. From this similar partings should be made along the shoulders and thighs to the legs and also parallel ones along the sides. These furrows must have the ointment lightly rubbed into the skin as made. On the great Western plains, and in Australia, vast herds of sheep are kept, often with but little in the way of buildings to show the wealth of the proprietor. On page 858 is an illustration of such an establishment, the sod-house, yards and sheep dipping apparatus comprising the sole outlay. In the article Scab will be found popular recipes for sheep dipping.

SHELL LIME. Lime procured from burning shells. If it is well made, it is excellent for agricultural purposes, as it contains nearly two per cent. of bone earth, and is free from caustic magnesia.

SHELL MARL. This is very rich in the remains of shells; when especially so it may often be profitably burned for lime.

SHELTERING STOCK. We provide ourselves with comfortable clothing in winter to ward off the effects of cold. We eat fat meats for the same reason. The more northern and colder the climate, the more of fatty substances are consumed. The Esquimaux drink train oil. These substances contain much carbon, and carbon produces heat. Farm stock in the winter crave oily grains, as corn, for the reason that they assist in keeping up the animal heat. Is it not poor economy, in view of these facts, to let your cattle, colts and sheep winter at the lee side of some bleak hill, or in the fence corners, when a little time and money expended at odd times would provide them with comfortable stables, or at least, with warm sheds? The money paid for this will pay for itself each season, to say nothing of the satisfaction of knowing that you have done all in your power to make your farm stock as comfortable as possible. The farmer knows full well that a plant once stinted while young can never after recover to fully develop itself. It is the same with live stock, only in a greater degree. If allowed to stop growing and get thoroughly poor while young, they never, however well fed thereafter, fully recover. Our most successful and most money-making feeders continue to feed liberally from younglings to maturity. It will make a pig as heavy at ten months old as he would become, under ordinary feeding, in eighteen, and the full fed steer will be as heavy at three years, as the lighter fed one will be at five. It takes a certain amount of waste to supply the animal economy, and the waste is in proportion to the length of life. It costs just twice as much to prolong this waste two years as it does one, and more goes to waste in cold weather than in warm, hence the economy of providing warm shelter and plenty of food. Animals so provided will be sleek and healthy, while the others will be gaunt and shivering, and their coats staring. Stablemen understand the economy of keeping fine horses warmly clothed in winter. It is only another name for preventing waste. Too many ordinary farmers fail to see it. Try sheltering your stock one winter and see how you and they like it. We know of no experiments having been undertaken in the West with a view of determining this question accurately; that is, under different given ranges of the thermometer. We do know, however, that animals kept in stables when the temperature is at fifty degrees, have their coats soft and sleek, and that as the temperature falls below forty degrees, their coats begin to get rough and staring. A rough coat, however, is not always indicative of ill health; for an animal may be kept in good health out of doors in the winter, if it be provided with shelter where it may be protected from the direct force of the wind, and against storms of rain and sleet. Nevertheless it is always at the expense of an extra quantity of food, and this in just proportion to the temperature, force of the wind, or the effect of rain on the animal; for the escape of animal heat is in just proportion to the effects of the conditions mentioned above, and this wasted heat must be kept up by an extra supply of carbonaceous food. Hence the well-known maxim, stock can not be wintered in the West on hay and straw, when exposed to the inclemencies of the weather. On the other hand, John Johnston, the well-known farmer of New York State, long since asserted—and this is well known to practical men—that he could keep his cows in milk during the winter, on good sweet hay, by attending to the warmth of the stable. A certain portion of the food eaten by animals is consumed in keeping up the vital warmth; another portion in supplying the natural waste of tissue, etc., the rest goes to make flesh and fat. So, food is consumed in due proportion to the waste of heat, from low temperature or exposure. Experiments made some years ago in the comparatively mild, or rather equable, climate of England, is thus stated: One hundred sheep were fed in a shed twenty pounds each of Swedish turnips per day; another hundred in the open air or field were fed twenty-five pounds each per day; and yet the former on one-fifth less food had gained at the end of a few weeks three pounds each of flesh more than the others. Five sheep were fed in the open air between the twenty-first of November and the first of December, consuming ninety pounds of food per day, the temperature being at forty-four degrees At the end of this time they weighed two pounds less than when first exposed. Five sheep were then placed under a shed in a temperature of forty-nine degrees. At first they consumed eighty-two pounds of food per day; then seventy pounds; and at the end of the same time as the others, they had gained twenty-three pounds Again, five sheep were placed in a shed as before, and not allowed to take exercise They ate at first sixty-four pounds a day, then fifty-eight pounds, and increased in weight thirty pounds. Thus it will be seen that the first lot on the largest amount of food lost flesh, and that additional warmth not only decreased the amount of food eaten, but they increased largely in flesh. Our experience is that animals for fattening will thrive best in warm and moderately dark stables. And however cheap or abundant the forage, it pays to provide warm shelter, whether for stock or fattening animals. This fact is more noticeable with milch cows than with other stock. We have known them to shrink fully one-half in their mess from being inadvertently exposed to a cold storm of rain; and they did not regain their full flow of milk again for several days after being again placed in the stable.

SHERDS. Fragments of garden pots, used to under-drain the soil of boxes, pots, etc.

SHETLAND PONIES. The Shetlands, the smallest of the pony breeds. are round, closely ribbed up, with heads bony and well shaped, but wide at the brow, and often with the basin-shaped face of the true Arab. The ears are small, erect, well shaped and placed, eyes large, bright and intelligent; the neck short, strong, and with long, coarse, thick manes; the shoulders thick, but sloping; the withers low; back slightly hollowed, loin strong and wide, tail exceedingly long and thick like the mane; the quarters are strong, with particularly good legs and hoofs. Their endurance is wonderful, and for such animals their speed is considerable, they being capable of performing journeys of forty miles a day upon the rocky, hilly pathways of their native country. When petted and treated kindly they become much attached to their masters, are gentle, sagacious, easily trained, but like the mule, will resent abuse sometimes with their heels. In color they are generally dark sorrel, brown and black. Yet many are now found parti-colored, with considerable white. When reared in a semi-wild state they are often reduced to extreme straits, for want of food, even subsisting on kelp and sea weed along the sea shore, but quickly respond to better care and treatment. The Shetlands of the smallest size combined with the most perfect form are said to be found in the extreme northern islands of Unst and Tell. Many of them are not more than seven to eight hands in height, the average being not more than nine or ten hands, or thirty-six to forty inches. In fact it is held that no true Shetland ever reached the height of eleven hands.

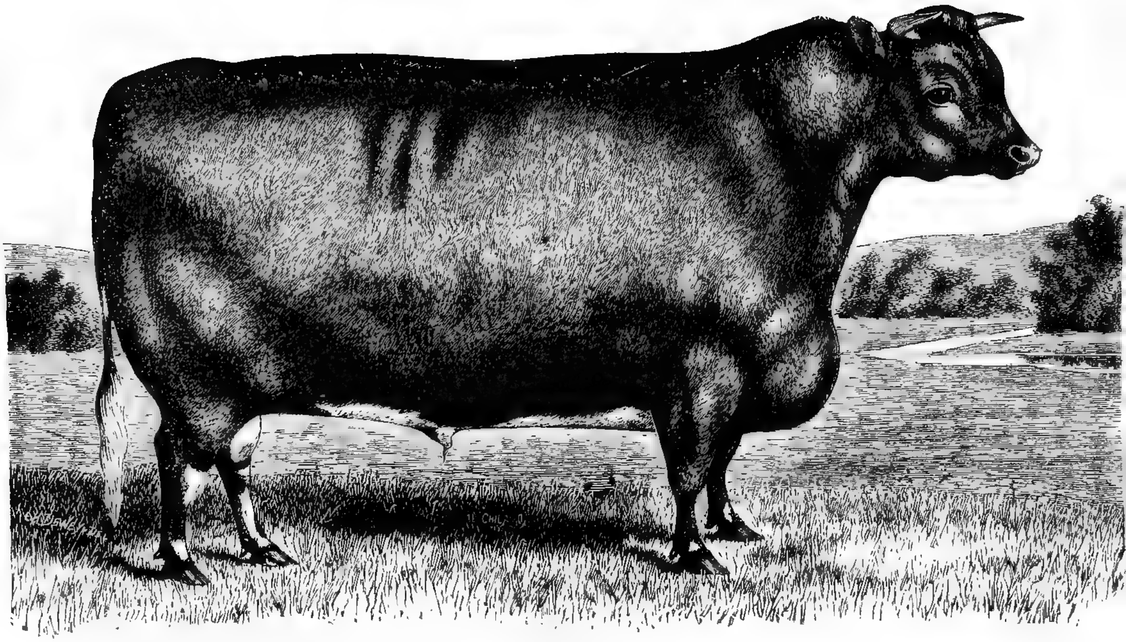
SHIELDS. In botany, little colored cups or lines with a hard disk, surrounded by a rim, and containing the sporules, or seeds of lichens.

SHOCKS. Assemblages of sheaves, from six to twelve or more. Shocks of corn are composed of from eight to twelve hills square, or from sixty-four to one hundred and forty-four hills.

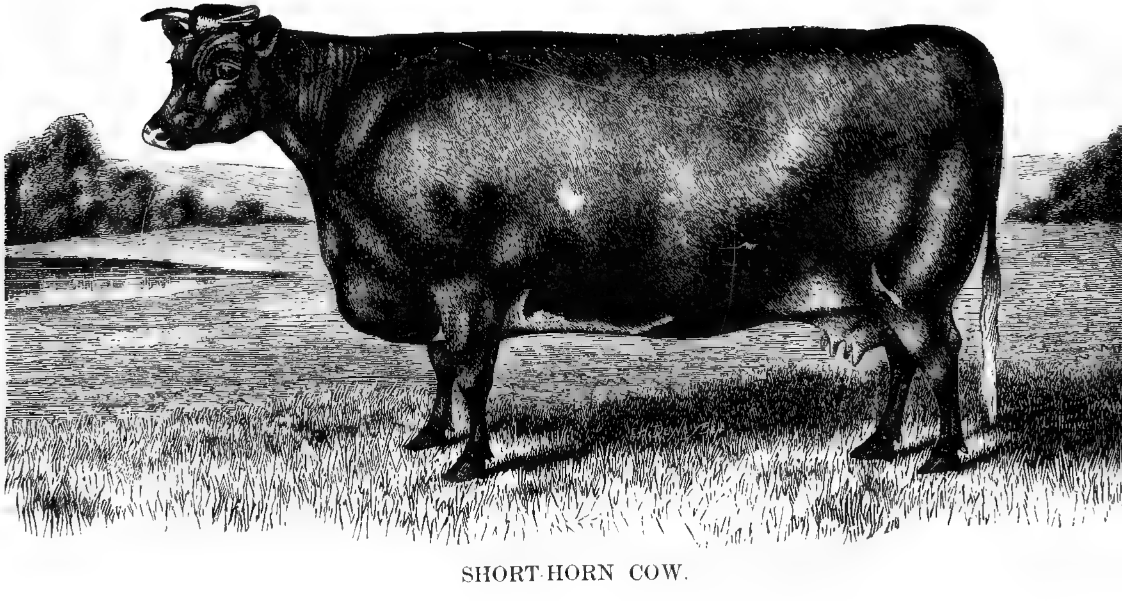
SHOEING HORSES. The proper shoeing of horses, when employed on city pavements or hard roads, is one demanding the most earnest attention of every horse owner. Nevertheless, not one in a hundred ever take the pains to inform themselves as to the correct manner of doing this, but trust to horse-shoers, many of them as ignorant of the varying necessities of the case, according to the shape and quality of the hoof, as is the owner. On soft roads, and on all work in soft ground, the hoofs are undoubtedly better without shoes, and hence many good farmers properly refuse to allow the horses worked on the farm to be shod in summer, except those that are to be driven on stony or other hard roads. Some years since, Mr. George Fleming, Veterinary Surgeon Royal Engineers, England, prepared a paper on Horse Shoes and Horse-shoeing, that has been accepted as one of the best monographs on the subject extant. We therefore give it nearly entire as well worthy of study: It would take us rather beyond the limits of our subject if we attempted to point out the very important part the horse plays in the world and in the progress of civilization, and to what an extent mankind has to rely on him for most essential services, rendered in peace or in war. Neither need we dwell on the share this creature has taken in the development of civilization, and in the great events which have marked the history of our species. Suffice it, therefore, to state, that on no other animal has devolved, or could be imposed, the same onerous duties, and to no other creature is man indebted for so many services and benefits. These could never have been rendered but for the fact, discovered at a very early period in the history of man, that the horse was gifted with a special conformation, which adapted him for the most varied uses under the most diverse circumstances, and that the chief point in this conformation was the presence of a solid foot cased in tough, elastic horn. The varied uses to which the horse has been subjected since he was taken from a wild condition, and the willing and cheerful manner with which he has undergone fatigue and performed duties which are, one would think, quite foreign to his nature, have certainly all been owing to his combined and unequal qualities of strength, courage, speed, fidelity, and obedience, as well as docility; and though his great value has mainly depended upon a just disposition of these, yet it cannot be doubted that to the presence of a wonderfully contrived foot the horse largely owes his exalted position above all those creatures which have submitted themselves to domestication and toil for the benefit of the human species. The history of mankind abundantly testifies that every possible use and application of this animal, whether in war, commerce, or pleasure, seems to have been anticipated by the most ancient peoples; and old-world nations which, ages ago, most largely employed the horse, were the great centers of antique civilization. Indeed, it may safely be asserted that but for the horse the human race could not have reached its present state of progress or refinement, or have been able to contend against the numerous obstacles to advancement and material happiness which surrounded it; and it has been well said that, next to the want of iron, the want of horses would have been one of the greatest physical barriers to the perfecting of the arts of civilized life. And but for the horse being endowed with a continually growing hoof, which covers the most beautiful and delicate structures, and which, being solid, and a slow conductor of heat and cold, eminently fits him for traveling in snow and ice during the winter of northern regions, and in the burning sands of tropical climates, he would scarcely have proved himself worth the trouble of domesticating. For, notwithstanding his other grand qualities, no invention or device of man could have compensated for the absence of his solid, hoof-cased foot. Therefore it has happened that, from the earliest ages, the attention of horsemen has been largely centered on the feet of the horse; and no matter how perfect the other points of his conformation may have been, if these organs were defective all was bad, as none of his good qualities could then be made effective. And from these ages to the present time, when the uses to which the horse can be put have become so multiplied, and so much more necessary for our business or pleasure, this truth has been daily receiving further confirmation, until the aphorism, no foot, no horse, has become a painful reality in modern days; though it is but a re-echo of what was, no doubt, enunciated centuries beyond two thousand years ago. For the manifestation of his strength and the due development of his other good qualities the horse must rely upon the soundness of his feet, as in them are concentrated the efforts created elsewhere, and on them depend, to a great extent, the solidity and just equilibrium of the whole animal fabric. So that it is wisely considered that the foot of the horse is one of the most, if not the most, important part of the body, and that all the splendid qualities possessed by the noble creature may be diminished in value, or hopelessly lost, if through disease or accident, natural or acquired defects, or other causes, this organ fails to perform its allotted task. Seeing, then, the great interest and importance which attach to this animal, in its being of all creatures most concerned with man in promoting a progressive and long-continued civilization, and to the means and appliances which have from time to time been brought to bear in increasing the utility of this devoted servant, it cannot but be a matter of public interest to inquire into an art which, however insignificant it may generally appear, yet increases a hundred-fold the usefulness of the horse. I refer to the art of shoeing, through which, in arming that portion of the hoof which comes in contact with the ground and sustains the whole weight and propelling power of the animal, injury is not only averted, but the power of the horse is greatly developed. An art which has indirectly exercised much influence on the destiny of mankind, and lent its aid to the restless wave of human action, surely deserves some notice; and if it be looked upon as a modest and obscure art, it nevertheless merits the attention of the humane no less than that of the utilitarian, in consequence of its being so closely related to the comfort and the preservation of this animal, whose value is every day becoming more appreciated and exaggerated. It may be said that with the horse in a state of nature the hoof requires no protection. The solidity and toughness of the material of which it is composed; the absence of artificial roads; nothing but the weight of the body to be supported; and the horn never being subjected to any other influences than those it is naturally adapted to resist, maintain it in health and uninjured. But, in connection with climate, domestication alters more or less the conditions on which the horse depends for the horn's integrity as an efficient protection to the living and extremely sensitive parts it encloses. In several regions of the world, which have a dry climate and a soft soil, and where the hoofs are firm in texture, shoeing is seldom, if ever required. When the journeys are long, however, and the labor severe, some kind of artificial protection is needed, or the animal's feet become denuded of horn, and lameness results. Among the Mongols this accident is repaired by the horseman exchanging his pony for one whose hoofs are not worn; or, if he has a number, he rides another until the cripple has had time to grow a new supply for wear. In some regions, as with the North American Indians and the Tartars, raw hide is used on such occasions, and even the horns of other creatures; and in Japan, when a traveler is about to start on a long journey, a bundle of rice-straw slippers for his steed, is tied to his saddle, and these he attaches to the animal's feet from time to time, as they become worn. Strange to say, the Japanese knew nothing of attaching an iron shoe to the hoof by means of nails until some troop farriers were sent from North China to that country in 1860, to attend to the horses purchased for the expedition to Pekin. These farriers introduced the art into Japan. But even in the most favored countries the usefulness of the horse can be but limited without some means of protecting the hoof from undue wear. And doubtless this fact was soon recognized by the people who, at a very early period, trained and employed this animal, and who, no doubt, were compelled to resort to various devices to protect it from inefficiency from this cause. For, with the increasing spread of civilization, the demands upon the services of the horse became more urgent and heavy, and the diversities of climate to which he was carried, as well as of races which resulted, would lead one to suppose that greater wear and modification in the nature and consistency of the hoof would render some kind of defense absolutely necessary. This necessity led to the bold and efficient method now in vogue, of attaching a metal rim to the lower border of the hoof by means of nails driven through the horn, a device which the nineteenth century can not improve, and one which, to the individual who proposed or first practiced it, must have been a feat of no ordinary magnitude; while to us it has proved to be an invention scarcely inferior to that of the steam engine in importance. But, like so many other inventions, this one is lost in the obscurity of ages; and archæologists and antiquarians have for nearly two centuries puzzled themselves in vain in trying to arrive at the period when the art of horse-shoeing was introduced; while ancient writers afford little or no assistance in enabling us to judge whether the art was practiced even in their day. Up to a recent period horse-shoeing was traced no further back with certainty than the ninth century, though the legends, traditions, and superstitions relating to it proved that it was very old. But the great advances made in archæology now make it manifest that shoeing was known to the Romans and the ancient Gauls; and though it is persistently stated in every-day books of reference, such as Haydn's Dictionary of Dates, that the farrier's art was introduced into Britain by William the Conqueror, it is certain that during the Roman occupation of this country horses were shod in a similar manner to what they are now-a-days. Horse-shoes have been discovered repeatedly in the camps and graves of ancient Gaul, and even in battle fields of these people. They have been found in numerous instances with Roman relics, such as arms, brooches, lamps, coins, etc., in France, Switzerland, and Belgium; and in this country many have been discovered in excavations in London, in the streets of some of our towns at considerable depths, in Roman camps, roads, villas, and various other situations; and as a further proof that horse-shoeing was known in this country before the arrival of the Normans, we find that in the ancient laws of Wales the court farrier was an important personage, and had certain valuable privileges conferred upon him while he shod the king's horses. Indeed my researches have carried me as far back as about 300 years before our era, when a coin of Tarentum was struck, which was evidently designed to represent something in connection with the farrier's art; perhaps it was intended to commemorate the birth of the art itself. I may also mention that there can be no doubt that a temporary protection for the hoofs was sometimes resorted to, as we find it mentioned by different Roman writers under various names. This protection was in all likelihood something of the same kind as that now used by the Japanese; but it would also appear to have been made of iron, and to be something of a sandal. Often with the ordinary Roman horse-shoe, sometimes alone, there have been found articles of different shapes, though alike in some particulars, which have been designated, hipposandals, by those who believe them to have been these temporary protections. It is questionable whether many of these could have been used for such a purpose, however; while it is not at all improbable that others may have been attached to the hoofs of the horse for some other purpose than that of a sandal. A word with regard to the Roman horse-shoe. In the preparation of my work on horse-shoeing I had occasion to examine and to read the description of very many of the shoes which undoubtedly belonged to the Roman period, and I was surprised to find they all bore the greatest resemblance to each other; so much so, indeed, that if they had been laid together any one who did not know that they had been collected in France, Switzerland, Belgium, and England, would be likely to assert that they were made by the same artisan; and there is also a wonderful uniformity of size amongst them, which would go to prove that the horses then applied in these countries were small. The shoe is of the simplest kind, being merely a narrow strip of iron bent like the shoe now in use, the ends of the branches being rolled over to form calks, and there are nearly always three holes on each side to receive the nails. The holes and nails form the distinctive features of the shoe, however, and have led me to consider such shoes as peculiar to the Romano-Gallic or Romano-British period. At each nail-hole is a wide oval indentation, in the middle of which the round hole for the nail is made. This indentation was intended to and did receive the base of a large flat-headed nail which it supported, and prevented from being twisted out of the shoe. With the two calks, each foot in this way stood on eight distinct points, which insured a good foothold. But in making the oval cavity for the nail head the narrow rim of metal was bulged out at each hole, and thus the border of the shoe presented an undulating appearance, which is exceedingly of these shoes. Toward the middle ages the art of shoeing acquired much importance in Western Europe. Armor of a heavy description began to be worn; horses of a large size, to carry the increased weight, were bred, and they had to be protected with heavier shoes. So important did the art become that the farrier or his superintendent was often a high officer of the royal household; and kings, princes, and nobles did not disdain to be taught and to practice that art upon which so much depended in those days. Noblemen received their titles and names from their connection with the craft, as Marshal, Ferrers, Laferriers, and Ferrier; and gifts were bestowed and tenures held in connection with horse-shoes and horse-shoeing, more especially in England during the reign of William the Conqueror. Northampton and a large tract of country was held by Simon St. Liz on condition that he provided shoes for William's horses; and it is probably in connection with this peculiar tenure that the Northamptonshire militia wear a horse-shoe on their pouches. And for superintending the shoeing of the same monarch's steeds, Henry de Ferrarus, or Ferrers, had bestowed upon him the honor of Tutbury, in Staffordshire. In other parts of the country tenures were held on similar terms; and even in your own city of London, in 1235, during the reign of Henry III., Walter le Bruin, or Brun, a farrier, or marechal, as the shoer was then designated, had a piece of land granted him in the Strand, in the parish of St. Clement's Danes, whereon to erect a forge, on condition that he should render at the exchequer, annually, for the same a quit rent of six horse-shoes, with the nails (sixty-two) thereto belonging. This curious payment was made twice during the reign of Edward I., and is continued up to the present time, the shoes and nails being paid on the 30th September, at the swearing in of the newly-elected sheriff of London and Middlesex, to the representatives of the sovereign for the said piece of ground, though it has long been city property. Noblemen and others had horse-shoes on their coats of arms and seals, and even towns sported the hoof-iron, as is seen in the old corporation seal of Gloucester, in use during the reign of Edward III. But we need not pursue the history of the art any further, except to remark that the grooved or fullered shoe came into use in this country about four or five centuries ago; though shoes of this kind, of a much earlier date (fifth century), have been found in graves in Burgundy, the groove having evidently been made by the same tool that cut the furrows in the formidable scramasacs, or swords worn by the warriors, for the farrier was often also the armorer. The shoes were ponderous and clumsy, and the hoofs appear at a later period to have become subjected to serious mutilations by the farrier's boutoir, or buttress, as the hoof-cutting implement was named. In this country, towards the end of the last and commencement of this century, an attempt was made to place the art on a scientific basis, but, unfortunately, wild theories with regard to the functions of the horse's feet were promulgated; the hoof alone was studied, and no regard was had to the important structures it contained, and to which it was a mere shell; fantastic notions as to the expansion of the hoof at the heels, the descent of the sole, and other strange ideas, were carried into practice; and shoeing on what was, and is still, termed improved principles—though the improvement was an infraction of nature's laws—proved a veritable curse to horses. The hoof was reduced to the thinnest film where it should have been left strong, and was pared away until it yielded on the sole to the pressure of the thumb, or until the blood came oozing through; a knife was devised to search into the inflexions at the heels, which were so many natural bulwarks, and the elastic cushion at the back part of the hoof was recklessly sliced away, until at last the foot was so robbed of its natural covering that it required great skill and an artificial protection between it and the shoe to enable the animal to travel for a few years. The shoe was beveled off on the upper surface, so as not to press on the tender sole, and this threw all the strain of the weight and exertion upon the margin of the foot. In short, no treatment devised to ruin horses prematurely in their feet could have been more appropriate and successful, so far as the lower surface of the hoof was concerned. With regard to the outer part, this was rasped and chiseled away to make fine work, until there was scarcely sufficient material left to drive the nails through; consequently these had to be increased in number. The evils horse-shoeing thus introduced have continued, and are as prevalent now as they were fifty years ago. The number of horses rendered useless by improved farriery is very great, and only too frequently inefficiency is brought about at an early period of the horse's career. The farriers only too frequently work by rule of thumb, and on no fixed principle. Their knowledge is mainly traditional, passed from father to son, or from an elder to an apprentice, without cultivation, or without being enhanced by educated observation. This is due to the neglect into which the art has fallen for many centuries; and yet this neglect is somewhat unpardonable. Not very many years ago the farrier was the only authority on the diseases of animals, and to his tender mercies was entrusted their restoration to health and soundness when they were sick or lame. Science has relieved him of this responsibility, and transferred it to the medically-trained veterinary surgeon, who, from the general and professional education, should be better fitted for such a duty. But this deprivation has still further lowered the status of the farrier, and, it is to be feared, his art; for he has not the same incentive to maintain his ancient position, and to be a shoer of horses is to rank very inferior indeed; while the veterinary surgeon, from the many subjects he has to study while at college, and the far too brief period he spends there, has no time to acquire even elementary notions of the horse's foot and the best means of keeping it sound. He therefore imagines this matter is of but little moment; and I fear some members of the veterinary profession think it rather degrading to pay any attention to what they consider such an humble mechanical handicraft. This is deeply to be regretted, when we know how many horses are prematurely ruined through mismanagement of their feet; how many suffer the most horrible torture, for perhaps years, through bad shoeing; and how many are rendered more or less inefficient and worn out in their limbs from badly adjusted, ill-constructed, or far too heavy shoes. There is no remedy for this unfortunate state of affairs but teaching the farriers their art in some school or college presided over by competent teachers, and licensing them when they are able to carry the principles they have been taught into practice. A certificate of competency would be a guarantee that the possessor had devoted some attention to the theory of his art, and was so far acquainted with the anatomy and physiology of the organ with which he had to deal, that if he could not treat it as a surgeon when it was diseased, he would yet be in a position to prevent much disease in it. It does seem strange that, in a country like our own—the home of the best and most valuable horses in the world—and among a horse-loving people such as we are, some such an establishment has not been instituted. If the Society of Arts wished to confer a great service upon horse-owners and upon the noble beast itself, and through them upon the entire public, it could not do better than propound a scheme for supplying educated farriers to all parts of the country. The Society would have abundant support, and nothing would tend more to improve the minds and elevate the position of the farriers themselves. Though the end of the horse's limb is named the foot, yet it has no analogy to the human foot, except that both rest on the ground and are essential instruments in progression. The fore foot of the horse is, in fact, the extremity of the middle finger of man's hand, and the hind foot is the analogue of the middle toe of his foot; while the nail on each represents the horse's hoof. In this way the horse's knee is the human wrist, and the hock the human ankle and heel. It is sometimes useful to bear this distinction in mind. A sort of conical semi-lunar bone fills the anterior two-thirds of the hoof, and to it the hoof is moulded, as well as firmly attached. This is the foot-bone—admirably adapted for its purpose in being light, yet strong, and affording ample protection to the large blood vessels which supply the organ in such profusion. Above this bone is the small pastern-bone, and behind it, between the wings of the crescent, is another narrow bone—the navicular or shuttle bone, as the old farriers used to name it. Over this bone the powerful flexor tendon of the foot passes, to be inserted into the lower surface of the foot bone; and this tendon again rests upon, and is supported at this its weakest part by a large mass of elastic substance, which plays a very necessary part in the function of the foot. From each wing of the foot-bone spring two wide, cartilaginous plates connected with the elastic cushion; and these, rising above the heels of the hoof, have a large share in promoting springiness, and obviating injury to the organ. The whole of the foot within the hoof is covered by an exquisitely sensitive membrane, which secretes the horn. The hoof consists of three parts—wall, sole and frog. The wall is attached to the foot-bone by means of a very large number—over six hundred—of very sensitive and vascular leaves, which run from above to below, and are received between similar, but horny, leaves on the inner surface of the wall. This union is of the most intimate and beautiful character, and I regret that time will not allow me to show you how wonderfully adapted it is for the end in view. The wall itself, as indeed is the whole of the hoof, is composed of very minute cells, not unlike those which compose the skin, but differently arranged to form fibers, which pass from the top to the bottom. These fibers can be distinguished by the naked eye on a very close inspection, and to form them the cells are laid lengthways, or vertically, while the fibers themselves are united by interfibrous cells, which lie horizontally, so that we have cells laid in two directions; and this not only affords a better resistance to wear, but prevents splitting. The wall grows from the coronet, or upper part of the foot, and this growth is incessant. The outer, or surface fibers, are very dense and smooth, but the deeper they are situated the more soft and spongy they become—a fact of much importance in shoeing. At its upper part the wall is covered by a soft, elastic horn, which protects it while it is being formed. The sole is formed of fibers passing in the same direction, and constructed in the same manner as in the wall, but it differs from the latter in one important point. When it has attained a certain thickness, the superficial horn becomes detached in flakes, which, even in a semi-detached state, serve a useful purpose in retaining moisture for the growing horn beneath, and acting as a springy defense against injury from loose stones. The wall, on the contrary, grows to an indefinite length, or rather depth, when indeed it is not worn away by contact with the ground—another important fact to be remembered. The frog is also fibrous, but the horn of which it is composed is different in quality, being soft, dense, and elastic, like india rubber. It is an essential constituent of the elastic apparatus of the foot, and in situation and function it is analogous to the pad on the foot of the dog, cat, and other animals, and the cushion beneath man's heel. The elastic apparatus of the foot also consists of a cushion of springy material around the top of the organ, and which fits into a recess at the upper margin of the wall, so that we not only have elastic cartilages and cushions at the back part of the foot but an excellent contrivance all round the top to break the primary shock of contact with the ground. The fore foot, when well formed, is nearly circular in shape, but the hind one is oval, otherwise there is not much difference between them. The angle or slope of the wall varies, but it is generally between fifty and fifty-two degrees. This is as much of the anatomy of the foot as we now have time to notice: but I may tell you that perhaps no organ of the animal body will better repay a careful study, if only to trace the evidences of design so wonderfully displayed in every part and combination of parts. With regard to function, it may be sufficient to mention that the wall sustains the largest portion of the weight, and is the part chiefly exposed, as it is that which is mainly designed to encounter wear. The sole also shares in weight bearing, but a wider surface participates on soft than on hard ground, owing to its concave shape. The frog has also to sustain weight to a great extent, but its most important duty is undoubtedly to support the flexor tendon of the foot through the intermediate cushion, to prevent slipping, and also to assist the animal in suddenly checking its pace when moving rapidly. The lower border of the hoof does not expand to any appreciable extent when the animal is in motion. For years this has been taught, but it is a fallacy, and many circumstances prove it to be so. The expansion takes place at its upper border, and towards the heels, where the chief elastic apparatus is situated. The function of the fore foot is chiefly to support weight, that of the hind foot is to propel the body. Now as to shoeing: It is obvious that the horse's foot was designed to meet every natural demand, so far as the animal's weight and movements are concerned; but when a heavy load is imposed on his back, or attached behind, and when he is compelled to travel, particularly over hard roads, in all kinds of weather, nature's arrangements are overtaxed, and the wear of the hoof is greater than the repair. Consequently, art must step in to assist nature. The part of the hoof which suffers most from undue wear is that which was intended to encounter it, the wall; and when this is too much worn the sole becomes broken around its margin, and the sensitive parts within wounded and contused. Therefore all that the hoof requires, in order to enable the horse to remain serviceable, is merely some kind of protection for the lower border of the wall; but this protection should not be heavy, else the muscles, which were designed to move a marvelously light foot, will be unduly strained, as will also tendons and ligaments, for the muscles—the moving power of the limb—are all situated at the upper part of the leg, and act upon short levers, the mechanical means being designed rather for speed than strength. This protection must be durable; it should not damage or interfere with the functions of the foot, but allow every part to perform its office unimpaired; it ought to be easily applied, and secure when attached to the foot; it should not render the animal less sure-footed, if possible, than before it was applied; and, finally, it ought to be simple and cheap. Grave charges have been brought against this method of preserving the hoof from the effects of wear, by men whose absurd theories, when carried into practice, inflicted most serious injury to the foot; but we may dismiss these and all other charges by the declaration that it is not the use, but the abuse, of the method which is to be inveighed against. The abuses are due to the farrier trying to improve, not to assist nature, and to make improvement costly. The most serious abuse is the very unreasonable and barbarous mutilation of the hoof. This is often carried to an excess scarcely credible. The sole is robbed of its natural protection until it yields to the pressure of the thumb, or even until the blood is passing through it. The frog is cut away to a shred to make it look neat: the bars are carefully removed; and then a shoe is put on much too small for the hoof. This leaves a portion of the wall projecting beyond the outer margin of the metal; and to make the foot fit the shoe, the horn is removed by means of a rasp from the front of the wall, which is consequently considerably weakened at the very part of all others where it should be strong, to support the nails which retain the shoe. Not only this, but the dense resisting outer fibers being removed, the soft, spongy inner horn is exposed, and this being acted upon by external influences, cracks and splits, until there is scarcely any sound material to retain the nails, which have, consequently, to be driven higher and nearer to the sensitive parts; and this, in time, leads to disease and deformity. A hoof so maltreated has an unmistakably ugly and ragged appearance. In addition to this mutilation of the hoof in the vicinity of the shoe, the farrier, in order to complete a fine job, as he imagines it, rasps the outer surface of the wall as high as the hair, and in this way not only destroys the horn so rasped, but impairs the growth of that from the coronet, which becomes weak and brittle; so that at length the workman has to employ his utmost skill to fasten on the shoe without laming the horse, and has also to employ a greater number of nails, which immensely exaggerates the evil. These mutilations and their consequence are quite common, and one can scarcely pass a horse in the streets of London without noticing them, and the majority of the shoes which are applied to the hoofs are no more reasonable in their construction. Great clumsy, unsightly masses of iron, the weight of which is perfectly outrageous, are attached to the feet of horses which have to travel sometimes at a rapid pace, carrying or drawing heavy loads. This weight is not only injurious to the feet, through the strain it imposes on them, but is extremely fatiguing to the muscles; so that a large portion of the animal's power is expended in carrying about unwieldy. clogs of iron. And the useless weight is not the only objection to very many of the shoes in daily use. In order that the denuded sole may not suffer injury from the pressure of the shoe, this is beveled away on its upper surface, until there is only a narrow rim left on which the foot rests; so that in reality the whole of the weight bearing is thrown upon the wall; and in consequence of the thickness of the shoe, neither sole or frog ever come in contact with the ground, and sustain their fair share of the weight and strain. In this way the horse is compelled to travel as no other animal does, or was ever designed to—on the outer margin of its feet. The space between the shoe and the sole is admirably adapted for the lodgement of stones, dirt, etc, and in heavy, stiff ground wonderfully increases suction. So much for the upper surface of the shoe; the lower, or ground surface, is not much less defective. It is usually a large, wide, smooth surface of metal, well contrived to promote sliding and slipping, furnished with a groove near its border, in which the nail holes are punched, but which groove is a mere waste of labor and time, for the farrier to make, as it is useless. Sometimes, with a view to prevent slipping, two projections, or calks, are raised at the end of the branches of the shoe; and these, though they may to a trifling extent answer their purpose, nevertheless throw the foot and limb into a most unnatural and uncomfortable position, the pain and inconvenience of which we may realize by walking in very high-heeled boots. These are only some, not all, of the evils of shoeing as commonly practiced, and it must be confessed that they are very serious, and sooner or later lead to painful traveling for the horse, as well as impaired efficiency; and yet this art, which the farrier makes so difficult and costly, both directly and indirectly, should be neither. To shoe a horse properly, if we take observation and a study of nature's plans into consideration, is certainly not a very difficult operation, and neither need it be a very expensive one. Our object should be to protect the hoof from wear—nothing more; and in doing so we ought to maintain the integrity and soundness of the hoof, while we do not overburden or disturb the natural direction of the foot and limb; and, as a secondary object, we should endeavor to increase the animal's foothold on the ground, if possible. The first object is attained by leaving the sole, frog and bars in their natural condition; as I have already explained that when they have acquired a certain thickness the outer surface falls off in flakes of dead horn, so that they never become too thick. It is different with the wall, which would grow to an indefinite length, because it is not thrown off in flakes, and the shoe prevents it from being worn. This, therefore, every time the horse is shod, has to be reduced in length at its lower border to a degree corresponding to the growth which has taken place since the previous shoeing; and the manner in which this is done, as well as the extent, constitutes, in my opinion, the chief test of the farrier's skill. If the wall is too much reduced, generally, injury will follow; if too much at the toe or front, the heels will be naturally high, and this will alter the animal's gait, particularly in the fore feet, and make its paces uncomfortable to the rider; if too much at the back part of the heels, it throws the unnatural strain on the fetlocks and some other joints; and if one side is lowered more than another, it leads to twisting of the limbs and strain on the lateral ligaments of the joints. All these can be avoided by the skillful artisan; and yet, strange to say, the normal position or direction of the limb and foot is seldom taken into consideration, and we see numbers of horses of all descriptions with these more or less crooked in consequence. The unmutilated hoof only requires as much iron as will protect the lower border of its walls, say for a month or six weeks, and insure security of foothold—nothing more—and all beyond this is loss or injury; while, if possible, the sole and frog should be allowed to play their part. A shoe and method of shoeing which admirably answer these ends is that introduced some years ago by M. Charlier, a Parisian veterinary surgeon. A narrow rim of iron is imbedded in a recess formed by removing the wall only, to a certain depth of its lower border; the iron, in fact, takes the place of the removed wall, and is retained securely by a small number of very small nails. The first, I believe, to try this method of shoeing in this country, I have continued its use, but in a modified form, up to the present time, and can affirm that it is, for many horses, the best method of shoeing known. In principle it is founded on a sound physiological basis, and in practice I can testify to its great utility. My modification consists in having only a short rim of metal passing round about two-thirds of the wall, and imbedded on a level with the sole, leaving that and the frog to reach the ground, and the heels free of iron—in all respects, in fact, as though the foot were in an unshod state. The rim weighs about one-third of the common shoe, and is retained firmly in position by only four of the very smallest nails, and yet it wears longer than the heavy shoe, which requires eight, ten, and sometimes twelve nails. This is easily accounted for by the fact that horn and iron wear together in this instance, and that the limbs are not fatigued, but move lightly and easily. Traveling is also safer on slippery roads, as there is only a very small portion of metal exposed, and the frog prevents slipping. The saving in manufacture, nails, and iron is also very great. If this shoe can not be employed, then we ought to resort to one in conformation the opposite of that now adopted, in so far that it should be much lighter, be concave on the ground surface and flat towards the foot, and instead of having a groove, have merely the nail-holes punched for the reception of the nail-head. This would assure a safer footing, diminish the strain on the wall by allowing the sole to share in sustaining the weight, as it was intended it should do, and obviate the effects of suction in heavy ground, as well as picking up stones, etc. A shoe I have devised meets these ends, and is merely an imitation of the lower border of the wall, sole and bars. I have tested its utility among troop horses and in the hunting-field for a number of years, and it has proved a good shoe for road work. The bevel on the ground surface suddenly ceasing within an inch or so of the end of the branch leaves a catch, which imitates the angles of the bars, and acts like them in assisting the horse to check his motion suddenly. The nails should be as few and as small as possible, and be driven only a short distance into the wall, which, if reduced to its proper dimensions before the shoe is put on, will not, and ought not to, receive any further rasping, especially on the face, as the shoe should be fitted full to the circumference. A word as to fitting. To secure a perfect coaptation between the shoe and hoof is not an easy matter, and requires much time and tact; and when it has been obtained the shoe is far from being as securely attached as is desirable, particularly if the hoof is exposed to wet. The fitting is greatly simplified, and an accurate adjustment, as well as a solid surface for the shoe, secured, if the latter be used in a hot state to prove the evenness of the surface on which it is to rest, as well as to fuse or char the immediate ends of the fibers, which are thereby hardened, and resist pressure and the effects of moisture to a wonderful degree. Persons ignorant of the subject imagine this injures the foot, but in all my experience I have never observed any harm to follow. Horn is a very slow conductor of heat, and provided the shoe is sufficiently hot to leave its imprint when momentarily applied, and the hoof is not mutilated to a shred of horn, no injury can or will follow. With regard to security of foothold, and adding to the horse's power in draft, particularly with those horses which travel at a slow pace with heavy loads in our cities, there can be no doubt that calks are necessary, but their utility is greatly diminished, and they do harm to the limbs and joints if a toe-piece is not added. In nearly every town and city in this country, with the exception of London, the claw-shoe, as it has been termed, is in use; and without it the horse would be much more liable to falls, and would draw much less loads with quite as much fatigue. This shoe is not worn in London, and we see horses not drawing half the loads those in these places do, and yet are scarcely able to keep their feet. Surely this is short-sighted policy. With a toe-piece, the hind foot of the horse has a powerful aid in seizing the ground securely, and its propelling muscles can then be brought into full play in moving the load to which it is attached, instead of expending half its force in maintaining equilibrium. Various contrivances have been from time to time proposed to give the horse a better foothold, but none have proved so successful and so cheap as the calks and toe-piece. In connection with this subject of slipping, which is chiefly observed in the streets of our towns and cities, it must be confessed that the manner in which these are paved only too frequently does us little credit as a humane or economical people. Certainly economy has much to do with their construction; but it is short-sighted economy, and chiefly in favor of the rate-payer, not of the community in general, or yet of horses. Indeed, looking at the variety of pavements and their difficulties in the matter of traffic, one must feel that the horses which have to travel on them must be greatly perplexed, and if they have any reflective power they will doubtless consider their masters as very stupid and embarrassing road-makers. Some of the streets in London are infamously cruel to horses. Those paved with granite may be cheap to lay, but they are most objectionable in every respect, and the most expensive of all to horse and carriage owners. They are at all seasons very dangerous and fatiguing for horses in the matter of slipping; they inflict great injury to the limbs and feet from concussion; traction upon them is heavy: they are extremely noisy, and the jar and vibration they occasion to carriages wear these out more rapidly than any other kind of road. When wet and muddy, they are as dangerous to human passengers as to horses. In fact, though granite blocks make a very durable pavement, yet, on the whole, looking at such a pavement from an equestrian point of view, it is the most expensive and dangerous of any in use. As to macadamized roads, there is certainly a better foothold upon them, but their traction is heavy; in wet weather this is increased, and the mud is most objectionable; while in dry weather the dust is a great drawback, and watering is a nuisance and expensive. Noise is also considerable, and repair must be frequent. The asphalt pavement is in many respects objectionable; traction is, no doubt, easy, but when the surface of the pavement is damp there is no foothold for horses, and the danger from serious falls is great. It is not at all a noiseless pavement; sprinkling sand over it to render it more safe increases the noise and the traction, and makes its surface disagreeably dirty. Besides, asphalt does not at all answer on hilly streets. The best pavement, perhaps, ever introduced for horse traffic is that of wood, such as is laid down at Ludgate hill. From the fact that the cubes of wood are so laid that the fiber is vertical, that the interspaces are filled with pitch and gravel, and that they are laid upon diagonal planks, we have not only a very safe and comfortable pavement, so far as the horse's footing is concerned, but the nature of the material and the manner in which it is disposed render it a most humane roadway, with regard to obviating jar and concussion to the feet and legs. Traction upon it is easy. There is comparatively little noise, dirt or dust; and, altogether, for the human and equine population of our towns and cities, perhaps no more economical, safe, and agreeable pavement could be devised. [This fully coincides with the opinion in the article Roads, by an authority thereon.—Editor.] The farrier must do his best to preserve and protect the horse's feet by shoeing, but we have a right to expect that the engineer will not fail to second his efforts by constructing roads which, while insuring safety to horses traveling upon them, will not counteract the advantages of good farriery. The more frequent use of brakes for carriages, and particularly omnibuses, is pulling up suddenly, and also in going down hills, would prove of great benefit to horses, in connection with shoeing and slipping. This matter of roads and brakes for carriages is one of great moment, but particularly the former. It is painful to witness unfortunate horses unable to keep their feet on the horrible pavements with which the majority of streets are laid, and brutal drivers plying their unmerciful whips on the poor creatures' skin for no fault whatever, but merely because a stupid and mistaken economy will persist in constructing a particular kind of road, upon which it is impossible the animals can travel with anything like safety, and at the same time exercise their powers in draft. This consideration brings me to winter, or frost shoeing. In a climate so uncertain and fickle as Great Britian it is difficult to make more than a guess as to the kind of winter we may have in any year, and therefore no provision is made against the occurrence of frost. Indeed, in some winters we may have no frost at all, and the ordinary shoeing suffices for the whole season; but at other times the temperature may suddenly fall, and frost and snow appear; and then all is confusion, partial suspension of traffic, dangerous traveling, serious accidents, and such other incidents as hard winters provide in abundance. The ordinary method of roughing the shoes, as it is termed, consists in taking them off the hoofs, turning up a sharpened calk, and perhaps adding a sharp toe-piece, and putting them on again. This is a slow and expensive process, and of course requires the aid of the farrier either in the stables or at the forge; it is very injurious to the hoofs, takes a good deal of time, and, in consequence of the projections being only soft iron, must be repeated at short intervals. Besides, in the hurry which always exists at this time, the shoes are often badly put on, and get loose or are lost, or the nails are driven into the quick. To obviate all these disadvantages and inconveniences, various contrivances have been proposed. A very temporary one consists in inserting some large, sharp headed nails in the place of others withdrawn. These also injure the hoof. Another is the insertion of sharp studs screwed in at the heels of the shoe. These are convenient, but somewhat expensive, and are liable to break at the neck, leaving the screw portion immovably fixed in the shoe. Other more or less expensive and inefficient appliances have been proposed, but have not succeeded in meeting the requirements of those whose horses must do regular work during frost. This winter-shoeing has attracted my attention for many years. During a campaign it is sometimes of the utmost importance that horses should be able to travel on ice—indeed, the fate of an army or the success of some great movement may depend upon it. I may point to the French retreat from Moscow, in November, 1812, as described by Thiers, when the terrible disasters that occurred were largely due to the absence of some contrivance for enabling the horses to travel on the slippery roads. We may also read with profit the Danish retreat from Schleswig to Sonderburg on the night of February 5, 1865. I have tried every method proposed, but have found none which was economical, efficient and speedily applicable when required, and without the necessity of taking off the shoes. Three years ago I ventured to experiment with a method which has certainly proved to be the nearest to perfection in these respects. During last winter it was very extensively used, and reports were most favorable. This method consists merely in punching a square hole at the end of each branch, and, if thought desirable, at the toe of the shoe, and inserting into it a square, slightly tapering, plug of steel, with a sharp point projecting beyond the lower surface of the shoe. The plug may be of any reasonable length, from one to three inches, but it must fit the hole somewhat accurately and tightly, and must not go quite through the shoe to the hoof. It should be well tempered at the point, to give it durability; and then nothing more is necessary than to insert it into the hole, give it a slight tap on the point, to fix it until the horse puts its weight on it and drives it home, when it is firmly retained, every step keeping it tighter in. This stud rarely falls out if properly made, and when required to be removed, as to be re-sharpened, replaced by another, or left out altogether, a few taps on each side will generally start it, owing to the taper on that portion which fits into the shoe. A set of studs will last four or five days, and the simple square hole takes but little time to punch. At the commencement of winter—say November—all shoes put upon my troop horses are provided with these holes, and the farriers have their studs ready. Should the frost suddenly set in, all the horses can be made proof against slipping on sheet ice, even in a few minutes, and, with a good supply of studs, may travel for weeks without going near a forge, or requiring the farrier. When the frost disappears the studs can be taken out again, and they may be removed every night in the stable, and inserted in the morning before going to duty. I must now conclude what I have to say concerning horse-shoeing in general, and the principle on which it should be based. I have made no mention of the different kinds of shoes sometimes required for particular hoofs, nor what we may term pathological horse-shoeing, for the cure of disease or defects, natural or acquired, of the feet and limbs. This, though a most interesting and important section, nevertheless comes more within the domain of the scientific veterinary surgeon, and is of too extensive and perhaps technical a character to be here introduced.

SHORE. A piece of timber which props up a wall.

SHORT-HORN CATTLE. The history of this wonderful breed of cattle, once as eminent for their combination of milk and flesh producing qualities as they have in later years been made to excel as strictly beef producers, is very much mixed up, writers, both English and American, having endeavored to cast discredit upon certain strains of blood, either to subserve their own particular views, or to bring into repute the stocks of particular breeders. The following, from the work of Mr. Lewis T. Allen, editor American Short-Horn Herd Book, is undoubtedly as nearly correct as it can now be had. He says: For some centuries anterior to the conquest of England by the First William, (of Normandy,) the northeastern counties of England, Northumberland, Durham and York, (then called Northumbria,) had been possessed, with occasional interruptions, by the Danes, and other Scandinavians of northwestern Europe. They were a warlike people, not only conquering, by their bold raids, the countries along the continental coast to the south of them, even into Holland, but pirates and sea kings as well, carrying their devastations across the water into Northumbria, and some adjoining parts of Britain. While they held the frontier coast of England they established trade in many articles of merchandise and agricultural products, and shipped them to and from both sides of the ocean channel. Among these were cattle in considerable numbers. Southern Denmark, Jutland, Holstein, and Utrecht, long held by the Danes, possessed a breed of cattle—short-horns essentially—having their general appearance, and peculiar colors, but coarse in their form and flesh, yet yielding largely of milk. It is supposed by a majority of the earlier English writers on agriculture and cattle, who paid particular attention to these subjects, that it was from these foreign cattle, imported at that early day from the neighboring continent, that the present race of short-horns are descended, and that for some centuries they inhabited that part of England only. The earliest accounts we have seen, first found them there. Holderness, a district of Yorkshire, was said to number these cattle in considerable herds. They possessed a great aptitude to fatten, in addition to their milking qualities, yet their flesh was coarse, accompanied by a large amount of offal. That they possessed valuable characteristics in their high and broad carcases, and contained within themselves the elements of refinement, when brought within the conditions of shelter, good fare, and painstaking, we may well conjecture. The people of those days were rude and uncultivated, and the cattle must have been rude also. Oftentimes pinched with poverty and scant fare, subject to the storms and blasts of an inclement winter climate, unsheltered, probably, in all seasons, except as the woods or hollows of the land could protect them, the worst points in their anatomy took precedence in their looks, and they were but a sorry spectacle to the eye of an accurate judge, or breeder. Following down to near the middle of the last century, we find that some of the authors named speak of these cattle, on the banks of the river Tees, (a stream dividing the counties of York and Durham,) existing in a high degree of improvement, and superior to almost any others which they had seen. As we have before remarked, it is not surprising that they were found in these counties only, as every district in England had its own local breeds to which their people were partial, and cattle were not interchanged as now, except for the purposes of feeding, and going to London, or other large seacoast markets, for consumption. No doubt, in the agricultural progress of the country, these cattle had received considerable attention, and were much improved in their forms, flesh, and general appearance by their breeders, until they arrived at a considerable degree of perfection. Here, then, we find them existing in several excellent herds, and bred with much care. Some pedigrees can be traced, more or less distinctly, back to the year 1740, or even earlier. The late Mr. Bates, in one of his accounts of these cattle, says, in 1784 the estates of the Earl of Northumberland had fine short-horns upon them, for two hundred years previous to that time. Let us see: Bailey, in his survey of Durham, written in the year 1808, says that, seventy years since (1738,) the colors of the cattle of Mr. Milbank and Mr. Croft, were red and white, and white, with a little red about the neck, or roan, as related to him by old men who knew them at the time. Cully also states the same fact. Milbank and Croft were both noted cattle breeders of that day, and into their herds many modern cattle trace their pedigrees. The Duke of Northumberland had good short-horns on his estate at Stanwick, in that county. The Aislabees, of Studley Park, and Sir William St. Quintin, of Scampston, also kept excellent short-horns; and the Stephensons, Maynards, Wetherells, and many others, too numerous to mention, were breeders. As the merits of these cattle became more known, they rapidly increased among the local breeders and farmers of those counties, but they did not obtain anything like a general reputation over the country, until Charles and Robert Colling came on to the stage and commenced breeding them. They were young farmers, brothers, and their father had been a short-horn breeder before them. They established themselves as farmers and cattle-breeders about the year 1780, each having separate herds, but working more or less together, and interchanging the use of their bulls. Charles, the younger, was the more enterprising, but not a better breeder than his brother. With great sagacity and good judgment, they picked up some of the best cows and bulls from the herds of the older breeders around them, and for many years bred them with success and profit. They early possessed themselves of a bull, afterwards called Hubback, claimed, by some, to be the great progenitor of the improved short-horns. He proved a most excellent stock-getter while in the hands of the Collings, as well as before they obtained him, and after he left them. The possession of Hubback proved fortunate for the Collings, as some of their best cattle traced into his blood, which was more or less participated in by the breeders around them. The blood of this bull—Hubback—became so famous, indeed, that any good and well bred beast which could trace its pedigree to him, was counted of rare value. This breed of cattle early attracted attention in America. Soon after the Revolutionary war, cattle supposed to be pure Short-horns were imported into Virginia, cattle as remarkable for their milking qualities as for the flesh they carried since it reported that individual animals gave as high as thirty-two quarts of milk a day. As early as 1797 the produce of these cattle were taken to Kentucky by a Mr. Patton, that soon became widely disseminated over the West as the Patton breed. The editor of this work nearly forty years ago saw descendants of this stock in Illinois, having all the characteristices of the short-horns and they were known as the Patton breed. Among those having them may be mentioned the late Rev. Mr. Morrison, near Momence, Ill. These cattle were still famous for their large size and milking qualities. Indeed those imported up to fifty years ago were remarkable for their milking qualities, and particular herds and strains of this stock still exist excellent in this quality as well as in their flesh making aptitude. As to the further history of the short-horns in America, Mr. Francis M. Rotch, of New York, a gentleman perfectly well qualified, in a report to the United States Government in 1861, says: The majestic size, proud carriage, and beautifully variegated colors of the Short-horn render him easily recognized by the merest tyro; but few who thus admire and recognize them are aware how many qualifications go to make up this splendid whole, or how carefully each point has been weighed and discussed, and its relative value decided; how the useful parts are divided from the ornamental and fashionable, and how systematically the whole has been carried out. The high caste short-horn should have a small head, a broad, flat forehead, with no projection of the frontal bones; the face should be well cut out below the eyes, tapering to a fine muzzle with open nostrils; the nose must be flesh or chocolate colored; any discoloration hinting towards black or blue is very objectionable, though occasionally seen in some of the highest bred families; the eye must be bright, prominent, and yet placid; a small, piggish or hollow eye, or one showing viciousness or nervousness, are alike to be avoided, the latter indicating a bad feeder almost invariably; the horn should be well set on, curving forward, not too heavy, and of a waxy, yellow color at the base; the body should be square, massive, and symmetrical, set on short legs which should be straight and well under the animal; the fore legs should be small in the bone below the knee, whilst the forearm must be broad and tapering downwards, fitting level into the girth; the hind legs must be nearly straight; if the hocks are too much bent, turn inward, or not well under the body, it not only gives an awkward gait in walking, but is generally a sign of weakness; the neck is moderately long, clean in the throat, and running neatly into the shoulders, which should not be too prominent at the points, nor too wide at the top, else the crops will be certain to seem defective; they should mould nicely into the fore-quarters, and be well covered with flesh on the outside; the neck vein should be well filled up with flesh, and form on smoothly to the shoulder points; the chest must be broad and deep, and full back of the elbows, which secures a good girth and consequent room for the most important vital organs; the brisket should be full and broad rather than narrow and projecting; it is of inferior quality as beef, yet, as a point of beauty and as indicating a propensity to fatten, must not be overlooked. We now come to the upper portion of the frame, carrying the best beef, and here we must have width and thickness and length; the crops must fill up level with the shoulders and back; the ribs must spring level and full from the back, and fill well up to the hips, (the short-horn is apt to be loosely ribbed up). The loin must be broad and well carried forward into the crops, and covered with thick flesh moulding nicely on to the hips, which though wide must not be too prominent, but slope away gradually to the rump or side bones at the tail; a quarter badly filled up between hips and rumps or scooped-out, as it is termed, is very objectionable; the back must be level from neck to tail, with no drops back of the shoulders, nor any rise where the tail is set on; the rumps must be well laid up but not too high, else when the animal is fat we shall have those large masses of fat aggregated about them so common among the breed some years since, but now deservedly stigmatized as bad; the twist should be well filled out in the seam, wide and deep, the outside thigh full, the flank deep, and forming with the fore-flank and belly (the latter well supported by its plates) a parallel line with the animal's back. The whole frame must be evenly covered with flesh, of a mellow elastic nature, readily yielding to the fingers, yet following them as the pressure is withdrawn; the skin must be of a moderate thickness, neither papery (too thin) nor thick enough to be stiff and hard; it must be covered with a coat of thick, soft, mossy hair. As regards color the latitude is very great, from deep blood-red through all the intermediate shades and mixtures to pure white, but any other colors, as brown, black, or dun, are never met with in thoroughbreds. Fashion has vindicated the rich red and purple roan as the most desirable colors, and after them red. White is sometimes objected to, under the impression that it is apt to spread through a herd and overpower the other colors; but this fear is more common in this country than in England, where white bulls are often used. Red and white, in blotches, with defined edges not running into roan, is disliked, and the term patchy is applied to it. This discrimination, however, as regards color, is entirely arbitrary, animals of equal excellence and breeding being found of all these colors. We may gather from the foregoing pages that the essential peculiarities of the improved short-horns are, early maturity, a great disposition to fatten, a remarkable evenness on laying on their flesh, a gentle, quiet temper, and, in some tribes and families, a large secretion of milk. It has been claimed by some of their more zealous advocates in this country that they make good oxen, but we hardly think, however docile and powerful they may be, that they can compete in activity and speed with some of the other breeds Taking into consideration these characteristics, we see how admirably adapted they



SHORT-HORN BULL.



SHORT-HORN COW.

are for the larger portion of our country. Wherever there is fair pasturage, good water, and shelter from the extremes of heat and cold, there the short-horn thrives. Over the broad prairies and blue grass pasture of the west, in the rich valleys of our great rivers, he roams and flourishes as though in his native vale, and readily adapts himself to the change of situation and climate. But it is to the crosses of the short-horn that we must look for the most general adaptation and dissemination of the breed. The high value of the thoroughbreds for breeding purposes must for many years prevent their universal adoption, and it is only by crossing them upon our so-called natives that we can reap immediate benefit from them. Fortunately for us, no breed more promptly and strongly stamps its impress upon other blood than this one. All the writers on cattle unite in this opinion, and some even advocate crossing the short-horn or other pure races, with a view to their improvement. We shall usually find, however, the most remarkable and satisfactory results when a short-horn is put upon a mongrel or a lately established breed, as then the deep breeding of the sire will obliterate the numerous thin strains of the dam's blood, and the produce will resemble the superior race. The cross between the native cow and the short-horn bull almost always produces good milkers, and, as a whole they afford more milk of a better quality than other beef breeds, and, when dry, they feed quickly and make excellent beef. In this connection we extract from the Fifth Annual Report of the Massachusetts Board of Agriculture a portion of a statement made to them of the dairy performance of some grades of short-horns belonging to Mr. Robinson, of Barre. The cows were half and three-quarters bred. Seven of them yielded, during the first seven days in June, 2,207¼ pounds of milk, averaging forty-five pounds per diem to each cow. From this milk 232 pounds of cheese was made, averaging one pound of cheese to nine and a half pounds of milk. The same cows gave during the three following days 955 pounds of milk, from which forty-one pounds nine ounces of butter was made, averaging one pound of butter to twenty-three pounds of milk. It will be seen that the milk that makes one pound of butter will make two and a half pounds of cheese. These cows had no extra feed during the trial, having been turned to pasture on the 15th of May. This instance is selected not as a very extraordinary performance, but as a well-authenticated and carefully-conducted experiment. We may, without fear of contradiction, pronounce the females of the cross of the short-horn and native as essentially and almost uniformly deep milkers. The original strong predisposition to milk that marked the race, which is shared by none of the other pure races, is admirably fitted to combine with the occasional and accidental quality in the native and in the progeny to assure pre-eminence on this point. The steers are thrifty, and lay on flesh rapidly and evenly, and are ready to turn off at two and a half or three years old. They are hardy as their native parent, and bear transportation and driving admirably, shrinking less than the thoroughbreds. The greater proportion of the cattle now brought from Ohio, Indiana Illinois, Iowa, and further west, to supply markets of the seaboard cities, and for exportation, are crosses of this character, and none pay the feeder better, and again the butcher is rarely disappointed in the fifth quarter. Among the eastern importations were those of 1815, 1822, 1823, 1828, 1835, 1839, 1849–50 into the State of New York. Into Massachusetts, in 1818, 1820, 1823. Into Kentucky, in 1817, and again in 1837–38 and '39. In 1834, large importations were made into Ohio, and again in 1835–36. These were widely distributed, and that they were good animals may be inferred from the fact that they were sold at prices varying from $500 to $2,500 each. The first direct importation of short-horns from England to Illinois was in 1858. These were superior animals and sold at satisfactory prices. Since that time the work of importing and breeding has been carried on all over the North, the Middle States, the West, the Northwest and the northern line of States South, until the time came when animals superior to those English bred were sent back to England, at prices all the way up to $30,000 for single animals. In the breeding of short-horns Canada has not been behind the United States. Since 1835, importations have been common, from England. The breeding has been prosecuted most successfully, and of late years there has been many interchanges of blood between the Dominion and the United States, back and forth, and with satisfaction to all parties concerned, and to-day there are no higher bred or better short-horns in the world than are to be found in the United States and Canada. The points of short-horns, and which will apply in judging all beef animals, with slight variations, are worthy of a somewhat minute description. The points are of two classes, those observed with the eye and those felt with the touch. By the eye we observe the general contour of the animal, size, length, breadth, thickness, fineness of body, head and limb, the loin, back, thigh, the spring of the rib and the manner in which the animal is ribbed close to the hip bones. The touch, that is the feeling under the touch, shows length and quality of the ham, thickness and elasticity of the skin. Thus, the eye and expression of countenance is indicative of disposition and temper; an elastic, mellow, and yet firm hide of medium thickness, shows thick, well marbled flesh. A floating, soft skin of blubbery fat, indicates a bad feeder and often an animal of dark colored flesh. The butcher, in buying an animal for beef has now-a-days but a single object in view. The animal that will turn out the greatest amount of lean meat, in the prime parts with the least offal, and only a moderate amount of fat, for fat is now one of the cheapest portions of the animal. Years ago in the days of tallow candles, the reverse was the case. The back, loin and ribs are the choice bits, next the rump and thighs, then the shoulders, while the neck and head are comparatively worthless The sagacious breeder while keeping this constantly in view, seeks to add early maturity to good flesh. He who comes nearest to this has the best animal whatever the breed, or the pedigree of the particular breed, for, the butcher's block is the final and the crucial test. Derived from a large breed, the improved short-horn is heavy, less in height than the originals of the Tees, rounder and deeper in the trunk, the limbs shorter, chest and back broader, appearing less in bulk, while really greater in weight. The skin is light-colored, hair reddish brown or white or mixed, the muzzle flesh-colored, the horns shorter and lighter-colored than the former breed, the skin soft to the touch, the form square, the shoulder upright, and the hind-quarter large. The color can not be characterized by a single term, varying greatly from a pure white to a rich red, a mixture being quite common as roan or strawberry. The skin should be velvety and not too thin, while the hair should be plentiful and of a mossy softness. The head of the female is finer and more tapering than that of the male, the neck thinner and lighter, and her shoulder inclining to narrow towards the chine. The short-horn looks smaller than he is. He excels all other stock in facility of fattening, making good and heavy beef in thirty months, and even in two years. Henry Strafford, an excellent judge, thus sums up his points: The head of the male animal is short, but at the same time fine; very broad across the eyes, but gradually tapering to the nose, the nostril of which is full and prominent; the nose itself of a rich flesh color, neither too light nor dark; eyes bright and placid, with ears somewhat large and thin. The head, crowned with a curved and somewhat flat horn, is well set on to a lengthy, broad, muscular neck; the chest wide, deep, and projecting; shoulders fine, oblique, and well formed into the chine; fore legs short, with the upper arm large and powerful; barrel round, deep, and well ribbed up towards the loins and hips, which should be wide and level; back straight from the withers to the setting on of the tail, but still short, that is, from hip to chine, the opinion of many good judges being that a short-horn should have a short back with long frame. Well treated and kept, both alike in the same pasture, with equal winter forage and shelter, at eighteen months old the native may acquire a weight of 600 to 800 pounds, while the short-horn will weigh 1,000 to 1,200 pounds. At two and one-half years the native may have attained a weight of 1,000 pounds, and the short-horn of 1,200 to 1,400 pounds. The latter will be in a profitable beef-condition, while the former will be immature and not fit for market. By adding another year to their keeping, the native arrives at perhaps 1,200 pounds and the short-horn at 1,500 to 2,000 pounds, the former being still unripened, while the latter is at full maturity, and will sell at one or two cents per pound higher than the native. The common steer, at less than four and one-half years, is not fully ripe as a market-animal, and then, with the capital and interest invested in him, together with the risk of disease or death, and the additional forage for the extended time, he brings less money than a short-horn a year younger. These facts, together with the fact that the short-horn has but a small amount of bone and offal according to its weight, and gives a much larger percentage of choice meat than the native, slaughtered at whatever age, prove that the short-horn is more profitable for the breeder, the grazier, the feeder, and, what is quite as important, the consumer.

SHOULDER LAMENESS. Dr. Dadd says: Lameness is more apt to arise in the shoulder than in the corresponding part of the hind extremities; the latter having a bony union to the body, which prevents, or rather limits, undue extension of the muscles. The lameness may exist in the muscular tissues, or at the point of articulation between the shoulder blade and the *os humeri*. The principal symptom is, that the horse, instead of advancing the leg straight forward, moves it in a circular manner; and the action of the shoulder is quite different from that of the other side; it will be observed also, that the animal throws the weight of the body as much on the sound side as possible. The treatment of shoulder lameness will depend altogether on the nature of the case; if it be one of muscular origin, caused by heavy drawing, violent tugging, or galloping on hard roads, rest, fomentations, and a light dose of medicine are indicated. Should the animal still be lame after the inflammatory symptoms have subsided, use the following liniment: one pint linseed oil, one ounce chloric ether, one-half ounce oil of cedar; mix, and apply to the shoulder night and morning. If the disease is confined to the joint, counter-irritants are indicated: some recommend blisters, or use the acetate of cantharides, to be applied occasionally over the parts effected. A stimulating liniment may, however, answer the purpose, composed of equal parts olive oil, spirits camphor and tincture of ginger.

SHREW MICE. *Sorex.* The family of shrews are properly insectivorous, and from the fact of their being nocturnal are seldom seen, even where they are most numerous. They should be protected. The young are blind and naked at birth. Their general characteristics are as follows: The body slender, legs short, the feet and nails resembling those of a mouse; neck short and powerful, and the head stout, terminating in a long, pointed nose, extending much beyond the teeth, the slender, but strong, cartilaginous point of which is movable. The eyes are exceedingly small, and usually hidden by the fur. The lower incisor teeth project horizontally forward from the jaw, at the base, and are curved upward near the tip; the points of the teeth usually of a dark color. The body is densely clothed with soft, glossy fur. On each side are glands, which secrete a fluid of peculiar odor; these glands being more fully developed in the males. The short-tailed shrew, *Sorex blarina,* Cooper's shrew, *S. Cooperi*, and Arnold's shrew, *S. eximina*, are varieties.

SHRIKE. Butcher bird. *Callyria borealis.* The shrikes closely resemble the jays, and get their name, butcher bird, from their habit of impaling their prey on thorns or sharp branches of bushes. It is, however, more than a match for the jay in rapacity. Its food is large insects, small birds, and such small animals as it may be able to overcome. It inhabits most of the Middle and Southern States, coming North in summer to breed. The nest is lodged in the fork of a small tree, often an apple tree. The female lays six eggs, the general appearance being a dirty lead-colored white, dashed with spots of brown at the larger end.

SHRUB. A small, low, dwarfish tree, which, instead of one single stem, puts forth from the same root several sets of stems. A collection of these, tastefully arranged, is a shrubbery.

SHUCK. The husk, or collection of involucra about the corn ear. Shucks are much esteemed for fodder, being very superior to straw and corn fodder. When cut into shreds, they make a good material for mattresses.

SHY. Starting aside, in horses; the result of fear, produced by strange objects.

SIALAGOGUES. Drugs which produce salivation, or an increased flow of saliva.

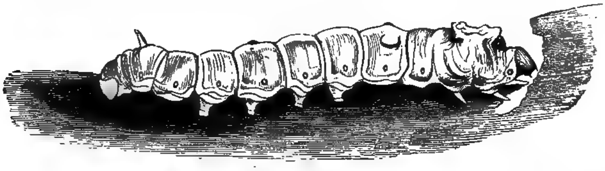
SILEX, SILICIC ACID. Pure sand, rock crystal. An acid, consisting of one equivalent of silicium, (22.22), a body resembling in appearance charcoal, and three equivalents of oxygen, 46.22. In the cold it is inactive, but at a white heat it forms an exceedingly active acid, combining with bases, and displacing most other acids, except the phosphoric and boracic. The silicates are nearly all insoluble in pure water; glass and common earthen-ware are specimens of silicates, but they gradually decay in the presence of acids, and of carbonic acid and water. But the compounds of silicic acid, with two or three times its weight of carbonate of potash or soda, are soluble silicates, and have been recommended as manures for the cerealia, which always contain a large amount of silicic acid in their stems, leaves, and husks. Most of the minerals and rocks of the earth are silicates, this acid forming from one-quarter to one-third of its entire solid mass. Soluble and other silicates are formed by fusing together sand and the desired chemical body, usually in the state of carbonate, in a black-lead crucible, at a full red heat. Potash, soda, lime, and magnesia in the soil which supply plants with saline matters, are often in the form of silicates; these are slowly decomposed under the influence of the carbonic acid of the air, or from decaying vegetable matter, which converts them into soluble carbonates, whereby they gain access to the plant.

SILICATES. Salts containing silicic acid, usually flinty and insoluble; slate, feldspar, and granite are specimens.

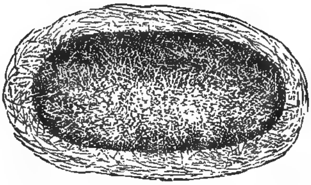
SILIQUA, SILIQUE. A one or two-celled, many-seeded, linear fruit, dehiscent by two valves separating from a septum; the seeds are attached to two placentæ adhering to the septum, and opposite to the lobes of the stigma. The seed pods of the mustard is an example.

SILIQUOSE PLANTS. Improperly applied to leguminous plants, but properly to the cruciferous family.

SILKWORM. The Silkworm has attracted so much attention in all civilized countries where it may be propagated and raised for the silk which is obtained from the cocoons spun by the larvæ, and especially in the United States, where much money has from time to time been spent in establishing this industry, that more than a passing notice is deemed necessary. There is no reason why the rearing of silkworms may not be practiced in any portion of the United States south of 40°, the only question being the cost of labor in attending them. We believe the only two States where the industry is profitably carried on at present is in California and Kansas. The importance of the silk industry and the increasing demand for these products, as wealth increases, will undoubtedly prevent any glutting of the market, since the price of silk fabrics has steadily increased for the last forty years until now the possession of real silk fabrics, unmixed with other material, for dresses is beyond the reach of any but the more wealthy. So important was this industry considered that Dr. Riley was employed by the government of the United States to write a manual on the habits and rearing of the worm and the puperation of the cocoons, and the food-plants of the worms, to which the reader is referred for information not contained in this article. From Dr. Riley's manual, we extract as follows: The Silkworm proper, or that which supplies the ordinary silk of commerce, is the larva of a small moth known to scientific men as *Sericaria mori*. It is often popularly characterized as the Mulberry Silkworm. Its place among insects is with the *Lepidoptera*, or Scaly-winged insects, family *Bombycidæ*, or Spinners. There are several closely allied species, which spin silks of different qualities, none of which, however, unite strength and fineness in the same admirable proportions as does that of the mulberry species. The latter has, moreover, acquired many useful peculiarities during the long centuries of cultivation it has undergone. It has in fact become a true domesticated animal. The quality which man has endeavored to select in breeding this insect is, of course, that of silk producing, and hence we find that, when we compare it with its wild relations, the cocoon is vastly disproportionate to the size of the worm which makes it or the moth that issues from it. Other peculiarities have incidentally appeared, and the great number of varieties or races of the Silkworm almost equals those of the domestic dog. The white color of the species; its seeming want of all desire to escape as long as it is kept supplied with leaves, and the loss of the power of flight on the part of the moth, are all undoubtedly the result of domestication. From these facts, and particularly from that of the great variation within specific limits to which the insect is subject, it will be evident to all that the following remarks upon the nature of the Silkworm must necessarily be very general in their character. The Silkworm exists in four states—egg, larva, chrysalis, and adult or imago. The egg of the Silkworm moth is called by silk-raisers the seed. It is nearly round, slightly flattened, and in size resembles a turnip seed. Its color when first deposited is yellow, and this color it retains if unimpregnated. If impregnated, however, it soon acquires a gray, slate, lilac, violet, or even dark green hue, according to variety or breed. It also becomes indented. When diseased it assumes a still darker and dull tint. With some varieties it is fastened to the substance upon which it is deposited, by a gummy secretion of the moth produced in the act of ovipositing. Other varieties, however, among which may be mentioned the Adrianople whites and the yellows from Nouka, in the Caucasus, have not this natural gum. As the hatching point approaches, the egg becomes lighter in color, which is due to the fact that its fluid contents become concentrated, as it were, into the central, forming worm, leaving an intervening space between it and the shell, which is semi-transparent. Just before hatching, the worm within becoming more active, a slight clicking sound is frequently heard, which sound is, however, common to the eggs of many other insects. After the worm has made its exit by gnawing a hole through one side of the shell, this last becomes quite white. Each female produces on an average from three to four hundred eggs, and one ounce of eggs contains about 40,000 individuals It has been noticed that the color of the albuminous fluid of the egg corresponds to that of the cocoon, so that when the fluid is white the cocoon produced is also white, and when yellow the cocoon again corresponds. The worm goes through from three to four molts or sicknesses, the latter being the normal number. The periods between these different molts are called ages, there being five of these ages including the first from the hatching and the last from the fourth molt to the spinning period. The time between each of these molts is usually divided as follows: The first period occupies from five to six days, the second but four or five, the third about five, the fourth from five to six, and the fifth from eight to ten. These periods are not exact, but simply proportionate. The time from the hatching to the spinning of the cocoons may, and does, vary all the way from thirty to forty days, depending upon the race of the worm, the quality of the food, mode of feeding, temperature, etc.; but the same relative proportion of time between molts usually holds true. The color of the newly-hatched worm is black or dark gray, and it is covered with long stiff hairs, which, upon close examination, will be found to spring from pale-colored tubercles. Different shades of dark gray will, however, be found among worms hatching from the same batch of eggs. The hairs and tubercles are not noticeable after the first molt and the worm gradually gets lighter and lighter until, in the last age, it is of a cream-white color. When full grown it presents the appearance of Fig. 1. It never becomes entirely smooth, however, as there are short hairs along the sides, and very minute ones, not noticeable with the unaided eye, all over the body. The preparation for each molt requires from two to three days of fasting and rest, during which time the worm attaches itself firmly by the abdominal prolegs. In front of the first joint a dark triangular spot is at this time noticeable, indicating the growth of the new head; and when the term of sickness is over, the worm casts its old integument, rests a short time to recover strength, and then, freshened, supple, and hungry, goes to work feeding voraciously to compensate for lost time. This so-called sickness which preceded the molt was, in its turn, preceded by a most voracious appetite, which served to stretch the skin. In the operation of molting, the new head is first disengaged from the old skin, which is then gradually worked back from segment to segment until entirely cast off. If the worm is feeble, or has met with any misfortune, the shriveled skin may remain on the end of the body, being held by the anal horn; in which case the individual usually perishes in the course of time. It has been usually estimated that the worm in its growth consumes its own weight of leaves every day it feeds; but this is only an approximation. Yet it is certain that during the last few days before commencing to spin, it consumes more than during the whole of its previous worm-existence. It is a curious fact, first noted by Quatrefages, that the color of the abdominal prolegs at this time corresponds with the color of the silk. Having attained full growth, the worm is ready to spin up. It shrinks somewhat in size, voids most of the excrement remaining in the alimentary canal; acquires a clear, translucent, often pinkish or amber-colored hue; becomes restless, ceases to feed, and throws out silken threads. The silk is elaborated in a fluid condition in two long, slender, convoluted vessels, one upon each side of the alimentary canal. As these vessels approach the head they become less convoluted and more slender, and finally unite within the spinneret, from which the silk issues in a glutinous state, and apparently in a single thread. The glutinous liquid which combines the two, and which hardens immediately on exposure to the air, may, however, be dissolved in warm water. The worm usually consumes from three to five days in the construction of the cocoon, and then passes in three days more, by a final molt, into the chrysalis state. The cocoon consists of an outer lining of loose silk known as floss, which is used for carding, and is spun by the worm in first getting its bearings. The amount of this loose silk varies in different breeds. The inner cocoon is tough, strong, and compact, composed of a firm, continuous thread, which is, however, not wound in concentric circles, as might fairly be supposed, but irregularly, in short figure-of-eight loops, first in one place and then in another, so that in reeling, several yards of silk may be taken off without the cocoon turning round. In form the cocoon is usually oval, and in color yellowish, but in both these features it varies greatly, being either pure silvery-white, cream or carneous green, and even roseate, and very often constricted in the middle. It has always been considered possible to distinguish the sex of the contained insect from the general shape of the cocoon, those containing males being slender, depressed in the middle, and pointed at both ends, while the female cocoons are of a larger size and rounder form, and resemble in shape a hen's egg with equal ends. The chrysalis is a brown, oval body, considerably less in size than the full-grown worm. In the external integument may be traced folds corresponding with the abdominal rings, the wings folded over the breast, the antennæ, and the eyes of the enclosed insect—the future moth. At the posterior end of the chrysalis, pushed closely up to the wall of the cocoon, is the last larval skin, compressed into a dry wad of wrinkled integument. The chrysalis state continues for from two to three weeks, when the skin bursts and the moth emerges. With no jaws, and confined within the narrow space of the cocoon, the moth finds some difficulty in escaping. For this purpose it is provided, in two glands near the obsolete mouth,

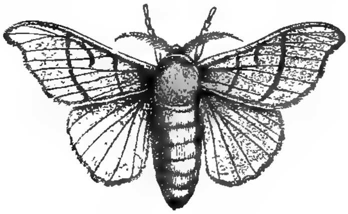


FULL-GROWN LARVA OF SILKWORM.

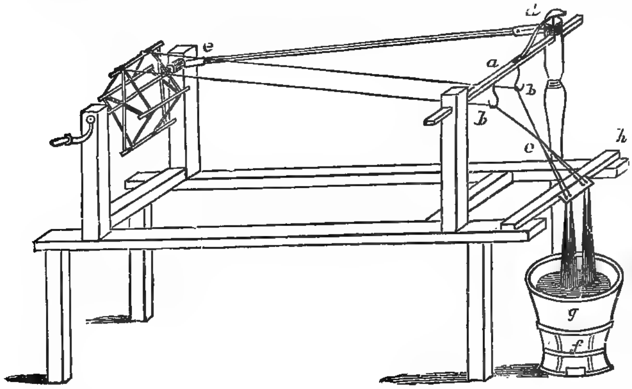


SILKWORM COCOON.

with a strongly alkaline liquid secretion with which it moistens the end of the cocoon, and dissolves the hard gummy lining. Then, by a forward and backward motion, the prisoner, with crimped and damp wings, gradually forces its way out, and when once out the wings soon expand and dry. The silken threads are simply pushed aside, but enough of them get broken in the process to render the cocoons, from which the moths escape, comparatively useless for reeling. The moth is of a cream color, with more or less distinct brownish markings across the wings. The males have broader antennæ, or feelers, than the females, and may, by this feature, at once be distinguished. Neither sex flies, but the male is more active than the female. They couple soon after issuing, and in a short time the female begins depositing her eggs, whether they have been impregnated or not. Domestication has had the effect of producing numerous varieties of the Silkworm, every different climate into which it has been carried having produced either some changes in the quality of the silk, or the shape or color of the cocoons; or else altered the habits of the worm. Some varieties produce but one brood in a year, no matter how the eggs are manipulated; such are known as Annuals. Others, known as Bivoltins, hatch twice in the course of a year; the first time, as with the Annuals, in April or May, and the second, eight or ten days after the eggs are laid by the first brood. The eggs of the second brood only are kept for the next year's crop, as those of the first brood always either hatch or die soon after being laid. The Trevoltins produce three annual generations. There are also Quadrivoltins, and in Bengal, a variety known as Dacey which is said to produce eight generations in the course of a year. Some varieties molt but three times instead of four, especially in warm countries and with Trevoltins. Experiments, taking into consideration the size of the cocoon, quality of silk, time occupied, hardiness, quantity of leaves required, etc., have proved the Annuals to be more profitable than any of the polyvoltins, although Bivoltins are often reared; and Mr. Alfred Brewster, of San Gabriel, Cal., says that he found a green Japanese variety of these last more hardy than the Chinese Annuals. Varieties are also known, by the color of the cocoons they produce, as Greens, or Whites, or Yellows, and also by the country in which they flourish. The white silk is most valuable in commerce, but the races producing yellow, cream-colored, or flesh-colored cocoons are generally considered to be the most vigorous. No classification of varieties can be attempted, as individuals of the same breed exported to a dozen different localities would, in all probability, soon present a dozen varieties. The three most marked and noted European varieties are the Milanese (Italian), breed, producing fine, small, yellow cocoons; the Ardêche (French), producing large yellow cocoons, and the Brousse (Turkish), producing large white cocoons of the best quality in Europe. Owing to the fearful prevalence of *pébrine* among the French and Italian races for fifteen or twenty years back, the Japanese Annuals have come into favor. The eggs are bought at Yokohama in September, and shipped during the winter. There are two principal varieties in use, the one producing white and the other greenish cocoons, and known respectively as the White Japanese and the Green Japanese Annuals. These cocoons are by no means large, but the pods are solid and firm, and yield an abundance of silk. They are about of a size, and both varieties are almost always constricted in the middle. Another valuable race is the White Chinese Annual which much resembles the White Japanese but is not as generally constricted. We have already seen the importance of getting healthy eggs, free from hereditary disease, and of good and valuable races. There is little danger of premature hatching until December, but from that time on, the eggs should be kept in a cool, dry room in tin boxes to prevent the ravages of rats and mice. They are most safely stored in a dry cellar, where the temperature rarely sinks below the freezing point, and they should be occasionally looked at to make sure that they are not affected by mold. If at any time, mold be perceived upon them it should be at once rubbed or brushed off, and the atmosphere made drier. If the tin boxes be perforated on two sides and the perforations covered with fine wire gauze, the chances of injury will be reduced to a minimum. The eggs may also, whether on cards or loose, be tied up in small bags and hung to the ceiling of the cold room. The string of the bag should be passed through a bottle neck or a piece of tin to prevent injury from rats and mice. The temperature should never be allowed to rise above 40° Fahr., but may be allowed to sink below freezing point without injury. Indeed, eggs sent from one country to another are usually packed in ice. They should be kept at a low temperature until the mulberry leaves are well started in the spring, and great care must be taken as the weather grows warmer to prevent hatching before their food is ready for them, since both the Mulberry and Osage Orange are rather late in leafing out. One great object should be, in fact, to have them all kept back, as the tendency in our climate is to premature hatching. Another object should be to have them hatch uniformly, and this is best attained by keeping together those laid at one and the same time, and by wintering them as already recommended, in cellars that are cool enough to prevent any embryonic development. They should then, as soon as the leaves of the food plant have commenced to put forth, be placed in trays and brought into a well-aired room where the temperature averages about 75° Fahr. If they have been wintered adhering to the cloth on which they were laid, all that is necessary is to spread the same cloth over the bottom of a tray. If, on the contrary, they have been wintered in the loose condition, they must be uniformly sifted or spread over sheets of cloth or paper. The temperature should be kept uniform, and a small stove in the

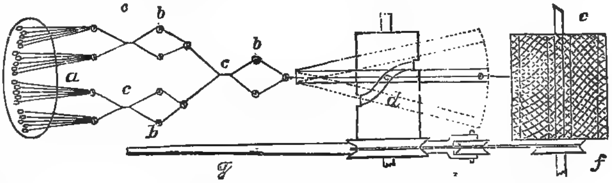


MOTH OF SILKWORM.



PIEDMONTESE SILK REEL.

hatching-room will prove very valuable in providing this uniformity. The heat of the room may be increased about two degrees each day, and if the eggs have been well kept back during the winter, they will begin to hatch under such treatment on the fifth or sixth day. By no means must the eggs be exposed to the sun's rays, which would kill them in a very short time. As the time of hatching approaches, the eggs grow lighter in color, and then the atmosphere must be kept moist artificially by sprinkling the floor, or otherwise, in order to enable the worms to eat through the egg-shell more easily. They also appear fresher and more vigorous with due amount of moisture. The room in which the rearing is to be done should be so arranged that it can be thoroughly and easily ventilated, and warmed if desirable. A northeast exposure is the best, and buildings erected for the express purpose should, of course, combine these requisites. If but few worms are to be reared, all the operations can be performed in trays upon tables, but in large establishments the room is arranged with deep and numerous shelves from four to eight feet deep and two feet and six inches apart. All wood, however, should be well seasoned, as green wood seems to be injurious to the health of the worms. When the eggs are about to hatch, mosquito-netting or perforated paper should be laid over them lightly. Upon this can be evenly spread freshly-plucked leaves or buds. The worms rise through the meshes of the net or the holes in the paper and cluster upon the leaves, when the whole net can easily be moved. In this preparation for moving, paper has the advantage over the netting; it is stiffer and does not lump the worms together in the middle. They may now be spread upon the shelves or trays, care being taken to give them plenty of space, as they grow rapidly. Each day's hatching should be kept separate in order that the worms may be of a uniform size, and go through their different moltings or sicknesses with regularity and uniformity; and all eggs not hatched after the fourth day from the appearance of the first should be thrown away, as they will be found to contain inferior, weakly, or sickly worms. It is calculated that one ounce of eggs of a good race will produce 100 pounds of fresh cocoons; while for every additional ounce the percentage is reduced if the worms are all raised together, until for twenty ounces the average does not exceed twenty-five pounds of cocoons per ounce. Such is the general experience throughout France, according to Guérin Méneville, and it shows the importance of keeping them in small broods, or of rearing on a moderate scale. The young worms may be removed from place to place by means of a small camel's-hair brush, but should be handled as little as possible. The best mode of feeding and caring for them is by continuing the use of the feeding-net first mentioned. As the worms increase in size the net must have larger meshes, and if it should be used every time fresh food is furnished, it will save a large amount of time and care. It entirely obviates the necessity of handling the worms, and enables the person having charge of them to keep them thoroughly clean; for, while they pass up through the net to take their fresh food, their excrement drops through it and is always taken up with the old litter beneath. It also acts as a detective of disease; for such worms as are injured, feeble, or sickly, usually fail to mount through the meshes and should be carried off and destroyed with the refuse in the old net below. Placing on of the new net and carrying away of the old is such a great convenience and time-saver that, in France, for many years, paper, stamped by machinery with holes of different sizes, suited to the different stages of the worms, has been used. The paper has the advantage of cheapness and stiffness, but a discussion as to the best material is unnecessary here, the aim being to enforce the principle of the progressive rise of the worms. Details will suggest themselves to the operator. Where the nets are not used, there is an advantage in feeding the worms upon leaf-covered twigs and branches, because these last allow a free passage of air, and the leaves keep fresh a longer time than when plucked. In thus feeding with branches consists the whole secret of the California system, so much praised and advocated by M. L. Prevost. The proper, stamped paper not being easily obtained in this country, mosquito-netting will be found a very fair substitute while the worms are young, and when they are larger I have found thin slats of some non-resinous and well-seasoned wood, tacked in parallel lines to a frame just large enough to set in the trays, very serviceable and convenient—small square blocks of similar wood being used at the corners of the tray to support the frame while the worms are



OLD FRENCH REEL.

passing up through it. Coarse twine-netting stretched over a similar frame will answer the same purpose, but wire-netting is less useful, as the worms dislike the smooth metal. Where branches, and not leaves, are fed, the Osage Orange has the advantage of Mulberry, as its spines prevent too close settling or packing, and thus insure ventilation. It is recommended by many to feed the worms while in their first age, and, consequently, weak and tender, leaves that have been cut up or hashed, in order to give them more edges to eat upon and make less work for them. This, however, is hardly necessary with Annuals, although it is quite generally practiced in France. With the second brood of Bivoltins it might be advisable, inasmuch as the leaves at the season of the year when they appear, have attained their full growth and are a little tough for the newly-hatched individuals. In the spring, however, the leaves are small and tender, and nature has provided the young worms with sufficiently strong jaws to cut them. Many rules have been laid down as to regularity of feeding, and much stress has been put upon it by some writers, most advising four meals a day at regular intervals, while a given number of meals between molts has also been urged; but such definite rules are of but little avail, as so much depends upon circumstances and conditions. The food should, in fact, be renewed whenever the leaves have been devoured, or whenever they have become in the least dry, which, of course, takes place much quicker when young and tender than when mature. This also is an objection to the use of the hashed leaves, as, of course, they would dry very quickly. The worms eat most freely early in the morning and late at night, and it would be well to renew the leaves abundantly between 5 and 6 a. m. and between 10 and 11 p. m. One or two additional meals should be given during the day, according as the worms may seem to need them Great care should be taken to pick the leaves for the early morning meal the evening before, as when picked and fed with the dew upon them they are more apt to induce disease. Indeed, the rule should be laid down, never feed wet or damp leaves to your worms. In case they are picked during a rain, they should be thoroughly dried before being fed; and on the approach of a storm, it is always well to lay in a stock, which should be kept from heating by occasional stirring. Care should also be taken to spread the leaves evenly, so that all may feed alike. During this first and most delicate age the worm requires much care and watching. As the fifth or sixth day approaches, signs of the first molt begin to be noticed. The worm begins to lose appetite and grow more shiny, and soon the dark spot already described appears above the head. Feeding should now cease, and the shelves or trays should be made as clean as possible. Some will undoubtedly undergo the shedding of the skin much more easily and quickly than others, but no feed should be given to these forward individuals until nearly all have completed the molt. This serves to keep the batch together, and the first ones will wait one or even two days without injury from want of food. It is, however, unnecessary to wait for all, as there will always be some few which remain sick after the great majority have cast their skins. These should either be set aside and kept separate, or destroyed, as they are usually the most feeble and most inclined to disease; otherwise, the batch will grow more and more irregular in their moltings and the diseased worms will assuredly contaminate the healthy ones. It is really doubtful whether the silk raised from these weak individuals will pay for the trouble of rearing them separately, and it will be better perhaps to destroy them. The importance of keeping each batch together, and of causing the worms to molt simultaneously, can not be too much insisted upon as a means of saving time. As soon as the great majority have molted they should be copiously fed, and, as they grow very rapidly after each molt, and as they must always be allowed plenty of room, it will probably become necessary to divide the batch, and this is readily done at any meal by removing the net when about half of the worms have risen and replacing it by an additional one. The space allotted to each batch should, of course, be increased proportionately with the growth of the worms. The same precautions should be observed in the three succeeding molts as in this first one. As regards the temperature of the rearing-room, great care should be taken to avoid all sudden changes from warm to cold, or *vice versa*. A mean temperature of 75° or 80° F. will usually bring the worms to the spinning-point in the course of thirty-five days after hatching, but the rapidity of development depends upon a variety of other causes, such as quality of leaf, race of worm, etc. If it can be prevented, the temperature should not be permitted to rise very much above 80°, and it is for this reason that a room with a northern or northeastern exposure was recommended as preferable to any other. The air should be kept pure all of the time, and arrangements should be made to secure a good circulation. Great care should be taken to guard against the incursions of ants and other predaceous insects, which would make sad havoc among the worms were they allowed an entrance, and all through the existence of the insect, from the egg to the moth, rats and mice are on the watch for a chance to get at them, and are to be feared almost as much as any other enemy the Silkworm has. The second and third casting of the skin takes place with but little more difficulty than the first, but the fourth is more laborious, and the worms not only take more time in undergoing it, but more often perish in the act. At this molt it is perhaps better to give the more forward individuals a light feed as soon as they have completed the change, inasmuch as it is the last molt and but little is to be gained by the retardation, whereas it is important to feed them all that they will eat, since much of the nutriment given during the last age goes for the elaboration of the silk. At each successive molt the color of the worm has been gradually whitening, until it is now of a decided cream color. Some breeds, however, remain dark, and occasionally there is an individual with zebra-like markings. During these last few days the worms require the greatest care and attention. All excrement and litter must be often removed, and the sickly and diseased ones watched for and removed from the rest. The quantity of leaves which they devour in this fifth age is something enormous, and the feeding will keep the attendant busily employed. Summed up, the requisites to successful Silkworm raising are: 1. Uniformity of age in the individuals of the same tray, so as to insure their molting simultaneously. 2. No intermission in the supply of fresh food, except during the molting periods. 3. Plenty of room, so that the worms may not too closely crowd each other. 4. Fresh air and as uniform temperature as possible. 5. Cleanliness. The last three are particularly necessary during the fourth and fifth ages. While small, the frass, dung, and detritus dry rapidly, and may, though they should not, be left for several days in a tray with impunity, but he who allows his trays to go uncleaned for more than a day during the ages mentioned will suffer in the disease and mortality of his worms just as they are reaching the spinning-point. With eight or ten days of busy feeding, after the last molt, the worms, as we have learned before, will begin to lose appetite, shrink in size, become restless, and throw out silk, and the arches for the spinning of the cocoons must now be prepared. These can be made of twigs of different trees, two or three feet long, set up upon the shelves over the worms, and made to interlock in the form of an arch above them. Interlace these twigs with broom-corn, hemlock, or other well-dried brush. The feet of each arch should be only about a foot apart. The temperature of the room should now be kept about 80°, as the silk does not flow so freely in a cool atmosphere. The worms will immediately mount into the branches and commence to spin their cocoons. They will not all, however, mount at the same time, and those which are more tardy should be fed often, but in small quantities at a time, in order to economize the leaves, as almost every moment some few will quit and mount. There will always be a few which altogether fail to mount, and prefer to spin in their trays. It is best, therefore, after the bulk have mounted, to remove the trays and lay brush carefully over them. The fact that the worms already mounted make a final discharge of soft and semi-fluid excrement before beginning to spin makes this separation necessary, as otherwise the cocoons of the lower ones would be badly soiled. As the worms begin to spin they should be carefully watched, to guard against two or three of them making what is called a double or treble cocoon, which would be unfit for reeling purposes. Whenever one worm is about to spin up too near another, it should be carefully removed to another part of the arch. In two or three days the spinning will have been completed, and in six or seven the chrysalis will be formed. Eight days from the time the spinning commenced, it will be time to gather the cocoons. The arches should be carefully taken apart, and the spotted or stained cocoons first removed and laid aside. Care should be taken not to stain the clean ones with the black fluids of such worms as may have died and become putrid, for there are always a few of these in every cocoonery. The outer cocoons of loose or floss silk are then torn from the inner cocoons or pods, and the latter separated according to color, weight, and firmness of texture; those which best resist pressure indicating that the worm has best accomplished its work. Too much care can not be taken to remove the soft or imperfect cocoons, as, if mixed with the firm ones, they would be surely crushed and soil the others with their contents. The very best of the firm cocoons are now to be chosen as seed for the next year, unless the raiser prefers buying his eggs to the trouble of caring for the moths and keeping the eggs through the winter. Eggs bought from large establishments are, however apt to be untrustworthy, and it is well for all silk-raisers to provide their own seed. These cocoons should be chosen for their firmness, and the fineness and color of the silk, rather than for their size. Mr. Crozier says: If white, take them of the purest white, neither soft nor satin-like; if yellow, give preference to the straw-colored, which are the most sought after; and, last, if they are the green of Japan, the greener they are, of a dark, sharp color, very glossy, the better is the quality of the thread. Discard the pale shades in the last breed. If there are any double or treble cocoons in the batch, of the right color, quality, and consistency, they should be used before the others, as they are just as good for breeding purposes, though unfit for reeling. In estimating the quantity that will be required, the following figures will be of use: The general estimate is always made of 40,000 eggs to the ounce, and also that each female lays from 300 to 400 eggs. Taking the higher estimate, it will require only 100 females to lay an ounce of eggs; taking the lower, it will require 133. It will, therefore, not be safe to take fewer than 200 cocoons, half males and half females, if an ounce of seed is desired, and from that to 225 would be safer. While it may not always be possible to determine the sex of the cocoons by their shape, we may approximately separate them by weighing. The whole quantity set aside for breeding purposes is first weighed in order to get the average, and then each one is weighed separately, and all above the average may be pretty accurately considered females and all below it males, These breeding cocoons should now be either pasted upon card-board on their sides, or strung upon a string, great care being taken to run the needle through the silk only and not deep enough to injure the chrysalis, the object being in both cases to secure the cocoon so that the moth can the more readily make its escape. They can be laid aside in a rat-proof place to await the appearance of the moths, and in the mean time the other cocoons should be taken care of. In most silk-producing countries the parties who raise the cocoons sell them to the reeling establishments before suffocation is necessary, as these establishments have better facilities for this work than are to be found in private families. If, however, the reeling is done by the raiser, or some time must elapse before the cocoons can be sent to a reeling establishment, some means must be used to kill the contained chrysalis before the cocoon is injured for reeling purposes by the egress of the moth. This can be done by stifling them with steam or choking them by dry heat. Steaming is the surest, quickest, and best method, if the facilities are at hand. It can be done at any steam mill. The cocoons are laid upon shelves in a tightly-sealed box and the steam is turned in. Twenty minutes will suffice to do the required work, and the cocoons are then dried in the sun. The dry heat method occupies a much longer time. The cocoons are placed in shallow baskets and slipped on iron drawers into an oven which is kept heated to a temperature of about 200° Fahr. This should not be increased for fear of burning the silk. This operation lasts from two to twenty-four hours. A certain humming noise continues so long as there is any life, and its cessation is an indication that the chrysalids are all dead. Where the choking is well done there is little loss, only about one per cent, of the cocoons bursting at the ends. After choking in this manner, the cocoons should be strewn upon long, wooden shelves in the shade, with plenty of air, and, for the first few days, frequently stirred. After remaining on these shelves for about two months, with occasional stirrings, the chrysalids become quite dry and the cocoons will preserve indefinitely. They are, however, still subject to the attacks of rats and mice, and the little beetles known as museum pests, belonging to the genera *Dermestes* and *Anthrenus*, are attracted by the dead chrysalis within and will penetrate the cocoon, injuring it for reeling purposes. In the warm, Southern States the dry-heat choking can be accomplished by simple exposure to the sun. This was done by M. L. Prevost, in Southern California, and is practiced habitually by Mr. Crozier in Silkville, Kansas, who says: Here the cocoons need only to be fully exposed to the rays of the sun, from nine o'clock in the morning till four o'clock in the afternoon. Two or three days of such exposure are sufficient. But, as some time strong wind can annihilate the effect of the sun's warmth, it is good to have for that purpose long boxes, four feet wide, sides six inches high, to be covered with glass frames. This will increase the heat, and, by absorbing the air of the box, stifle your chrysalis most surely. Ed. Müller, another California grower, (Nevada county), always makes use of this method of stifling by the sun's rays, but says that the glass cover of the box should be left cracked open to allow the evaporation of the moisture, which otherwise would collect in large drops upon the glass, and, falling back upon the cocoons, would keep them moist for a longer time. Do not, however, allow the ants to creep in at the crack, as they too will penetrate the cocoon to feed upon the chrysalis. In the colder climates it has been suggested that the chrysalis could be well choked, with no injury to the cocoons, by placing them in a vacuum box and exhausting the air. Chloroform has been used to a certain extent, and experiments are now being made in France with sulph-hydric acid gas, a vapor which is evolved from the mixture of dilute sulphuric acid and sulphide of iron; also with bisulphide of carbon. In from to twelve to twenty days from the time when the worm commenced to spin, the moths will begin to issue from the cocoons laid aside for breeding purposes. They issue abundantly during the early morning hours, from four to eight o'clock, and as they appear, they should be taken by the wings and the sexes kept apart for a short time. The males may be readily distinguished from the females by their broader antennæ and smaller bodies, as also by the incessant fluttering of their wings. The females remain comparatively quiet, their abdomens being heavy and distended with eggs. A few hours after issuing, the sexes, in equal numbers, may be placed together, great care being taken to destroy any that are at all deformed, in order to keep the breed as fine as possible. They should be placed upon paper or card-board, and the room should be kept as dark as possible in order that the males shall not uncouple themselves. For the complete impregnation of the eggs, the sexes should be kept together six hours, neither more nor less, and occasionally visited in order to replace those males which may have become separated. Should there, on this day, more males than females issue, the superfluous males may be put in a closed box and kept till the next day, when the state of things may be reversed. Should there, on the other hand, be a superfluity of females, a sufficient number of the strongest and most vigorous males should be uncoupled at four hours and placed with the unpaired females for six hours more. As the pairs are uncoupled at the end of six hours, care should be taken to injure neither sex. The female should be held by the wings with one hand and the abdomen of the male gently pressed with the other. The males may then be laid aside in a box, as there may be use for them before all the moths have appeared. After all the females are impregnated, however, they may be thrown away. These last, as soon as separated, should be placed for a few minutes upon sheets of blotting-paper, where they will free themselves of a quantity of greenish-yellow fluid. From the blotting-paper they should be transferred to trays lined with cloth upon which the eggs are to be laid. This cloth should be of the smoothest sort of woolen stuff rather than of linen or paper, if it is desired to remove the eggs at a future time, as they will stick so fast to the latter that it will be difficult to remove without bruising them. Upon these trays they may be placed in rows, and will immediately commence depositing. It is advisable to tip up the trays at one end so that they incline a little, as the moths are then more apt to lay their eggs uniformly. They should also be kept in the dark, in accordance with the nocturnal habit of the moth. The temperature of the room should be kept at about 75°, and plenty of air given during oviposition. All of the thoroughly impregnated eggs will be laid in about twenty-four hours, and the moth should be removed after that length of time. She may continue depositing a short time longer, but the eggs should be kept by themselves and not mixed with the others. It will be well, also, if the best and purest breed be desired, to keep the eggs of those moths which were coupled with males that had been used before, separated from the eggs laid by those which were coupled with virgin males. The eggs are best preserved on the cloth where originally deposited, as they are protected by a natural coating of varnish, and, being fastened, the worms, when hatching, eat their way out better. For commercial purposes, however, they are usually detached during the winter by immersing the cloth containing them in cool, soft water for a few moments; the moisture being then drained off by means of blotting-paper, and the eggs gently removed with a paper-knife. They are then washed in soft water, thoroughly dried, and put away for keeping. All eggs which swim on the surface are considered bad and discarded. The Japanese producers sell their eggs on cards or cartoons made of coarse silk. The cards are placed in wooden frames, the rims of which are varnished, so that the moths—disliking the varnish—are made to confine their eggs upon the cards, which are consequently covered in a very regular and uniform manner. The egg retains the characteristic color of the unimpregnated ones—light yellow—for twelve or fifteen days, when it gradually acquires the gray, lavender, or greenish tint of impregnation. The moths live but a few days after having perpetuated their kind.

SILVER. A well-known metal; it is soluble in nitric acid, the salt, nitrate of silver, being used as a caustic in farriery, and in the laboratory as a test for chlorine, with which it produces a white, curdy compound, chloride of silver, that is soluble in ammonia, and blackens by exposure to light.

SILVER GRAIN, IN WOODS. The bright markings; the medullary rays.

SILVER WEED. *Potentilla anserina.* A perennial running weed with yellow flowers, and five-parted, silvery leaves, generally growing on poor soils.

SINAPISM. A mustard poultice or other preparation.

SINCIPUT. The forehead.

SINUS. A cavity; the veins of the brain are so called.

SINUOUS. Full of cavities, tortuous.

SIT-FAST. In farriery, an ulcerated sore in which a part of the skin has turned horny; if a healthy tone can not be gotten up by rubbing with mercurial ointment, it must have a mild blister applied, which will cause it to suppurate. It generally proceeds from a warble or little tumor resulting from the presure of the saddle.

SIZE. A thin glue made from skins.

SKELETON. The bony frame on which the muscles and soft parts are placed.

SKID. A drag chain; ways for loading logs.

SKIN. The external coat of animals. It consists of a scarfskin, or epidermis, a *rete mucosum*, which is thin and colored, and the *cutis vera*, which forms the substance, and from which hairs, etc., proceed.

SKIRTING. In building, the narrow, horizontal board running along the walls of a room at the floor.

SKUNK. *Mephitis mephitica.* This well-known animal inhabits the entire United States, east of the Rocky mountains and north of Texas, preferring the banks of streams and open woods, or some secluded situation near dwellings. Where there is no suitable place for burrows, it will take up its habitation in a wood pile, under out buildings, or even under dwellings. Its mephitic odor, secreted from glands situated below the root of the tail, is its means of defense. From the two orifices the secretion may be ejected several feet. Its principal food is insects and small verminous animals, also eggs when it can get at them. The injury it does in destroying eggs is trifling, and were it not for its terrible odor it would become one of great benefit from its persistency as an insect destroyer. West of the plains, in California, Oregon, and Texas, the common species East is replaced by two other species, *Mephitis occidentalis* and *M. Bicolor*. The skunk may be rendered very tame, and by the removal of the secreting glands it will no longer have the power of giving out its terrible odor, which, however, is never done except when angry or frightened. Its skin and fur are valuable, if not tainted with its odor, and large numbers are collected by the fur companies.

SKUNK CABBAGE. *Symplocarpus fœtidus.* Marsh cabbage. A large-leaved plant of the family *Aroidæ*, growing in wet places at the North; it has an unpleasant odor, and is reputed antispasmodic.

SLATE. Any rock which has a close texture and is readily split into slabs. The term is more particularly applied to the fine aluminous slates used in roofing and for writing upon.

SLEEPER. Timbers on which are laid the ground joists of a building or railway.

SLEET. A cold rain mixed with snow.

SLIPS. Twigs or small branches taken from a tree or bush for the purpose of propagation.

SLOE. In Europe, this name is given to a small wild plum, the *Prunus spinosa*, which is used as a dwarf stock for grafting plums. In the United States it is given to the *Prunus pygmæa*, and also the *Viburnum prunifolium.*

SLOUGH. A name given to decayed matters separating from a wound: proud flesh; a muddy hole.

SLUG. A name applied to various larva, those of saw-flies, for instance, known by their slimy appearance, and which are particularly injurious to the pear, rose, and it is said in Europe an allied species attacks the cereal grains. The remedy is dusting with white hellebore, (*veratrum,*) or fresh slaked lime, the latter for large trees, and the former for small shrubs and plants. Snails and ground slugs are said to be attracted to small pots, sunk nearly even with the ground, and partly filled with a mixture of starch and iodine. They are said to be attracted by the emanations of iodine for considerable distances.

SLUICE. A water-way of stone, brick, plank, or other material for conveying water; in irrigation, connected with a head-gate. (See Irrigation.)

SMOOTH BROME GRASS. (See Chess.)

SMUT. The best preventives known are to keep the lands occasionally limed or salted, never using too much rank stable manure without some saline matters; and, secondly, steeping the seeds before sowing in solution of sulphate of copper, (blue vitriol). One ounce and a quarter of the salt is used to a bushel of wheat; it is dissolved in just enough water to wet the grain, which is steeped for three quarters of an hour, and dried by being spread out. A strong brine and milk of lime are also used with good success; but the copper solution is superior.

SMUT IN GRAIN. Smut is a fungus, or parasite, destroying or replacing, where it develops, the organs in which it is developed. The seeds (spores) are exceedingly minute, and can not be recognized singly, except under a considerable magnifying power. It attacks the leaves and stems of plants, of all the grains, but is especially destructive to the seed itself; and seemingly develops preferably in oats, barley, and Indian corn, but is not so much dreaded in Indian corn, by the farmer, since smutty ears of corn may be easily thrown out. In barley it is separated by washing before malting, so that only in our bread grains are means usually taken to prevent its ravages. There is no conclusive evidence to show that the various compounds used for soaking wheat actually kill the smut. On the other hand, evidence would seem to show that any wash strong enough to kill smut (*uredo*) will also destroy the vitality of grain. The probability is, rather, that, as smut germinates quickly, the soaking and subsequent liming gives the proper impetus to germinate them, and the lime forming a proper *nidus*, material growth ensues; and, subsequently, having no proper substance to sustain itself, it perishes before the smut is enabled to seize the growing plant. Klippart mentions placing smut balls in a solution of nitrate of potash, dilute nitric acid, sulphate of iron, of copper, and of zinc, and even in dilute sulphuric acid. The smut so treated invariably manifested undoubted signs of vitality when surrounded by proper conditions. Therefore, it is not safe to simply moisten wheat with lime or other washes. The simplest and surest plan, to prevent smut in wheat, is to make a solution by using one pound of blue vitriol (sulphate of copper) to every two gallons of water. Make a sufficient quantity so it may stand above the wheat. Stir the whole to allow the light material to rise. Skim, and at the end of an hour spread the wheat on a dry floor, and sprinkle with quick lime, previously so slaked with chamber lye as to leave the lime in powder. So continue until you have all the wheat treated. In this state it may be heaped and remain several days before sowing, if the heap be occasionally turned. If the wheat remains damp, it must be still further dried before sowing, if it is to be drilled, so it will pass easily from the drill. Many farmers use brine. In this case the solution should not be stronger than a pound of salt to the gallon of water. Proceed as before directed, and dry with lime. Some persons claim good success by sprinkling the wheat with a solution of five pounds of blue vitriol to six gallons of water, using this quantity for twenty bushels of wheat, turning the same until every grain is moistened, and sowing without further trouble. The way we have indicated is the surest, and in the end the cheapest, since the liquor can be used over and over again until exhausted.

SNAKEROOT. *Aristolochia serpentaria.* A perennial-rooted plant, growing wild in woodlands, the root of which is used as a bitter and tonic.

SNEAD or SNATHE. The handle of the scythe.

SNOW BIRD. *Junco hyemalis.* Several small sparrows which remain in the North late in the autumn and return early in the spring or late winter, and which breed, in the extreme northern limits of the United States and in Canada, are called Snow birds. Some seasons, the Snow birds remain all winter in the West, and before snow storms, or in extremely cold weather, gather in considerable flocks about houses and farm buildings.

SOAP. A chemical compound of fat or oil, animal or vegetable, with potash or soda. Various plants were used in ancient times for their cleansing qualities, among others, the juice of a plant called *Struthium* by the Romans. Pliny ascribes the invention of soap to the Gauls and credits the ancient Germans with making both hard and soft soap. Among plants known to the moderns for their saponaceous and detergent and cleansing qualities, are the berries of the soap tree, *Sapindus saponaria;* the bark of the *Quillaia saponaria*, both natives of South America. The juice of *Saponaria officinalis*, Bouncing Bet, has long been used in England, for cleansing dresses. In California, the bulbous root of *Phellangium pomaridianum* has been extensively used in the place of soap for washing clothes, since the settlement of the country. Of the two alkalies employed for making soap, soda is used for hard soap and potash for soft soap. The more solid fats, as tallow and suet, make firmer soaps than the soft fats which contain more oleic acid. In connection with potash, the soap fats make a still softer and watery soap. To harden these a small quantity of fused crystals of sulphate of soda are used. So if the soap is too hard rape or linseed oil, or rosin combined with the tallow will soften the product. Lard and soda make a very hard, white, and excellent toilet soap. Castile soap is made with olive oil and soda, and the peculiar marbled appearance is given it, the dark by stirring into it a solution of sulphate of iron, which, on and near the outside of the bars, by being oxygenated by the air, gradually assumes a reddish appearance; the streaks and patches are produced by the black oxide separating from the water after being stirred in the soap when in a semi-fluid state. Other colors and marblings are given this and other fancy soaps, by rubbing up vermilion or ultramarine olive oil in soap. A small portion is taken up with a spatula or thin knife and worked into the mass of melted soap and stirred about until the proper effect is produced. So turmeric is also employed for coloring, or any innocent coloring matter may be employed. Transparent soap is made from the hardest fats and soda. The soap is then dissolved in alcohol, filtered and evaporated to the proper consistency. Soap balls are made by dissolving soap in a very little water, and then working into balls with starch. The cleansing and detersive qualities of soap may be increased by the addition of ammonia, camphor, spirits of turpentine, perfumes being added to disguise the smell of the chemicals. Soap varies in its quality according to its power of taking up water in the making. Castile soap should not contain more than fourteen to fifteen per cent. of water. The soaps made of cocoanut oil often contain nearly seventy-five per cent. of water. Ordinary soft soap contains nearly forty-eight per cent. of water, while the ordinary hard washing soaps contain from thirty-five to twenty-three per cent. of water, according to quality. The proportions of fat and alkali in making soft soap, is, for 450 pounds, 200 pounds of clean fat or oil, and 72 pounds of potash in lyes of specific gravity 1.110. Lye that will just bear out an egg is called weak lye, and if it bears out an egg buoyantly or of the size of a shilling piece, it is called strong lye. When of the proper consistency of soft soap, or when it forms a half solid, jelly-like substance, when cold, it may be converted into hard soap, by adding two pounds of salt, in the form of strong brine, to each pound of fat or oil used. Add the solution of salt gradually into the boiling mass, stir, and the sodium of the salt will take the place of the potassium in the soap, and uniting with the chlorine, goes into the lye, which readily separates from the soda soap. Following are good recipes for making hard and soft soap: After the raw soda or barilla is ground or pounded, it is placed in a vat in alternate layers with unslacked lime, the bottom layer being lime. Water is allowed to infiltrate through those layers, and the lye is secured as it trickles through a hole in the bottom of the vat. The lime absorbs the carbonic acid of the soda, making the lye caustic or fit for the soap-kettle; and the quantity of lime applied must be in proportion to the quantity of carbonic acid in the soda. To every twenty pounds of tallow add one gallon of weak lye, and boil until the lye is spent. The mass must then cool for one hour, the spent lye drawn off, and another gallon of strong lye added; the mixture again boiled until the second dose of lye is spent; and the same process must be repeated for several days, until the mixture, if properly managed, is converted into white tallow soap, which should be allowed to cool gradually and settle, when it is poured into molds, and when solid it is cut into the bars which are found in our markets. Twenty pounds of tallow ought to make thirty pounds of first-quality hard soap, allowing three pounds of soda-ash for every twenty pounds of tallow. The balance of the weight is made up by the large quantity of water which enters into combination with the grease and alkali in the course of saponification. When yellow or resin soap is required, the hard soap has to be made in the usual manner, and at the last charge of lye, or when the soapy mass ceases to absorb any more lye, one-third the weight of pounded resin is introduced, the mixture constantly stirred, and the boil kept up vigorously until the resin has become incorporated with the soap. The whole must stand until it settles, and soap then dipped out. Resin soap, when well made, should be a fine, bright color. The principal difference between hard and soft soaps is, that three parts of fat afford, in general, fully five parts of hard soda-soaps; but three parts of fat or oil will afford six or seven parts of potash-soap of a moderate consistence. From its cheapness, strength, and superior solubility, potash-soap is preferred for many purposes, particularly for the scouring of woolens. The lyes prepared for making soft soaps should be made very strong, and of two densities, as the process of making potash or soft soap differs materially from that of making soda or hard soap. A portion of the oil or fat being placed in the boiling-pan and heated to near the boiling-point of water, a certain portion of the weaker lye is introduced and the fire kept up so as to bring the mixture to the boiling point; then some more oil and lye are introduced alternately, until the pan is filled. The boiling is continued gently, strong lye being added until the saponification is complete. The fire should then be removed, and some good soap, previously made, added while cooling down, to prevent any change by evaporation. One pound of oil requires about one-third of a pound of American potash, and will make one and three-quarters to two pounds of well-boiled soap, containing about forty per cent. of water. Sixty pounds of lard will make 100 pounds of first class soft soap by using one and a half cans of concentrated lye, made from salt, which is a soda lye.

SOAPER'S WASTE. The refuse of the soap-works has been much used as a manure. The nature of the manure depends on the use of ashes or soda ash in the manufacture; in the first case, it is a very valuable amendment; in the latter, considerably less so. The first contains a large quantity of ash, the chloride of potassium; the second contains but little soda salts, and when barilla is employed, the ash is merely calcareous matter: of the latter ashes, in the fresh state, from sixty to 200 bushels have been used on grass lands with effect. If ashes and common salt have been used, ten to twenty bushels of refuse will be enough.

SOBOLE. An underground creeping stem.

SOD. A turf of grass.

SODA, PROTOXIDE OF SODIUM. An alkali very analogous and isomorphous with potash. It is constantly found, in the ashes of plants performing the same function as potash; but in the vine and some other plants it is not equally serviceable. In the mineral kingdom it is abundant as a silicate, in the form of chloride of sodium, or salt, the nitrate, which is an important manure, is also abundant in certain places. Kelp, barilla, and soda ash all owe their value to the carbonate of soda, which is used in making hard soaps. The carbonate of soda resembles pearlash very closely in its properties, but is less active.

SOIL. Soil is distinguished from earth in that it contains a greater quantity of organic vegetable matter than the sands, gravels and clays, which constitute so large a portion of the upper surface of the earth's crust. The earths originally were composed of the detritus or decomposition of the various rocks. Until this wearing away and decomposition became partial at least no vegetation could subsist. This is primarily brought about by the action of the oxygen of the air, by the action of rain, running water, floods, but more generally by the grinding power of glacial action which at some time seems to have been present on nearly every portion of the earth's surface. Upon the relations of Geology to Agriculture—Hon. James Shaw, in an address to the Northern Illinois Horticultural Society, truly said: Soils are derived from the decomposition of the rocks. The silent processes of nature, to-day, as in past geologic ages, are grinding rocks into soils, and re-cementing and hardening soils into stratified rocks. There was a time when the earth was, indeed, rock-ribbed; but atmospheric and chemical agencies and aqueous forces kept in constant action, processes of slow decay, and the soils were gradually formed as precipitates and sediments in ancient geologic seas. We all know the old proverbs about the constant dropping that wears away the stone, and the file of time that wears and makes no noise; but few realize how important a part these peaceful agencies have taken in the creation of the present order of things. The frost and the rain, and other like agencies and energies of nature, are all-powerful to bring about the mightiest results. If undisturbed by mechanical forces, the superficial clays, loams, sands, subsoils and soils covering the underlying rocks would be nothing but the residuum left after the removal by the percolation of the water of the more soluble portions of the rocky ledges, which had decayed. The soil would be *in situ*. It would bear a close resemblance to the rocks from which derived. The geologist, by an examination of the rocks, could tell the nature of the soil with which they were covered, and, by an examination of the soils, could designate what rocks they concealed. Primarily, all soils are derived from fire rocks; secondarily, many of them are derived from water rocks. The first resemble, in composition, the primary rocks; the second, having first been granites, then, by the decay of the granites and the transportation of water, becoming stratified rocks, whose decay and chemical combinations and separations, separated and assorted by the elements, oftentimes do not resemble the first at all. The general proposition is, however, true, that rocks differ from each other, and soils also resemble the rocks from which they are derived. In small patches, and to a limited extent, this is true of the soils of the West. The alluvial bottoms of our rivers are generally sedimentary soils, sometimes hungry sandy soils, but often black, fat, sedimentary deposits. The latter produces great crops of Indian corn, when dry enough to cultivate; but, when low and wet, it grows heavy crops of the coarse prairie and slough grasses. But the most marked illustration of the proposition under discussion, may be noticed in localities underlaid by the Cincinnati shales. Here the soil and subsoil, if undisturbed, is a close grained, finely comminuted, buff or straw-colored clay. It is so compact and tenacious that it becomes water-soaked, and has not the power to rapidly absorb surplus moisture. The best soil is the formation known as Loess, by western geologists. It caps, and in most cases, makes up a large proportion of the bluff ranges along the Mississippi river, and some of the internal streams in that part of Illinois; it sometimes extends back for some miles from the bluffs into the interior; but, in the latter case, it is seldom pure, but is mixed with other sands and clays. It is white, buff-colored silt, of extreme fineness of texture, where purely developed; but it often consists of marshy, sandy deposits, and various mixtures and clayey combinations—for vines and deep-rooted trees no better deposits exist in the State. It owes its origin to the silt washed up by broad sea-like lakes and wide lake-like rivers. It affords little resistance to the penetrating rootlets of trees, is well-drained, and is unsurpassed, either for wheat, fruits, grapes or vegetables. The foregoing remarks are based on the argument that soils are derived from the decay of the underlying rocks. An examination of the soils of the prairie region of the West, however, will soon convince any one that this statement, as a matter of fact, is true to only a limited extent; it will do for fragmentary patches and driftless regions. Over wide stretches of country the decay of the rocks has not formed the soils covering them. Transportation of soils, a universal mingling of materials derived from widely different sources, is a fact susceptible of easy demonstration. That tremendous force which tore the bowlders from their parent outcrops in the distant Lake Superior regions, and drifted them along on their southward journey, which grooved and planed the surface of the solid rocks, which strewed, for hundreds of miles, beds of clay and sand and gravel, whether floes and bergs of ice, borne by winds and currents loaded with stones and detrital matter, or strong water currents mingling and wearing the moving beds of abraded materials, or the procession of the slow, silent, all-powerful glaciers, grinding the solid stones into soils, as wheat is ground to flour between the upper and nether mill-stones, whether one, or all these causes combined, it mingled, mixed, transported and formed the soils to such an extent as to well nigh destroy their separate and characteristictic origin, and greatly increase the difficulty of their proper classification. In attempting to classify soils and earths thus made and mingled there is no end to the distinctions and divisions. Soils are light or heavy, warm or cold, dry or wet, compact or porous, fine or coarse, hungry, leachy, loamy, sour, sweet, clayey, sandy, limy, marly, and various combinations of these too numerous to mention. Silica, or the earth of flints; alumina, lime, magnesia, potash, and various salts and metalloid compounds unite in various combinations to make up these soils. The humus, which gives richness and blackness of color, is chiefly derived from successive growths and decays of grasses and other vegetations. The question as to what soils will produce and mature good and constant crops depends not only upon the nature of the soils themselves, but also upon climatic influences, and upon the nature and properties of subsoils. If the subsoil is gravelly, marly, porous, leachy, sandy, or of such a texture as not to retain water too easily, almost any soil will produce trees and fruits. But, if a hardpan, or other tough, impervious clay, happens to be the subsoil, so as to retain the surplus moisture, the best soil in the world unless a very deep one, will not respond to a liberal cultivation, with a generous supply of good, vigorous, healthy, and sure crops. The best soils for wheat are dry, firm, but easily disintegrable, and rather compact soils, such as contain a good proportion of lime and clay. The best Indian corn is raised upon the deep humus, prairie soils and river bottoms of the West, but a good wheat soil is also a good corn soil if the summer is long enough to ripen the crop. In this connection the classification of soils, their composition and their organic and inorganic matter will give a good idea of what constitutes soils for cereal crops. A loess soil, as heretofore stated, is admirable for the grains, grasses, and for fruit. The classification of Boussingault is excellent and is as follows:

Soils according to composition.	Usually designated.	Clay.	Sand.	Lime or Chalk.	Humus.
Clay with humus...	Rich wheat land...	74	10	4	11.5
“ “ “	“ “	81	6	4	8.5
“ “ “	“ “	79	10	4	6.5
Marly soil..........	“ “	40	22	36	4
Light soil, with humus..............	Meadow land......	14	47	10	27
Sandy soil, humus..	Rich barley land...	20	67	3	10
Argillaceous land..	Good wheat land...	58	36	2	4
Marly soil..........	Wheat land........	56	30	12	2
Argillaceous land..	“ “	60	38	....	2
Stiffer “ “	“ “	48	50	....	2
Clay................	“ “	68	30	....	2
Stiff argillaceous land...............	Barley land, 1st cl's	38	60	....	2
Stiff argillaceous land...............	Barley land, 2d cl's	33	65	....	2
Sandy clay..........	“ “ “	28	70	....	2
“ “	Oat land...........	23.5	75	....	1.5
Clayey sand........	“ “	18.5	80	....	1.5
“ “	Rye land....	14	85	....	1
Sandy soil..........	“ “	9	90	....	1
“ “	“ “	4	95	....	0.75
“ “	“ “	2	97.5	....	0.5

Specific gravity is also one of the tests of a good soil, since it will show if the soil be finely comminuted the presence of a good proportion of clay. The percentage of clay and sand in various soils from pure clay (pipe clay), to humus soils and peaty soils is as follows: Pure clay, pipe clay, sixty per cent. silica, forty per cent. alumina, oxide of iron chemically combined. Strongest clay soil, brick clay, pure clay with five to ten per cent. of sand which can be separated. Clay loam fifteen to thirty per cent. fine sand and pure clay. Loamy clay thirty to sixty per cent. sand and pure clay. Sandy loam sixty to ninety per cent. sand and pure clay. Sandy soil containing no more than ten per cent. of pure clay. Marly soils, in which the proportion of lime is more than five, but does not exceed twenty per cent. of the whole weight of the dry soil. Calcareous soils, in which the lime exceeding twenty per cent. becomes the distinguishing constituent. Vegetable soils from garden mold, which contains from five to ten per cent., to the peaty soil in which the organic matter may amount to sixty or seventy per cent. These soils again may be clayey, loamy, or sandy, according to the predominant character of the earthy admixtures. A fertile soil, therefore, consists of three earths, clay, sand, and lime mechanically combined, organic matter from the decay of plants, etc., which may be resolved into carbon, oxygen, hydrogen and nitrogen, and the inorganic elements, in combination, chemically, with metals, hydrogen, oxygen, chlorine, and sulphur. These are in small quantities. Thus chlorine produces the chlorides, iodine, the iodides, sulphur, the sulphurets, and sulphuric acid; phosphorus, the phosphoric acid; potassium, the potash; sodium, the soda and common salt; calcium, the lime; aluminum, the clay; silicon, the sand; and iron and manganese, oxides and sulphurets. The mechanical texture of the soil has a strong influence upon its practical fertility, very heavy clay, and very light sands, being both, for opposite reasons, apt to produce badly. The soil in which the particles are the finest, so that the air can enter, and the roots spread without difficulty, is, other things being equal, the best. In clay soils this division of the particles must be produced by the plow and other mechanical means; while in loose sands it is too great, and must be amended by an admixture of clay and other substances. The cause of the great and lasting fertility of prairie soils, is, first, its extreme comminution—fineness—and its large proportion of clay, sand, and organic and inorganic elements. The color of the soil is not always an indication of its fertility. As a rule, however, dark soils are the most fertile. The absorbing power of soils is another indication of fertility, since a porous, or other soil that will easily absorb water and hold its vapor, is generally a fertile soil. The following table from Schubler, shows the relative absorbing power of the soils named:

Kinds of earth.	1,000 grains of earth on a surface of fifty square inches absorbed in			
	12 hours.	24 hours.	48 hours.	72 hours.
	Grains.	Grains.	Grains.	Grains.
Silicious sand...	0 water.	0 water.	0 water	0 water.
Sandy clay......	21 "	26 "	28 "	28 "
Loamy clay.....	25 "	30 "	34 "	32 "
Brick clay.......	30 "	36 "	40 "	41 "
Gray pure clay..	37 "	42 "	48 "	49 "
Garden mold....	35 "	45 "	50 "	52 "
Arable soil......	16 "	22 "	23 "	23 "
Humus	80 "	97 "	110 "	120 "

Thus while sandy lands may suffer from long continuance of dry weather, a neighboring field abounding in humus may absorb sufficient moisture from the air to serve all the requirements of vegetation. The power of saturation by water, and the retention of moisture, vary in the same manner, and nearly in the same degrees. Another important property of soils is their power to absorb oxygen from the air. According to Schubler:

Grains.	Kinds of earth.	Cubic Inches.	
1,000	Silicious sand, in a wet state, absorbed oxygen...........	0.24	From fifteen cubic inches of atmospheric air, containing twenty-one per cent. of oxygen.
1,000	Sandy clay......	1.39	
1,000	Loamy clay.................	1.65	
1,000	Brick clay....................	2.04	
1,000	Gray pure clay..............	2.29	
1,000	Garden mold.......	2.60	
1,000	Arable soil	2.43	
1,000	Humus........................	3.04	

Soils lose, in drying, the property of absorbing oxygen from the air, but regain it in the same proportion as before, on being moistened. The action of organic manures, and the production of carbonic acid, depend on the existence of oxygen in the soil. Capillary attraction or power, means the power by which a liquid ascends in the interior of a capillary tube, or tube of small bore, above the surface of the liquid which surrounds it. The phenomenon occurs in solid bodies which are capable of being wetted. Thus, when water is poured into the basin of a flower-pot, the soil gradually sucks it in, and becomes moist even to the surface. The same takes place in the soil in the open fields. The water from beneath—that contained in the subsoil—is gradually sucked up to the surface. Where water is present in excess, this capillary action keeps the soil always moist and cold. Evaporation takes place from the surface of the land, and as each atom of moisture is taken up into the atmosphere, its place is supplied by another atom, communicated by the contact of the particles of soil, the more superficial acting on the deeper particles like so many pumps, to elevate the water, and supply the loss. Thus a naturally porous soil may be kept injuriously wet by an impervious subsoil several feet below. Drainage counteracts this. The capillary action of the soil, however, is an important action of the soil, since thus the vapor of water is constantly passed upwards from below, to supply that lost by evaporation at the surface during droughts. A moderately compact, and yet porous soil, has strong capillary power; and hence, again, another reason for its fertility, since a soil, when abundantly dry, is always unproductive; and for one principal reason, that it is only in a soluble form, that is in combination with water, that the elements of plant food can become available. Thus, given a virgin and fertile soil, capable of producing those crops natural to a climate, it would seem to be of the utmost importance that the farmer keep it up to the original standard. This is accomplished by fallowing, manuring, or by a proper succession of crops, or, better, by a combination of the three. (See articles Fallow, Manure, and Rotation.) There is another agent fully as important, and that is disintegration. This enables natural agents to act promptly in restoring lost fertility, both summer and winter. These are heat, electricity, moisture, carbonic and other acids formed in the soil, and the complex chemical changes constantly going on in a soil in which heat, moisture, and porosity are present in normal conditions. This being the case and the elements of fertility present in due proportion we have a fertile soil.

SOILING. Soiling, as applied to farm animals, is the cutting and feeding, green, such forage crops as may be economically raised in contradistinction to pasturing. The principal soiling crops in the North are clover, rye, Indian corn and roots, as beets, carrots, etc. In California, these, with the addition of lucerne, and in the South the first named, with the addition, perhaps, of cow peas. The system has never been profitable except where only a little stock could be kept, and in situations where pasturage was not practicable.

SOILING CROPS. (See Soiling.)

SOLANACEÆ. A natural order of herbaceous or shrubby exogens, inhabiting all parts of the world, excepting the arctic regions. This order contains nightshade, henbane, mandrake, tobacco, stramonium, the potato, and the tomato, the leaves of all which are narcotic and exciting, but in different degrees, from *Atropa belladonna*, which causes vertigo, convulsions, and vomiting; tobacco, which will frequently produce the first and last of these symptoms; henbane and stramonium, down to some of the solanum tribes, the leaves of which are so inert as to be used as kitchen herbs. Even in the potato plant, the narcotic acrid principle is found in the stem and leaves, and even in the rind of the tuber. But the principal part of the latter consists of starch, and the small quantity of deleterious matter being volatile and near the surface, is readily driven off by the heat used in cooking.

SOLIDUNGULATES. Animals with an undivided hoof, as the horse.

SOLUTION. The diffusion in water, or other menstrua, of the particles of a solid or other body. The amount dissolved is definite at the same temperature, and is usually increased by heat. A fluid already holding in solution a given substance will not dissolve so much of a third as if pure, and sometimes none at all.

SOOT. Soot is a complicated and variable mixture of substances produced during the combustion of coal or wood. Its composition, and consequently its effects as a manure, vary with the quality of the fuel, with the way in which it is burned, and with the height of the chimney in which it is collected.

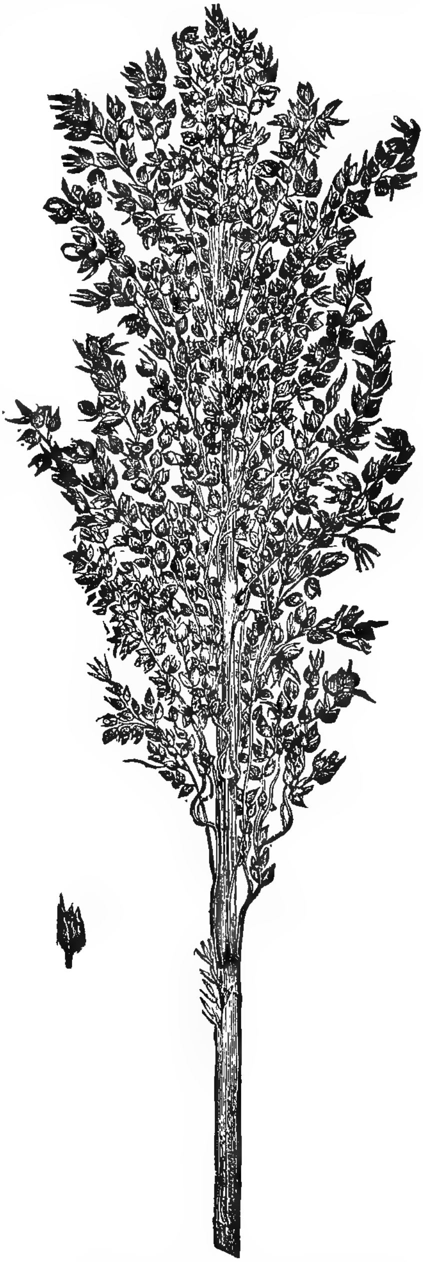
SORE EYES. (See Eyes, Inflammation of.)

SORE THROAT. Colds often are accompanied with inflammation and swelling of the air passages, and in the acute form are sometimes dangerous. The breathing is difficult and hoarse, the nose is protruded, the eyes bloodshot, the ears are cold, and cold sweats break out over the body. Relief should be obtained by fomenting the throat with cloths wrung out of hot mustard water, and the animal should be made to inhale the steam from a bucket of boiling water. When the fomentation is through, paint the throat with thin mustard and water. The difficulty in swallowing will probably prevent giving medicine, but the following mixture may be made and smeared on the tongue three or four times a day: One ounce of powdered guaicum, four ounces of powdered chlorate of potash, and one-half pint of molases.

SORGHUM. The importance which the cultivation of Sorghum has assumed as a crop in the West, within the last ten years, and more particularly within the last six years, through improved processes in its manufacture, by which a fair amount of crystallizable sugar may be produced, ranging from seventy to ninety per cent. of the mush sugar in concentrated syrup, has caused many to again undertake this industry, who from twenty to twenty-five years ago gave up the manufacture as unprofitable, as carried on with the crude apparatus then at hand. When the same capital and appliances are given to the production of sugar from sorghum in the North, and especially in the West, as are applied to sugar cane in the South, and to the manufacture of beet sugar in Europe, there is no reason why it should not enable the West to add immensely to her productive capacity, and in fact give the world as cheap sugar as she now does cheap grain. That the time is near at hand when the intelligent use of large capital will be so employed, and remuneratively, there is no doubt, and first from the fact that the climate and soil of the West are admirably adapted to the crop, and second, mechanical talent is now actively engaged in producing economical apparatus for condensing, as chemical talent is in cheaply neutralizing the acid qualities, and separating impurities from the juice. It is not necessary here to go into a long historical account of sorghum, and its varieties. It is now nearly forty years since sorghum was introduced from France to the United States, and disseminated as a crop that might be profitably worked into syrup. We believe the first seed was brought to New York in 1853, and sent out. In 1856 the writer received a small package from a friend, planted it in Cook county, Illinois, and made a kind of syrup by crushing it between crude rollers, and boiling down in a five pail kettle. The next year and the succeeding years it began to be disseminated all over the then settled portions of the West. In 1857 Mr. Leonard Wray brought to New York several varieties of Imphee, which he had procured from Natal, South Africa. This, it was confidently said, would produce sugar. It did not with the crude apparatus and the imperfect knowledge of the chemical requirements then known. Nevertheless, the sugar was there, and has since been brought out of it. The failures and losses have not been nearly so great as those attending the introduction and manufacture of beet sugar in Europe. Yet Europe now furnishes one-third the crystallizable sugar produced on the earth, and the beet crop has revolutionized the agriculture of the countries producing it, and added fully twenty-five per cent. to the product in other crops. How? By the clean cultivation of the beets required, by feeding the refuse to cattle, and by the manure made. Let us see how this industry has figured in the past. From the report of the Commissioner of Agriculture for 1876, we find that the aggregate of syrup reported from the census of 1860 was 6,749,123 gallons. The first State in production was Iowa. It reported 1,211,512 gallons, followed by 881,049 in Indiana, 806,589 in Illinois, 796,111 in Missouri, 779,076 in Ohio, and 706,663 in Tennessee. For the census of 1870 the aggregate was 16,050,089 gallons. Indiana reported 2,026,212; Ohio, 2,023,427; Illinois, 1,960,473; followed in the order of decrease by Kentucky, Missouri, Tennessee, Iowa, and West Virginia. Iowa, the first in production in 1859, but the seventh in 1869, returned 1,218,636 gallons, an advance only of 7,124. But the State census of 1867 gives for 1865 an area of 21,452 acres, producing 1,436,605 gallons; and for 1867, 25,796 acres, producing 2,094,557 gallons. The State census for 1875 gives, for 1874, 15,768 acres, yielding 1,386,908 gallons. The definite statistics for the State of Ohio, annually published since 1861, afford a fair illustration of the gradual advance in production up to about 1866 and the subsequent gradual decline throughout the section between the Ohio and the Missouri, and including Missouri. The production in Ohio for the years named was as follows:

Years.	Acres.	Sugar.	Syrup.
		Pounds.	Gallons.
1862	30,872	27,486	2,6 6,159
1863	31,255	27,359	2,347,578
1864	29,392	41,660	2,609,728
1865	37,042	56,066	4,003,754
1866	43.101	102,313	4,629,570
1867	17,804	20,094	1,255,807
1868	25,257	28,668	2,004.055
1869	53,317	27,048	1.683,042
1870	23,450	21,988	2,187,673
1871	23,072	23,505	1,817,042
1872	12,932	34,599	968,130
1873	9,426	36,846	692,314
1874	12.108	36,410	941,510
1875	13.144	21,768	928,100

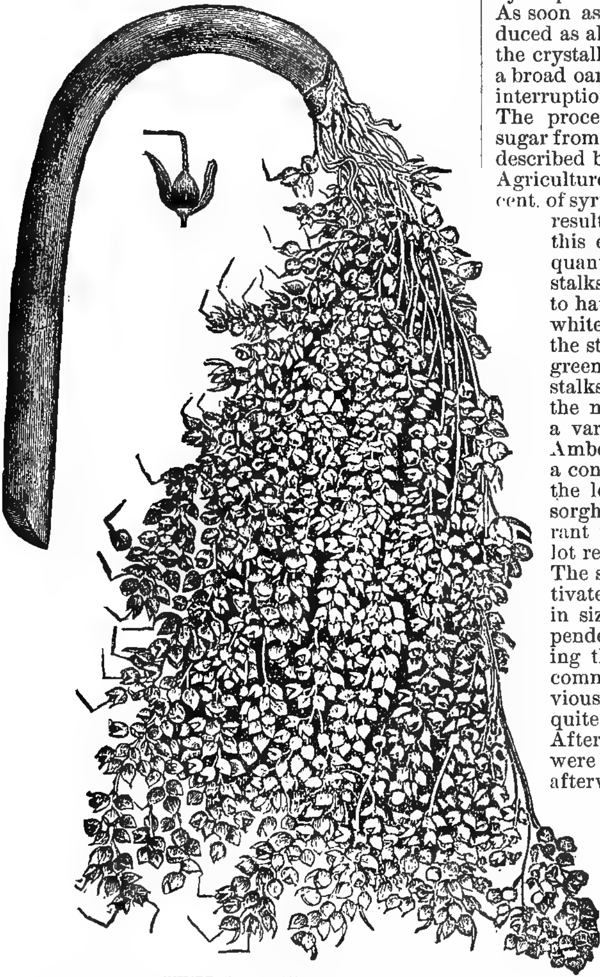
In the Ohio valley there has been a tendency to decrease the area of sorghum since 1869, while there has been a marked increase in the South and west of the Missouri. For fourteen years, ending with 1875, the average product of syrup in Ohio has been 2,054,605 gallons, a little more than the crop of 1869; the average area is 25,868 acres, and the yield 79.4 gallons of syrup and 1.39 pounds of sugar per acre. As an illustration of the increase in new Western States, the product, in 1875, in Kansas is reported as 2,542,512 gallons; in 1869, by the census returns, 449,409 gallons. The crop of 1875 was produced on 23,026 acres; average per acre, 110 gallons. Georgia reported the same year 15,905 acres, yielding seventy-three gallons per acre, or 1,161,065 gallons, averaging sixty-six cents per gallon, and estimated to cost twenty-eight cents per gallon. A larger quantity of syrup is extracted as experience is acquired and processes improved. As an estimate for twenty-one years since the introduction of sorghum, 11,000,000 gallons of syrup per annum might approximate the product. At an average value of sixty-five cents, (it is less now,) the value of the annual product would be $7,150,000. The sugar of the sorghum is a small item, yet in fourteen years, in Ohio alone, it amounts to 506,000 pounds. Including sugar and forage, the annual value must be not less than $8,000,000, and the aggregate value $168,000,000 since its introduction by the Department of Agriculture. Within the last few years much has been written upon corn as a sugar plant. That its juice is rich in saccharine, and that it could be made into syrup has long been known. That it contains notable quantities of crystal sugar has lately been demonstrated. That it can do more than add something to the length of the sugar making season—being earlier in ripening—is hardly probable. That sugar making from corn, where the ears, when in milk, may be utilized for canning and drying, may be made profitable there is no doubt, and fortunately, at the time the corn is in the early milk, and from this time while the corn is in perfection for eating green, sugar corn is in the best state for producing crystallizable sugar. At such time Stowell's Evergreen gave a specific gravity of 10.60; showed 11.34 of crystallizable sugar, and 1.56 of uncrystallizable sugar. Eight rowed yellow corn gave respectively 10.60, 11.42 and 1.65. These results were, we suppose, obtained by means of the polariscope, an instrument for testing saccharine juices. In the practi-



EARLY AMBER SORGHUM.

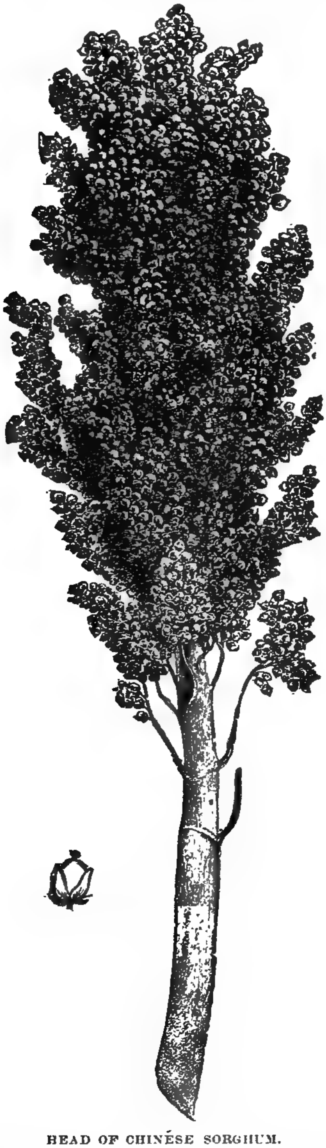
cal working, even where the best appliances are used, including a vacuum pan, some loss ensues, with any saccharine juices, including the beet and sugar cane. If five per cent. of crystal sugar can be obtained it will pay. Six per cent. will leave a handsome profit and seven per cent, give large returns for the capital invested. From what has been accomplished in Ohio, Illinois, Missouri, Kansas, Iowa, and especially Minnesota, and without the best appliances, this product would seem to be fairly attained; with more perfect apparatus better results would seem to lie in the future. All sugar plants seem to suffer from an excess of nitrogen in the soil. This was especially found to be the case in the manufacture of beet sugar in Illinois. A soil rich in the elements of fertility was selected, one capable of producing from seventy to one hundred bushels of corn per acre in good seasons. Its strong nitrogenous qualities destroyed, by reducing, the out come of sugar. Nitrogenous manures, therefore, should be avoided. The best soils are those deep, rich, well drained, calcareous soils—the wheat producing, rolling prairies, and the loess soils of our rivers and bottoms, are excellent. The range of production for sorghum is anywhere where the Dent corn of the West will ripen, Minnesota being the northern limit. Where manure is necessary, those abounding in the phosphates should be used—superphosphate of lime, bone dust, etc. Lime and gypsum would also be indicated. The varieties of cane used generally in the West have been Chinese, Liberian, and white and red Imphee. The Liberian and white Imphee have been favorites in the West from their power of standing heavy winds without much prostration, but they are late in maturing. The Chinese is most productive. The Amber cane of late years has proved most successful. It is early, productive in sugar, and seems well adapted to the soil of the West. Whatever the variety, early planting on well drained soil, say immediately preceding corn planting, careful attention while young with deep cultivation early in the season and shallow cultivation later is essentially necessary to the best success, since as the plants gain strength they acquire a mass of superficial roots, necessary to the production of sugar. The Chemist of the Department of Agriculture, in 1877, analyzed a sample of Early Amber sugar cane from Minnesota, given as follows: Cane sugar (saccharose) 88.8934; grape sugar (glucose) 5.6100; water, (by drying at 110 Centigrade thermometer), 5.8250. Thus showing nearly eighty-nine parts of sugar, and over five and one-half parts of glucose in 100. In Minnesota the yield of sugar is from five to six pounds from one gallon weighing thirteen and one-quarter pounds, and the yield varies from 125 to 150 gallons of syrup per acre. The following table prepared by Mr. L. L. Stewart, of Pennsylvania, for the Department of Agriculture, will show the composition of several varieties of sorghum juice. It will not be necessary in this article to go over the ground of preparation, grinding, defecating, evaporating and finishing the juice for crystallization. It would fill a large volume, and year by year improvements are being made that must be taken advantage of. Mr. Stewart, who has given much thought and attention, as a chemist, to saccharine juices, especially corn, says, in regard to crystallization, that, sorghum syrup should be reduced to a density that, after a lapse of from twenty-four to forty-eight hours, when kept in a warm room, it will become an almost solid mass of sugar. It requires then a special mode of treatment, the crystals being fine and held together by only a small quantity of molasses. When in this condition, the mass is to be thrown into a large tub or mixing-vessel, and a small quantity, (about one-tenth of its volume) of a fair, thin syrup, prepared from sorghum juice of a density of say about 30° Baumè, when cold, is to be poured upon it and thoroughly incorporated in it, by means of a wooden stirrer. This will bring it to a semi-fluid state, if the room in which the operation has been performed has been kept heated. The syrup dilutes the uncrystallized sugar sufficiently to render it mobile, and does not dissolve the cane sugar. The mass may then be drained in a centrifugal, the inner drum of which is very clearly but minutely perforated and running at the highest rate of speed. A number of linen and coarse muslin sacks are provided, of any convenient size, but their length should be about two and one-half times their width, say twenty by fifty inches; each sack is to be about one-third filled with this sugary mixture, folded once on itself in the middle, and flattened by placing it upon a table upon a sheet-iron plate with rounded corners, a little larger on every side than the partially flattened half of the sack and its contents, the loose half being folded under. The open end of the sack may be folded twice if necessary. The plate and sack are then to be placed within a frame on the bed of a powerful screw-press, and

VARIETIES.	STAGE OF GROWTH.	Specific gravity.	Crystallizable sugar.	Uncrystallizable sugar
			Per cent.	Per cent.
Chinese (regular)......	Flower just expanding....................................	10.42	6.72	2.18
“ “	In flower a few days { Butt joints......	10.60	11.30	1.60
	{ Top joints..........................	10.53	9.75	1.25
“ “	Seed ripening..	10.58	11.52	1.18
“ “	Seed quite ripe { Upper and middle joints............	10.63	12.72	0.78
	{ Lower joints.....	10.55	10.57	0.93
“ “	Mixed juice, ripe and unripe......	10.60	11.34	1 56
Red imphee.............	Seed in early milk.	10.53	9.92	0.98
“ “	Ripe...	10.60	11.92	0.98
Black imphee...	Coming in flower...	10.53	9.98	0.92
White imphee....	Not yet in flower..	10.59	10.90	1.90
“ “	Flower just expanded.....................................	10.57	10.30	2.20
“ “	Seed nearly ripe...	10.60	10.66	2 24
Chinese imphee...... }	Cut and stored (lower joints)..........................	10.82	14.97	3.53
	Whisks (upper and middle joints)......................	10.82	16.13	2.31



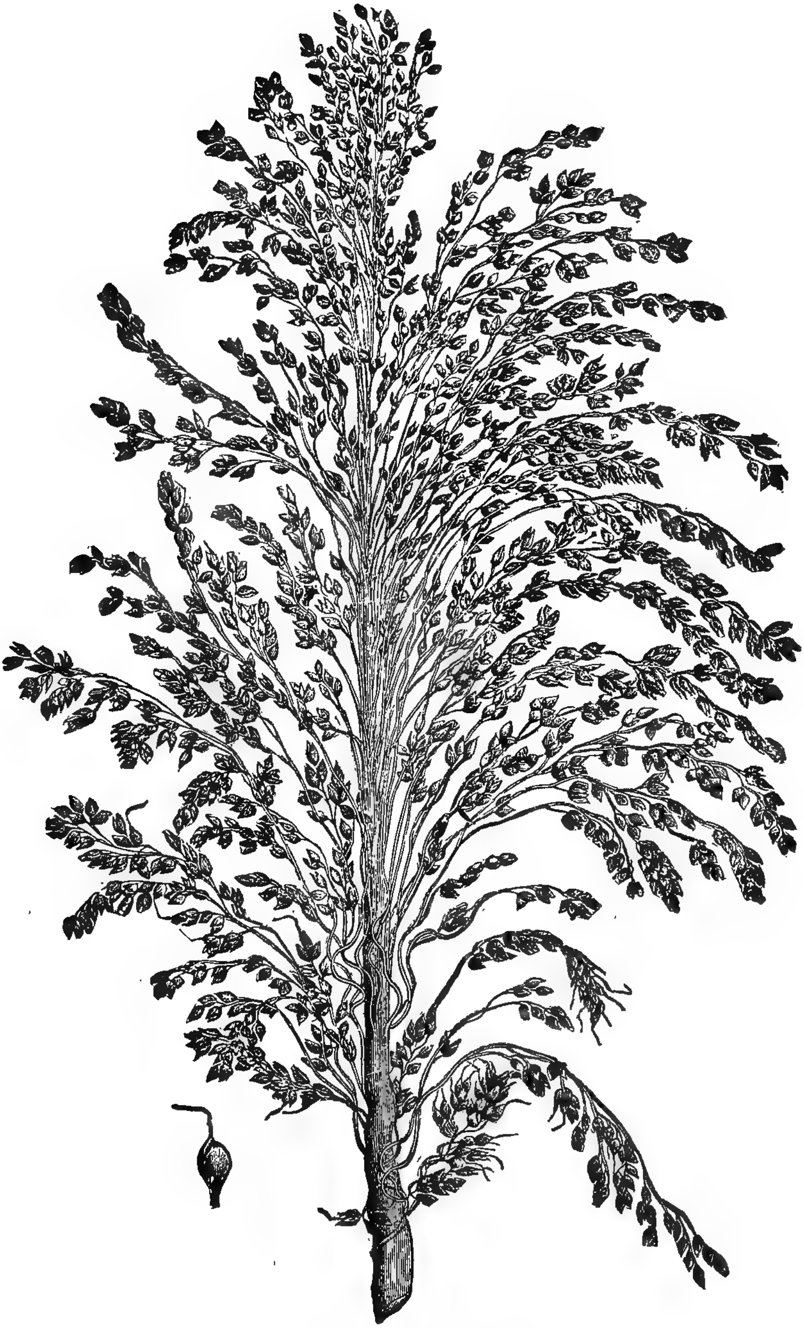
WHITE LIBERIAN CANE.

a series of such sacks and interleaved plates laid neatly one upon another, being turned in opposite directions, and subjected to pressure gradually applied, at first, to avoid rupture of the sacks, and afterwards with sufficient power to remove all the syrup and leave the sugar nearly dry. This fine dried sugar is then to be transferred without further drying to a heating vessel, and about one-tenth of its weight of pure water mixed with it. Here it is to be heated very gradually, with frequent stirring, to diffuse the heat through the mass, and when it has partially remelted and it is in the liquefied state, it is to be poured finally into the crystallizing boxes, in a room heated about 90° F., where it will form a solid mass of crystals as soon as it becomes cool. The result is a very coarse-grained, beautiful sugar of a high grade. If properly prepared, it will be almost white, and the immediate yield is almost double that which may be secured in any other way without reboiling. The sugar prepared from sorghum in this way has the additional advantage of not being contaminated with the secondary products usually formed by reboiling; the final crystallization is attended by no risk, is easily and cheaply done, and in quality, with due care should rank nearly or quite equal to vacuum sugar. The very small quantity of syrup left in contact with the crystals will drain off from the crystallizers, and, being almost free from glucose, will crystallize gradually if exposed in broad trays at the temperature of the room. If the production of sugar of a softer or more open grain is desired, it can readily be accomplished by a mode of treatment almost identical with the stirring off process adopted by maple sugar producers but with better results. As soon as the half-liquefied sugary mass, produced as already mentioned, has been poured in the crystallizing-boxes, it should be stirred with a broad oar-shaped wooden instrument, without interruption, until it is cool and the sugar dry. The process of experimental manufacture of sugar from both corn and sorghum in 1878, is thus described by the chemist of the Department of Agriculture, and also the results including per cent. of syrup. He says: The following tabulated results of my experiments are valuable in this especially, that they were conducted quantitatively throughout. The cornstalks were from a common field-corn, said to have been a cross between a yellow and white The ears had been plucked from the stalks and sold in our own markets as green corn some three weeks before the stalks had been cut and brought to me for the making of sugar. The sorghum was a variety known as the Minnesota Early Amber. Both corn and sorghum were in a condition of vigorous growth when cut, the leaves being green. The seed of the sorghum was sufficiently mature to warrant its preservation, and indeed the last lot received shelled slightly upon handling. The sorghum had not been planted or cultivated so as to produce even a fair average in size, as will be seen by the results appended. The mill made use of in expressing the juice was an old sorghum mill of common construction, which, through previous use and misuse, had been rendered quite unfit to give satisfactory results. After most of our experiments below given were concluded, it was repaired, so that afterward its working was very much better, as will be seen by the subsequent results given further on. The apparatus used in the experiments, besides a few barrels and pails for holding the juice, consisted of a copper tank of the following dimensions: four feet three inches long, two feet three inches deep, two feet three inches wide; a galvanized iron pan nine feet long by eight inches deep, and three feet six inches wide. This iron pan was entirely surrounded by a wooden frame of two-inch plank, so as to support the sides, and each pan was placed in brick-work with chimney, and so arranged as to permit a fire to be kept below it in direct contact with the bottom. In the case of the copper tank the flame played about the sides also, so as to heat the contents more rapidly. The galvanized-iron pan was such as could readily be constructed by any ordinary tinsmith or mechanic. The copper tank



HEAD OF CHINESE SORGHUM.

was used for defecation with lime; the galvanized-iron pan for evaporation. The process in brief is as follows. After topping or stripping the corn or sorghum, it was passed through the mill, and when sufficient juice had been obtained it was heated in the copper tank to a temperature of 82° Centigrade—182° Fahrenheit. After the juice had reached this temperature there was added to it, with stirring, cream of lime until a piece of litmus paper dipped in the juice showed a purple or bluish-purple color. The heat was now raised to the boiling point, and so soon as the juice was in good ebullition the fire was drawn, and a thick scum removed from the surface of the juice. After a few minutes the sediment from the juice subsided, and by means of a syphon the clear liquid was decanted off, leaving a muddy sediment which was equal to about one-tenth to one-twentieth of the bulk of the juice. This muddy sediment was drawn off by means of a stopcock, and filtered through a plaited-bag filter, and the clear filtrate therefrom was added to the liquid previously syphoned off. The clarified juice, which, during the above operation, is not allowed to cool below a temperature of 66° Centigrade, or 150° Fahr., was now emptied into the evaporating-pan, and there was added to it, with stirring, a solution of sulphurous acid in water, until the lime present was neutralized, as was shown by the reddening of litmus paper when it was dipped in the juice. The evaporation was now hastened as much as possible, and the juice concentrated to a syrup at a boiling point of 108° Centigrade equal to 226° Fahrenheit, or thereabout. It was the intention to concentrate the syrup still more (to a boiling point of 112° Centigrade, equal to 235° Fahrenheit) but it was found impracticable to do so in the evaporator, as the danger of scorching it was great, over a naked flame which could not well be controlled. When the syrup reached the density above indicated, it was drawn off into wooden tubs, the fire having previously been drawn from beneath the evaporator. Owing to the fact that each successive lot of stalks was a new experiment, I was unable to wait for the process of filtration of the sediment from the defecator to be completed, and therefore in every case lost a portion of the juice, which of course could have been saved in a continuous process such as would be practically carried out. This will explain what is meant by the juice utilized, as compared with that obtained. It was intended to have still further concentrated the syrups in a smaller pan of galvanized iron, so arranged that by a slide the heat could be instantaneously removed to prevent the scorching of the syrup; but before this pan was completed it was found that the several tubs of syrup were crystallizing, and they were therefore allowed to stand; and the sugar was obtained by pressing out the molasses by means of an ordinary screw press, the mass of molasses and sugar from the tubs being enclosed in an ordinary grain-bag. The sugar thus obtained was very greatly improved in appearance by the addition of five or ten per cent. of water, and stirring it into a mush, and again subjecting the mass to pressure, by which operation the adhering molasses was almost entirely removed, and the sugar obtained was, in the case of sorghum, nearly white, while in the case of corn it was of a rich golden yellow. I may add that in no case, either with corn or sorghum, did I fail to obtain satisfactory results in the way of crystallization, although of course the molasses still contains a very large percentage of crystallizable sugar, which will, at least in great part, be obtained by further concentration. I omit mention of seven experiments with comparatively small quantities of corn-stalks and sorghum, only saying that the results obtained were such as to fully warrant the more extended experiments here recorded; and it is unfortunate that the value of these experiments is vitiated somewhat by the imperfect apparatus employed, as also by the inferior material, which, however, was all that was obtainable in this vicinity. It is greatly to be desired that another season may find the department amply equipped with all



HONDURAS CANE.

necessary means to carry these important questions to complete solution. The point which these experiments have fully settled is, that there exists no difficulty in making from either corn or sorghum a first-rate quality of sugar, which will compare favorably with the best product from sugar cane grown in the most favorable localities. The experiments here given clearly indicate the probability that sugar may be thus made at a profit, and it is desirable that nothing be spared in continuing an investigation giving such fair promise of success. In 1879, and previous, the Commissioner of Agriculture, Gen. Le Duc, caused many experiments to be made in reducing the juice of the cane, and in ascertaining the best varieties for planting. We have reproduced four of those considered best, including the old Chinese and the deservedly popular Amber. The report of the chemist of the department is given in connection as explanatory so far as relates to these varieties with some of the conclusions arrived at. The chemist says: During the past season there have been made several series of investigations for the purpose of determining the development of sugar in varieties of sorghum, maize, and of pearl millet. These investigations appear to demonstrate that there exists little difference between the various kinds of sorghum as sugar-producing plants; and, what is quite a surprising result, each of them is, at a certain period of its development, nearly if not quite as rich in sugar as the very best of sugar-cane. It is a matter, also, of extreme practical importance that this maximum content of sugar is maintained for a long period, and affords sufficient time to work up a large crop. Another result of these investigations has been to satisfactorily explain the cause of repeated failure in the production of sugar during the past quarter of a century, and to give the assurance that in the future such failure need not attend this industry. For the purpose of making clear the above points, the results obtained in the laboratory and in out-of-door experiments are appended. The varieties of sorghum grown and subjected to continuous investigation during the season were Early Amber, White Liberian, Chinese, and Honduras and Pearl Millet. Besides the above there were made very many examinations of other specimens of sorghums and corn-stalks, all the results of which only confirmed the general principle above stated, viz., the practical equality and great value of every variety of this plant. The illustrations, as we have given them, show varieties of sorghum grown during the past season on the grounds of the Department of Agriculture at Washington, and used in the experiments of the chemical division as detailed in the report. The drawings were made by a gentleman employed in the department. The designations given them are somewhat different from those current in some parts of the country, but are conformed to what are believed to be the most authoritative standards. The cut, page 886, represents the Early Amber Sorghum, a favorite with planters in Minnesota and the Northwest. What is now called the Minnesota Early Amber cane is claimed as an improvement upon the Early Amber varieties grown formerly in different parts of Minnesota, by Hon. Seth M. Kenny and Mr. C. F. Miller of that State. Acting on the theory that cane in a high latitude will degenerate if grown continuously from its own seed, these gentlemen selected the finest specimens of seed from their own crops and sent them to a southern latitude to be grown. The seed products of this southern growth was returned to Minnesota. By this alternation of seed, and by other intelligent processes of culture they have succeeded in establishing a new and permanent variety, which they claim to be more productive in weight of cane and to contain a higher per cent. of saccharine matter than any other grown in that State. This claim needs to be substantiated by more careful and extended observations before it can be said to be fully established. Messrs. Kenny and Miller describe the Early Amber cane as presenting the characteristics of both sorgho and imphee. By sorgho they mean the Chinese sorgho, page 889, and by imphee, the White Liberian, page 888, and its kindred African varieties. The Early Amber receives its name from its early ripening and from the bright amber color which characterizes its syrup when properly made. The Early Amber cane on the department grounds did not grow quite so tall as the White Liberian. Its seed-heads were of moderate fullness and dark in color. Page 889 shows the Chinese Sorghum grown on the department grounds. Its height is about that of the

Number.	KIND OF STALK.	Pounds of raw stalks.	Per cent. of juice in raw stalks.	Pounds of juice used.	Specific gravity of juice.	Pounds of syrup made.	Per cent. of syrup in juice.
1	Corn-stalks, stripped and topped	2,353	25.29	520	1053	74	14.23
2	Corn-stalks, stripped and topped	2,769	23.91	597	1061	101	19.92
3	Corn-stalks, (butt ends), stripped and topped	3,568	29.04	971	1053	142	14.62
4	Corn-stalks, (top ends), stripped and topped	2,547	19.94	483	1050	65	13.46
5	Sorghum, stripped and topped	3,052	37.97	1,099	1057	146	13.29
6	Sorghum, stripped and topped	2,860	32.06	808	1057	135	16.71
7	Sorghum, topped, but unstripped	3,034	36.75	958	....	148.5	15.50
8	Sorghum (butt ends), unstripped	1,324	47.49	445	1059	73	16.41
9	Sorghum (top ends), unstripped	1,322	43.16	398	1057	58.5	14.70
10	Sorghum (butt ends), unstripped	1,240	41.49	346	1062	57	16.47
11	Sorghum (top ends), unstripped	1,126	34.09	291	1059	41.5	14.26
12	Sorghum, small stalks, stripped	963	56.20	538	1086	102	18.95
13	Sorghum, large stalks, stripped	515	58.55	299	1091	60	20.00
14	Sorghum, small stalks, stripped	1,623	55.87	781	1086	156	19.97
15	Sorghum, large stalks, stripped	1,549	58.01	711	1084	158	22.22

Early Amber. Its seed-heads are fuller and more compact and somewhat resembles a head of sumach; hence the synonym Sumach Cane. It is also known as Chinese Cane. Page 888 shows the White Liberian Sorghum grown on the department grounds. This variety is rather taller than the Early Amber. The stalk curves at the top leaving the head pendent; hence the synonym Gooseneck. The seed-heads are shorter, more compact, and of lighter color than the Early Amber. Page 890 shows Honduras, grown on the department grounds. It grows about one-half taller than either of the above varieties Its seed-top is reddish brown and spreading; hence the synonym Sprangle Top. It is also called Mastodon and Honey Cane. The Early Amber, Chinese, Liberian, and Honduras Sorghums and the Pearl Millet examined, mentioned as having been grown upon the department grounds, were all planted the same day, May 15, 1879. The relative weights of the different kinds of sorghum experimented upon are as follows:

Name.	Pounds.
Early Amber, average of 40 stalks.	1.73
White Liberian, average of 38 stalks.	1.80
Chinese, average of 25 stalks............ ---	2.00
Honduras, average of 16 stalks............. ..	3.64

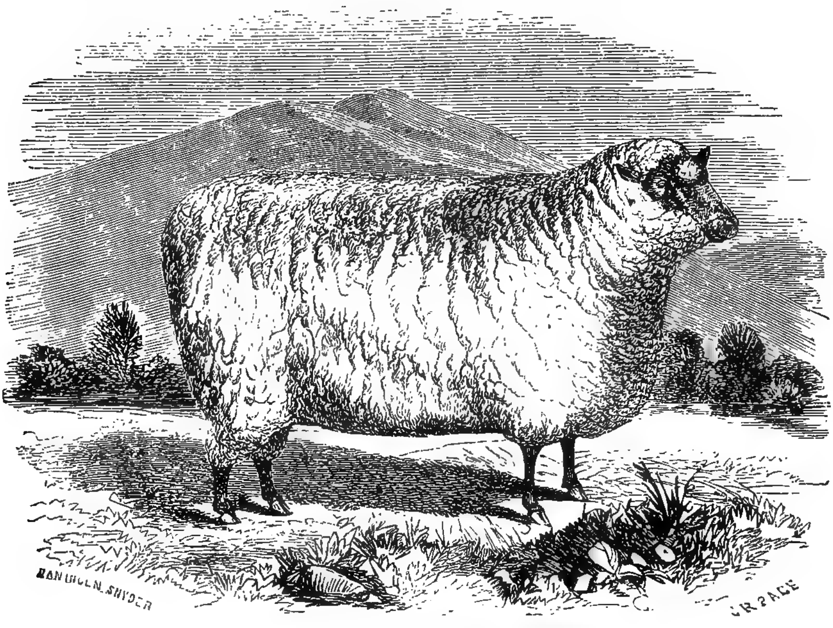
Since these were all grown side by side and upon land presumably of equal fertility, it will afford the data for calculating the relative amount of each variety, as required, to be grown per acre. An average of all the examinations made of these four sorghums, during these periods when they were suitable for cutting, gives the following results: Early Amber, from August 13 to October 29, inclusive, fifteen analyses, extending over seventy-eight days, 14.6 per cent. sucrose; Liberian, from August 13 to October 29, inclusive, thirteen analyses, extending over seventy-eight days, 13.8 per cent. sucrose; Chinese, from September 13 to October 29, inclusive, seven analyses, extending over forty-six days, 13.8 per cent. sucrose; Honduras, from October 14 to October 29, inclusive, three analyses, extending over sixteen days, 14.6 per cent. sucrose. Besides the investigations above mentioned, there have been made thirty-five experiments in making sugar from cornstalks, sorghums, pearl millet, etc., in all of which there have been used over twenty-three tons of stalks. The result of these experiments has been to fully confirm all the experiments, not only of the previous year, but also to help towards the solution of certain questions of the highest practical importance. In every case it has been found that the quality of the syrup obtained has been precisely such as the previous analysis in the laboratory of the juice used made probable. An average of the nine best syrups obtained showed a percentage of cane-sugar present equal to 92.7 of the amount originally present in the juice, while an average of the nine poorest (*i. e.*, containing the lowest percentage of cane-sugar) showed a percentage of cane-sugar present equal to 90.1 of the amount present in the juice.

SORREL. Field sorrel. Sheep sorrel, *Rumex acetocella,* well known from the acid nature of its weeds. It is supposed, erroneously, to be indicative of a want of lime in the soil, and liming has been recommended as a means of driving out this and other acid plants. It is natural to sandy soils. and those under which water slowly finds its way. It is not common in the West. Draining, cultivation, and manuring are the remedies.

SOUP. A nourishing and healthful food to be taken as the first course at dinner. Lean meat only should be used for soup. The conditions to be observed in boiling meat, both as respects its quality as food, and also when it is intended for soup, are as follows: If the mass of flesh intended to be eaten be introduced into the boiler when the water is in a state of brisk ebullition, if the boiling be kept up for a few minutes, and the pot then put in a warm place, so that the temperature of the water be kept at one hundred and fifty-eight to one hundred and sixty-five degrees, we then have united the conditions for giving to the flesh the qualities which best fit it for being eaten. When it is introduced into the boiling water the albumen of the flesh is immediately coagulated on the surface, and to a certain extent inwards, thus forming a skin or shell which no longer permits the juice of the meat to flow out nor the water to penetrate the mass. The flesh continues juicy and well flavored, the greater part of the savory constituents being retained in the meat. On the other hand, if the mass of flesh is set on the fire with cold water, and this slowly heated to boiling, the flesh undergoes a loss of soluble and savory matter, while the soup becomes richer in these. The albumen is gradually dissolved from the surface to the center; the fiber loses, more or less, its quality of tenderness, and becomes hard and tough. The thinner the piece of meat the greater its loss of savory constituents. This explains the well known observation that the mode of boiling which yields the best soup gives the toughest, driest, most vapid meat, and that in order to obtain well-flavored and eatable meat we must relinquish the idea of making good soup from it. If finely chopped meat be slowly heated to boiling with an equal weight of water, kept boiling for a few minutes, and then strained and pressed, we obtain the very strongest and best-flavored soup that can be made from flesh. When the boiling is longer continued some little organic matter is dissolved, but the flavor and other properties of the soup are thereby in no degree increased or improved. By boiling, mutton may be regarded as losing about one-fifth of its weight, and beef about one-fourth. By roasting, mutton and beef lose each about one-third of their weight; mutton is, however, the most nutritious meat.

SOUR DOCK. (See Dock.)

SOUTH AMERICAN CATTLE. The Rev. G. D. Carrow, some years since, when superintendent of the missions of the Methodist Episcopal Church in South America, contributed a graphic account of South American Cattle, and cattle farming in the Pampas, which we reproduce, as showing the origin of South American Cattle, their management, and much other interesting matter of general interest. The Reverend author writes as follows: There are two classes of men, discoverers by land and sea, and pioneers in new fields of tillage and commerce, who though almost invariably distinguished for great and good qualities, seldom realize an adequate return for their services to their country and to mankind. The truth of this statement is confirmed by many facts belonging to the history of the discovery and colonization of this continent. Were we not so strongly assured of the contrary, we might suppose that the discovery and exploration of the three greatest rivers of this continent and of the globe, were events certainly calculated to insure solid comfort to their authors during the brief period of their mortal life, as well as immortal fame on the pages of history. What are the facts which so sternly forbid this natural supposition? Fernando de Soto was the first white man who explored the banks of the Mississippi, and saw that father of waters roll beneath the boughs of the primeval forest to the sea. But only a few days after his passage of the mighty stream he had ceased to live; his body, to conceal his death from his enemies, was wrapped in his mantle, and, at the hour of midnight, was silently sunk in the middle of the current. The wanderer, says Mr. Bancroft, had crossed a large portion of the continent in search of gold, and found nothing so remarkable as the place of his burial. Francisco de Orellana, striking a stream that wound itself along through the rugged passes of the Peruvian Andes, built a mere raft of green wood, launched it, and drifted with the current. Onward it bore him through plain and forest, mountain gorge and fertile valley, ever growing deeper and wider, till, at the end of seven months, and at a distance of four thousand five hundred miles, his frail and rudely constructed vessel felt the heaving, and his experienced eye surveyed the great expanse, of the Atlantic Ocean. He called the river Amazon. Marvellous was the adventure, and immortal the fame. But, ten years later, the discoverer perished in an expedition designed to locate and further explore the river, whose course he had followed from its birth in the mountains to its death in the sea. In 1515, Juan Dias de Solis, crossing the equator, and steering boldly to the south, in the teeth of the terrific gales which sweep northward from the latitude of Cape Horn, entered what he soon perceived to be the mouth of a great river, and finding, or hoping to find, silver among its sands, called it El Rio de la Plata. But venturing ashore a few days after the discovery, he was put to death by the native savages. The explorers were in search of the precious metals, but died at the height of their career in poverty and disappointment. Posterity, however, was to reap incalculable advantage. Harvests of grain and cotton are now gathered in the valley of the Mississippi more valuable than the produce of the mines of Potosi. Harvests of fruit, corn and cotton are to be gathered in the valley of the Amazon worth more than all the gold which streaks the mountains whence that river flows. And from the far-reaching plains of La Plata's basin, supplies of meat and clothing might be drawn in quantities sufficient to meet the necessities of more than half the world. The pampas form the larger portion of that great river's basin. Of their wool-producing capabilities, and of the extent to which they are already laid under contribution, the writer has given some account in the report of 1864, Department of Agriculture. In the present communication his purpose is to give to agriculturists of the valleys of the North some information on the subject of horned cattle breeding on the great plains of the South American continent. There were no horned cattle either in the northern or southern division of this continent prior to the discovery. The first ever seen in the new world were imported by Columbus in 1493. Respecting their importation into the northern section of the southern continent, Lieutenant Gibbon, in his Exploration of the Valley of the Amazon, says: This pampa looks like a great pasture field, enclosed by the Mamoré ditch on the south, and the Securé on the north. Under the shade of the trees stand the cattle of the field. They have gradually clambered over the Cordilleras from the flats of Guayaquil, through the table lands of Oruro, and from the salt district of Charcas. The creoles drove them down by the side of the Mamoré river, and let them out into the grassy prairie lands of Chiquitos and Mojos. When the cattle came among the Indians they knew not what to make of them. There were no such animals in their wild lands. The fierce tiger, and the poisonous serpent which they had worshipped, were outdone. The cow interfered with the belief they previously had, that the largest animals were God's favorites, particularly those which had the greatest means for active aggression or self-defence. The cow helped to change such a religion. By degrees they learned that she neither bit, clawed, nor stung; that she carried a bag full of milk; that her teeth were given her to cut the pampa grass, and not to devour the flesh of a human being; that she was docile and friendly to man, and not his enemy. The Jesuits (missionaries) taught the Indians how to milk the cow and how to use her milk. They soon learned how to tend cattle, to lasso them, to yoke them by the horns, so that they may drag along a bundle of drift wood from the edge of the river to the middle of the plain. In this way they kept cattle near them, while herds roamed through the pampas, became wild, and are now so scattered through the lands that it is difficult to count them. The pampas described in the lieutenant's report form the central and southeastern departments of the present republic of Bolivia, and he is doubtless correct when he states that the first horned cattle introduced into that part of the continent came from the Pacific coast. In 1551 horned cattle were first brought into Paraguay from the coast of Brazil. These Sir Woodbine Parish regard as the progenitors of the numberless herds that for three centuries have roamed the southern plains. For the original importation Paraguay was, doubtless, indebted to the Jesuits, as was that country, and, in fact, the whole interior of the southern continent, for almost all the elements of their early civilization. Sir Woodbine is mistaken, however, in asserting that the whole pampas stock originated from the breed imported into their mission grounds by the Jesuits of Paraguay. Prior to the date to which that importation is assigned, settlements of Europeans had been effected in southeastern Peru, and the colonists, as Mr. Gibbon suggests, had brought cattle with them from the west coast. The present stock, therefore, may be regarded as the combined results of the two original importations, one from the Atlantic, and the other from the Pacific shore. As to the particular character of the original stock, it, no doubt, consisted of the common black cattle of Spain and Portugal. There is a very common mistake in regard to what some writers designate as the wild cattle of the south. The writers themselves are mistaken, and have led their readers to the same erroneous conclusion. The opinion is, that from an early period after the conquest, herds of straying and unclaimed cattle were allowed to run wild, and that these were, in the course of many years multiplied into countless millions, roaming wild and fierce through the forests and over the plains. It is true that portions of herds, which had never received proper care, or that by some special and violent cause had been separated and scattered, have become wild in their habits and fierce in their dispositions. But being regarded as common property, both Indians and white settlers have hunted them till the breed can no longer be said to exist, and the only wild cattle now are the few, comparatively, that have wandered away from the farms during the absence of the herdsmen in times of revolutionary commotion. The general characteristics of the present native stock are about the same as those of unimproved stock in this country. The principal points of difference are in the legs and horns; the legs being longer, and the horns longer and wider at the tips than those of our native breed. Their average weight is about the same as that of our ordinary farm cattle. In a large herd almost all shades of color may be distinguished, the prevailing hues being light and dark red, and black, and dark brown. Steers frequently attain a fine size, are very symmetrical in their proportions, and when broken to the yoke and put to service are gentle in their dispositions, and rapid and graceful in their motions. In regard to the qualities of the cows for the production of milk, but little can be said with certainty. On the cattle farms milk is but seldom used, and so little attention is paid to the cows that are kept by milkmen for the purpose of supplying the towns and cities, that the quantity of milk they yield can not be taken as a fair sample of their natural capabilities. The milk itself is very rich and has an excellent flavor. The town and city traffic in that article is somewhat noteworthy. Certain police regulations are made to prevent adulteration; but they are not very effectual. Every morning quite a troop of milkmen's horses may be seen in line before the door of the police officer, and after due examination, the charge of adulterating being brought home, the contents of the cans are condemned and confiscated. But the adulteration of milk, like the adulteration of whisky, is found to pay so well that the rogues can afford to suffer the penalty of the law, quite as often as a policeman can be found sharp enough to detect and sufficiently conscientious to arraign them. It must, indeed, be rather an extreme case of milk and water to be thought grave enough to be presented for the action of municipal authority. Hence it is worthy of note, as another peculiarity belonging to this traffic, that many of the milkmen will confess to the faces of their customers the sin of adulteration. The vachero who supplied the family of the writer, frankly acknowledged that he regularly brought three kinds of milk to market. I have, said he, a double share of cream for my customers who pay me an extra price, no cream for those who pay the regular price, and milk and water for such as may not pay anything. For reasons that will be stated in connection with another point remaining to be noticed, no attempt has been made to improve the native stock by the cattle breeders of the pampas. This, to many, may seem strange; for, considering the facilities afforded for such an experiment by the climate and pasturage of the country, it might prove successful there beyond precedent in those countries where, by crossing and careful treatment, stock has been brought to its highest degree of perfection. If the writer mistake not, there is a handsome fortune in store for any intelligent, enterprising cattle farmer who would go to that country and invest a moderate capital in the improvement of native stock, both for domestic supply and foreign exportation. An estancia, or cattle farm, varies in extent from one thousand to fifty thousand square leagues, the square league containing five thousand seven hundred and sixty English races. In the districts adjacent to the cities and towns, and in those which lie upon the margin of the Plate and Parana rivers, sheep are rapidly taking the place of horned cattle. The largest estancias for cattle, in fact, are now to be found only in the interior, and in such sections as are far from the great water-courses. The cattle farms abound in what the natives distinguish as strong grasses. These coarse grasses gradually disappear whenever the land is appropriated to sheep. In their place there comes a rich supply of smooth-stalked meadow grass, *Poa pratensis*, and meadow foxtail, *Alopecurus*. Horned cattle, like sheep, prefer these, but thrive very well on the trefoil, wild barley, and other varieties of coarse grass which abound throughout the plains. The coarse grasses are more hardy, and stand the dry season better than finer ones, but contain less nutriment; and while stock fed upon them are preserved in a healthy and plump condition, they neither fatten so quickly nor so abundantly as when favored with their choice pasture. Pasture is most abundant in winter, the rainy season of that climate, and of best quality during the months of summer and autumn. On a single estancia is frequently pastured a stock consisting of a hundred thousand head. The general herd is divided into smaller ones containing, each, from three to twelve thousand. A herd of three thousand can be properly cared for by one man. The entire herd is collected every evening at a spot near the farm house. This gathering place is called, in Spanish, *rodes*. And one marked peculiarity to be observed when the stock has been assembled for the night is, that each animal is careful to select precisely the same spot on which it laid the night before, and every night, probably, since it took its place among its full grown companions. The immense herd will all lie or stand together thus, each in its own place, without enclosure of any kind, and will not separate for the day's grazing until eight or nine o'clock in the morning. Cows calve once a year; heifers as early as at two years old. With regard to the longevity of horned cattle, no exact information can now be obtained. Farmers have not recorded nor perhaps even made any observations on that subject. In the opinion of Mr. Van Blarcom, an experienced and intelligent observer, the average age of animals may be set down at fifteen or twenty years. Neither the proprietors nor the men they employ will eat the flesh of an old cow or steer, and as stock is not bred to any extent either for milking or labor, there is no inducement to preserve animals till they have grown old, especially as the heifers and younger cows are preferred for the purpose of breeding. For these reasons but very few animals are allowed to grow old; and such as receive this privilege are permitted to die of neglect, or are killed for the hide and tallow, the carcase being thrown to the dogs and buzzards. To secure comfort and success in cattle breeding, water is a prime consideration. The most desirable land, therefore, for this purpose, is that which is situated in those slightly undulating districts of the great plains where large ponds of water collect during the rainy season. These, however, evaporate in most cases during the heat of summer, and water must be obtained from wells. In cases where care had not been taken to provide a sufficient number of these, great destruction of stock has sometimes been the consequence. In the province of Entre Rios, in 1846, there was a general drought, unusually prolonged and disastrous. The grass was literally reduced to dust. Cattle, suffering from thirst, wandered off from their accustomed pasture grounds in search of food and water. Some farmers lost five thousand, some ten, and some as many as fifty thousand animals. It is stated, indeed, and is doubtless true that at one estancia, an English gentleman, lost one hundred and fifty thousand head. In seasons of protracted drought cattle will stray in quest of water hundreds of miles. If they find water, and remain long enough in its neighborhood to calve, they will never return. But if the drought ceases before they calve, they will return to the grounds of their owners. Protracted droughts are not of frequent occurrence; and yet they are sufficiently so, one would think, to induce the farmers to adopt all suitable precautions. The immigrant farmers do provide wells sufficient to meet ordinary exigency. But the native proprietors in this, as in all things else, are disposed to take the world easy, and are perfectly willing that the morrow should provide for itself, or even prefer that it should be a day of disaster rather than to-day should be devoted to care and toil. Besides this, native labor is exceedingly scarce. The great pampas are very sparsely populated, and the necessaries of life are so cheaply and easily obtained that the few who are dependent upon their own exertions for a livelihood will do but little work. In one particular, both foreign and native proprietors are alike to blame. Dependent as they frequently are upon their wells, they have not adopted any modern improvements for pumping water. The horse-bucket system still prevails. An author very familiar with the modes and customs of the pampa cattle farmers thus describes the process: Over the well is a framework from which is suspended a pulley through which a rope is passed, one end being secured to the bucket and the other fastened to a horse. The bucket is made of hide, very long, and of a peculiar form; the adjustment of the rope is so secured that when the horse reaches the extreme length of the rope one mouth of the bucket leans into a cistern or trough, into which it empties itself. By this primitive and tedious process it takes one man and two horses eight hours to water two thousand head of cattle. So if there should be only fifty thousand head on a particular farm, and there is frequently double that number, it would require a day's work for twenty-five men and fifty horses to give the entire herd a single drink of water. There is one custom peculiar to horned cattle which the natives call standing rodes. The explanation is this: if one farmer lose a herd, or any portion of one, and sets out in search of the missing animals, every farmer he visits in the course of his search is required by an ancient law, enacted expressly for that purpose, to drive up his herd for the inspection of his unfortunate neighbor, that he may see whether he can identify any of his lost animals. This is what is meant by standing rodes. In a country where there are no fences, and causes are constantly occurring that tend to scatter the herds, it will be perceived that the law in question is very proper and necessary. As there are neither ditches nor fences of any kind to separate adjoining farms, each animal must be stamped with the mark of its owner, so that in case of occasional straying, or a general stampede, or other causes producing an intermixture of herds and great consequent confusion, each proprietor may distinguish and claim his own. Patterns of the various marks or brands adopted by the estancieros of a political department are preserved in the office of the *comandante*, with the names of the parties that use them; and to counterfeit or alter a mark is a penal offence of the same grade as forgery, or counterfeiting money. The season of marking is one of great sport for the young men and boys and even the girls of a family. It corresponds, in its way, to the cornhuskings and quiltings that were so highly appreciated and keenly enjoyed by our grandfathers and grandmothers. The process is very simple. The cattle are driven into a large pen; a man or half grown boy mounts a horse; the Spanish saddle is fastened very strongly with stout and broad leather straps; in the central strap, about half way between the horse's back and belly, there is an iron ring; to this the lasso (a strong, plaited raw-hide rope) is attached; the other end is formed into a noose which the rider throws over the horns of the animal, and the horse dragging it from the herd its legs are then securely fettered, and being thrown upon its side the red-hot brand is produced and the owner's mark is stamped indelibly upon its smoking flesh. The catching of a single animal for domestic use frequently presents an exciting scene. The particular one desired is singled out, and perceiving itself, as by instinct it frequently does, to be the object of some dangerous design, it breaks from the herd and bounds off into the plain. The horsemen duly equipped with a lasso clasps the spur to his steed and bears down upon the flying fugitive. Having gained a point within convenient distance, he swings the lasso several times around his head to give it momentum, and then throws the noose around the horns of his victim. This is done while horse and steer are at the top of their speed. The moment the noose lodges on the head of the steer the horse stops and wheels to receive the shock which is often so violent that the animal is thrown headlong and bellowing to the ground. The precision with which many horsemen throw the lasso can hardly be conceived by one not familiar with the customs of that country. The Indian's arrow or tomahawk scarcely speeds more directly to its mark. The performance is to be explained as are all the feats of human dexterity. Early training and long practice supply the horsemanship, the steady hand, and the unerring aim. The lasso is the native child's first toy; and one of his earliest amusements is found in throwing its noose over the heads of the dogs, cats, and tame sheep that follow him about his play grounds. Another method of catching cattle is with the bolas. This instrument is prepared in the following manner: Three round stones or iron balls, each the size of an egg, are covered with raw hide; one is fastened to each end of a forked strip of hide, about ten feet long; the third ball is secured to a strip, attached to the main one, about five feet long. The horseman takes this in his hand, and, as in the former case, pursues the animals. When he comes within easy reach of his object, he takes hold of the end of the rope, and swinging the other, that has the balls attached, several times around his head, throws the whole contrivance at the animal's legs In an instant it is entangled, and the more it endeavors to escape the more securely it is fettered till it falls. The bolas may be thrown fifty or sixty yards with certainty; and if the pursuit be rapid, the fleetness of the horse adding force to the throw, an animal may be struck with tolerable precision at a distance of eighty or ninety yards. An ordinary herdsman, or other laborer, receives per month from twelve to twenty silver dollars. The entire estancia, with all its arrangements, is placed under the superintendence of an experienced and well tried major-domo, whose salary differs, according to the wealth of the proprietor and the responsibilities of the situation, from three to five hundred Spanish dollars per annum. In killing cattle for home consumption the butchers first hamstring them and then cut their throats. In dressing them they are not suspended, but flayed on the ground. Some years ago the Buenos Ayrean city fathers prepared a slaughter-house of the same style and conveniences as are common in other countries, but the butchers refused to occupy it, and steadfastly adhered to the old custom of hamstringing and throat-cutting in an open pen. The carcase is divided in a mode somewhat peculiar. The tenderloin is taken out and sold by itself. Beef is never weighed in market, nor even measured, except by the butcher's eye, who acquires great exactness in subdividing the quarters of an animal so as to make the pieces suit the daily, bi-weekly, or tri-weekly demands of his customers. The beef market of the pampas was in former years probably the cheapest in the civilized world. So recently as twenty years ago an ordinary cow or heifer could be bought for one silver dollar, and a large fat steer for two dollars and a half. Now, the prices of the same animals range from eight to twenty dollars. In 1858 a piece of sirloin, weighing ten pounds, could be purchased in the market of Buenos Ayres or Montevideo for fifty cents, and in the towns of the interior for half that sum. The natives are very partial to roast beef, which they term *asado;* but their mode of preparing it is peculiar to themselves. They take the best roasting pieces and cut away the flesh till the rib is reduced to nearly the thinness of an ordinary sparerib of pork, according to our method of butchering. This is done to suit their mode of roasting, which is never in accordance with that which obtains in Paris, London, or New York. Instead of the oven, they still use the more primitive spit. This is a piece of iron about four feet long. It is run through the meat, and, if the meat be prepared in the open air, is stuck into the ground at such an angle as brings the meat into contact with the tip of the flame; or, if the meat be prepared in the kitchen, the spit is inclined against the chimney in about the same position. The fire is kindled with weeds or small dry faggots cut from the paradise or peach tree. As this consumes very quickly, fresh fuel is constantly supplied. When the fat of the flesh ignites and blazes, the cook seizes the spit, blows out the flame, and then returns it to its place. This is repeated till the meat is nearly done, when the spit is laid across two large bricks, and the process of cooking is completed by toasting a few minutes over the fresh coals. Meat cooked in this way is somewhat smoked and a good deal blackened, but it has a juiciness and a peculiar flavor which could not fail to commend it to the palate of a finished epicure. Some travelers complain of the toughness of the native roast, but the writer's experience is altogether in conflict with their statements, and his impression is that they must have fallen into the hands of a very unskillful cook, or upon the carcase of an animal that had been toughened by poverty and leanness or unusual length of days. The qualities of the beef are very superior. English residents, generally, do not esteem it; but this is owing to that intense national egotism from which few, even of traveled Englishmen, ever entirely recover. They will roundly assert that neither first-rate beef nor mutton can be found beyond the limits of the British isles. But many Americans, who have traveled extensively on both continents, consider the best pampas beef fully equal, if not a little superior, to the best beef ever brought to an English market. It has not the same amount of fat, nor is the fat so thoroughly distributed through the lean portions of the carcase, but it is sufficiently fat to meet the demand of any delicate and well-educated palate. The tissues are so fine as to render the flesh peculiarly tender, and, when cooked, it has a flavor akin to that which distinguishes the flesh of the wild duck from that of the flock which is hatched in the poultry house, and reared in the barnyard. It is also very easily digested. A feeble, dyspeptic stomach may take as much as the appetite of a hungry man will ever crave and not be oppressed by the indulgence. Pampas beef, as well as pampas air, might safely be prescribed for all invalids who are suffering from dyspepsia, and assailed by its veteran ranks of horrors attendant on dyspepsia or ennui. An establishment for salting and curing jerked beef is called a saladero, literally, salting tub. The mode of slaughtering the cattle and preparing the beef is very simple. As in the case of marking, the herd is driven into a large pen. A man or boy, with a lasso attached to his saddle girth, throws the noose around the horns of the animal. The lasso traverses a pulley, suspended from a cross-beam resting on two strong upright posts. The horse draws the head of the animal directly up to the beam where a man or boy sits with a long knife. The moment the head touches the beam the knife severs the spinal cord just back of the horns, and the animal drops on a movable platform which runs on a tramway, and is immediately drawn out of the pen by hand and placed under an open shed, where two men, without hanging the carcase, quickly flay it right and left; two others take out the intestines, cut off the head, divide the trunk into four quarters, hang them on hooks, cut them in slices, throw them into a handbarrow, and, while one wheels off the flesh to be salted, another conveys the hide, bones, horns, and tallow to their appropriate places. In the salting shed is a large tank filled with strong pickle. The slices are deposited in this for a short time, in order to wash them from all blood. They are then hooked out and packed under the shed in alternate layers of meat and salt. The slices take sufficient salt in about a week. They are then removed to another part of the shed, turned, and piled again. This moving and piling is repeated several times. The meat is then hung on poles in the sun for a few days, when it is again piled for the last time, and looks in this, its last stage of preparation, in the separate pieces, very much like codfish or sole leather; and, in the aggregate pile, very much like a stack of cornhusks that has stood the storms of a New England winter. And now, perhaps, the reader is ready to inquire whether, in its finished condition, it is a savory article of food. In reply, he may be reminded, in general terms, that taste is almost altogether a matter of education. At first, but very few persons relish tomatoes; and yet there is scarcely any one who does not learn to esteem them as one of the most delicious of all vegetables. Codfish, to an uncivilized palate, is at first about as agreeable as would be fine splints of pine board steeped in fermented and half putrid brine. Yet some civilized people esteem codfish a dish worthy to be set before a king. Tobacco stands among the very first articles on the long and varied list of human luxuries. But who does not remember the retching that followed the first chew, or the first cigar? On the same principle we should not be surprised to learn that jerked beef is highly esteemed where it has been longest and most generally used. The people that manufacture it, however, will not eat it at all. It is mostly exported to Cuba and Brazil, and is appropriated to the use of the negroes who cultivate the sugar and coffee plantations. Cattle are in the best condition in March, which is the first month of autumn in that hemisphere. The principal killing season is from November to March. But most of the saladeros are continued in moderate operation all the year around. These establishments for the manufacture of jerked beef were first founded in 1815, and were among the first fruits of the immigration that flowed into the country immediately upon the achievement of its independence. During the first few years of their existence, it was rarely the case that as many as a hundred animals were slaughtered at one establishment in a single day. Now, there are, probably, nearly a hundred such establishments, at each of which are slaughtered from two to four hundred head per day. The cost of a saladero capable of slaughtering four hundred head per day would be scarcely less than thirty thousand dollars. Take four men, skilled in such labors, and in fifteen minutes by the watch they will convert a living animal, standing in the pen, into jerked beef, salted in the common pile. The writer has measured the process, watch in hand, and is satisfied that four such workmen will average an animal to every fifteen minutes during the working hours of the day. Dried hides are from cattle that are killed for domestic consumption. The drying of them is rather a tedious operation, and one that requires a good deal of care. Those intended for German and English markets are stretched lengthwise only, by which the hide acquires a much greater thickness than it would if stretched both ways. As many as twenty-four or twenty-six stakes are used for fastening the extremities of the hide to the ground. The dry hides designed for Spain, and other markets requiring thin leather, are staked so as to stretch them both laterally and longitudinally as much as possible. Hides shipped to Liverpool and Antwerp are generally twenty per cent. heavier than those intended for other ports; and those which are sent to the Spanish markets are said to be ten per cent. better in quality. Salt hides are first steeped in brine, then washed, and after the washing are packed away in alternate layers of hide and salt. Thus prepared they will keep well for at least one year after being taken from the salt. As to the quality of the pampas hides, it may safely be affirmed that better are not known to the commerce of the world. They may owe some of their superior qualities to the climate, some to the pasture, but the principal reason for their superiority is, that the breed of cattle have never been improved. The finer the animal, the thinner and less valuable the general qualities of the hide. This is mainly the reason why the most enterprising estancieros of the south have made no attempt to improve the native breed of cattle. What would be gained in flesh and tallow they think would be lost in hide and labor, and, probably, they are not wrong in this opinion. Every part of an animal is made available—horns, hoofs, hair, bones, and tallow, as well as the flesh and hide. The tallow is one of the most important items belonging to the general traffic. As soon as the flesh is sliced from the carcase, the bones and fat are deposited in vats, in alternate layers, for the purpose of being steamed. The bones are so arranged as to leave apertures through which the steam may quickly penetrate. The door of the vat is then closed, and the steam turned on. In twelve hours or more, according to the size of the vat, the liquid is drawn off by means of a brass tap. The condensed steam, in the form of a greasy liquid, is discharged first, and afterwards the liquid tallow, which is received in tubs, and thence conveyed to a large cast-iron boiler, in which it is purified. From the purifying boiler the tallow is conveyed through a shoot into a large iron tank, where it is allowed to cool down. After this it is drawn off into casks, and is then ready for shipment. Steaming for the purpose of extracting tallow was commenced about thirty-five years ago, and the process has undergone great improvement. The general arrangements necessary for steaming are quite expensive. A saladero, costing thirty thousand dollars, would require a steaming apparatus that would cost, at least, one-half that sum. Cattle are always paid for in cash. The risk of delivery is with the purchaser, as stock is invariably bought as it stands on the farm. There is a class of professional drovers in the country. Unlike the same class in this country, however, they are not proprietors, but are simply hired by the purchasers to convey their droves to market. One capitaz (chief drover) with four or five assistants will convey to market a herd of five or six hundred head. The price per head for this service will be twenty-five to seventy-five cents, according to the distance. When taken from their accustomed



SOUTH DOWN RAM.

pasture grounds, cattle are sometimes restive and disposed to scatter. When any special causes of disturbance occur many are lost—in a few instances whole droves have broken away from their drivers and dispersed in the plains beyond chance of recovery. While en route for market, the custom is to halt for the night on some spot where the feeding is good. The drovers sleep and ride round the herds by turns. On stormy nights it is particularly difficult to keep the herd together, and whenever a general stampede occurs it is usually at such times. Cattle in good condition will stand driving twenty-five miles per day without injury. If pushed beyond this, the effect is very perceptible in what is called tired beef. Cattle once delivered, either at the city markets or the saladeros, receive no further attention; and, when the supply is large, animals are allowed to remain in the pens for a week without a blade of grass or a drop of water. If they do not starve long enough to produce shrinkage of flesh, the proprietors do not care for the sufferings of the poor beasts. Excepting live stock, the produce of the country is offered for sale in a public plaza or market-place. Sometimes the farmers themselves act as their own salesmen, but the general usage is to employ a broker. The broker is styled a barraquero, and his warehouse a barraca. When a mercantile house wishes to obtain hides, wool, or other produce of the country, a barraquero is employed to attend the sales in the plaza and make the purchase. The articles are then conveyed to his barraca. If it be wool, it is packed (or baled, rather) with a hydraulic press. Hides are simply stored in piles; and at the proper time the barraquero attends to the shipment of the cargo. The merchant has only to provide the money and keep the accounts, and the broker, for the entire cost and trouble of his agency, charges only one per cent. on the sum total of the exportation. It will readily be perceived from these facts that the barraca business is one of the most important branches of the general trade of the country. It is pretty equally shared by natives and foreigners. Some very sharp men are engaged therein. They can tell all about a hide when it is yet warm and whole on the back of the steer; or what the quality of a fleece is, and how many pounds it contains before the shears have touched it. While passing through the plaza, observing without being observed, the writer has often been reminded of the accuracy of the woodman's eye and judgment, by which he correctly estimates how many square feet of ship timber or how many cords of wood there are in a standing tree. The extent and importance of this will appear from a single statement. During one year the produce of five hundred and sixty-two thousand head of cattle was shipped at the port of Montevideo alone. That city is the capital and chief port of the republic of Uruguay. And something of the great wealth of that state, in horned cattle, may be inferred from such an annual shipment, especially when it is considered that the revolutionary has become its chronic and prevailing condition. The total number of hides exported from the river Plate and the Rio Grande for one year was one million five hundred and eighty thousand; another year, one million six hundred and fifty thousand. The amounts included in this statement are nearly all the product of the great pampas lands lying on the eastern and western shores of the river Plate and its tributaries.

SOUTH DOWN SHEEP. That the South Down sheep make the most superior mutton of any known breed, there is no doubt, yet superior as is their mutton, except in the vicinity of large cities, or in localities where transportation to market is easy, breeders do not take kindly to them, and for the reason that in American agriculture the wool is usually considered as of the first consequence. Hence, the larger mutton breeds elsewhere noticed in this work, with large bodies and producing more wool have regained the preference. Nevertheless, many breeders preserve the breed in its purity, and there is no doubt but in the hill country of the South, the breeding of these sheep and lambs for the markets of large cities, should prove most profitable. Within the last thirty years they have been fully as much improved as any other of the breeds of farm animals, and now there is no more pleasant view than a flock of pure bred South Down sheep and lambs, to any person accustomed to admire symmetry of shape, evenness of size, and uniformity of color. In their English history Mr. John Ellman was one of the earliest and most distinguished English improvers of this breed. He did not, as was the case with his great contemporary, Bakewell, the founder of the New Leicester, endeavor, as it were, to create a breed, but took as a basis a selection from the best flocks of the Sussex Down. He first turned his efforts to the improvements of this sheep about the year 1780, and, during a residence of fifty years at Glynde, by the closest attention and continual perseverance in the well-known principles of breeding, brought his flock to a high state of perfection. And it ought to be recorded of him that he exhibited none of that selfishness which, it is to be regretted, characterized Mr. Bakewell's proceeding; but was so zealous in his endeavors to advance their improvement generally, that he was always ready to give every information in his power. Mr. Ellman describes the South Downs, formerly, as being of a small size and far from possessing a good shape; they were long and thin in the neck, high on the shoulders, low behind, high on the loins, down on the rumps, the tail set on very low, almost perpendicular from the hip-bones, sharp on the back, the ribs flat, not bowing, narrow in the fore-quarters, good in the leg, although having a large bone. They are also described as having a very light fleece, and were not considered to have arrived at maturity for fattening till they were three years old. The Duke of Richmond, Mr. Jonas Webb, and other contemporaries and successors of Mr. Ellman, have, with varied results, but continued progression, carried further the work so well begun by him. These sheep, both for symmetry and constitution, as well as for early maturity, now rank on an equality with, if indeed they are not superior to, the best breeds in the kingdom. In shape and character, they have altered very much, being smaller in the bone, equally hardy, and with a greater disposition to fatten is combined a heavier carcase when fat. All good breeders, who have devoted much attention to the subject of sheep-rearing, concur in the opinion that a well-proportioned animal is the best criterion of a good constitution and aptitude for fattening. A small head, though an indication of a well-bred sheep, is also accompanied by a want of size; the head should be of a medium length, and the lips thin. The under-jaw, or chap, should be fine and thin; the ears tolerably wide apart, well covered with wool, full and thin. The forehead should be well covered with wool, especially between the ears, as it is a great protection against the fly; the eye full and bright, but not prominent. The neck should be of proportionate length, thin next the head, and enlarging towards the shoulders, where it should be broad and straight on the top, and not what is generally called ewe-necked. The breast should be wide and deep, projecting well forward between the fore legs. This is considered an essential point with graziers, as the breast gives the sheep a greater degree of weight, and also indicates a good constitution and disposition to thrive. The shoulders should be on a level with the back, and not too wide above. If the shoulder-plates are very wide on the top, it is generally found that the animal drops behind them. The back should be flat, from the shoulders to the setting on of the tail. The ribs should project horizontally from the spine, extending far backward, and the last rib projecting more than the others. The rump should be long and broad, the tail set on high, and nearly on a level with the spine; the hips wide, and the space between them and the last rib on either side, as narrow as possible, thus preventing the dropping of the belly; the ribs generally presenting a circular form. The legs should be of proportionate length; the hind legs full in the inside at the point called the twist; the hock, or hough, rather turning out. The fore legs should be straight from the breast to the foot, and not what is generally called knock-kneed. The South Down sheep, in fact, is the model of what the hill sheep ought to be, and the flesh, in the fineness of grain and flavor, is peculiarly excellent. The wool is of a very useful quality, but is both larger in fiber and less numerously serrated than the short Saxony, and does not, therefore, possess such a felting power; hence it is rarely used in the manufacture of fine broadcloths. Still, from its fineness and felting properties, compared with the wool of many other middle-wooled breeds, it is highly esteemed; and for flannels and worsted goods, in general, is extensively employed.

SOUTHERN CABBAGE WORM. (See Cabbage Butterfly.)

SOUTHERNWOOD. Wormwood.

SOWER. (See Seeding.)

SOWING. (See Seeding.)

SOW THISTLE. A composite plant of the genus *Sonchus*, smooth, perennial, with a milky juice.

SPADE. An implement of various shapes and different lengths of handle, strong and with a sharp cutting edge. They are of shapes adapted to particular uses, as the flat medium blade, flat long blade, and flat extra heavy; the latter for digging nursery and other trees. The half round, sharp or round pointed spade, is long in the bit for taking out deep casts from ditches. The long handled, somewhat spoon shaped, sharp pointed shovel, is used for cleaning out the bottoms of ditches. Spades for cutting peat are peculiar in shape, one of them being two sided so as to take out the turf in brick-shaped blocks.

SPADER. Machines worked by horse power, intended for digging or forking the ground instead of plowing. Many patents have been issued on these implements. The Comstock spader came nearer to performing its work satisfactorily than any other. With three strong horses we have spaded four acres per day to a

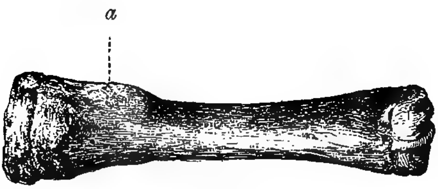


Fig. 1.

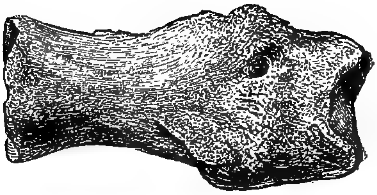


Fig. 2.

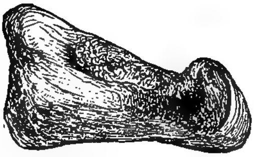


Fig. 3.

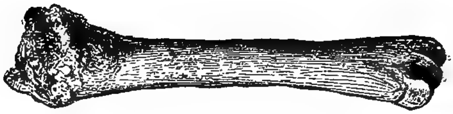


Fig. 4.

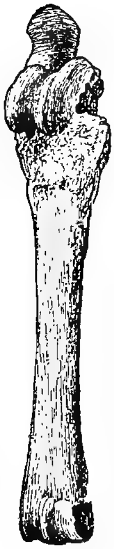


Fig. 5.

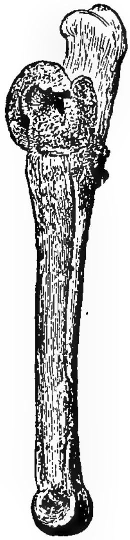


Fig. 6.

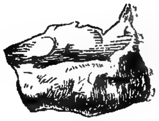


Fig. 7.

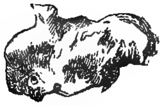


Fig. 8.

ILLUSTRATIONS OF SPAVIN

depth of six inches. For fallowing, it was really an excellent implement, but, unfortunately, it would not cover trash however slight, and the draft was excessive.

SPADIX. A form of inflorescence, in which the flowers are arranged around a fleshy rachis, enclosed within a kind of bract called a spathe, as in palms and araceous plants. The Indian turnip is an instance.

SPANISH CATTLE. (See Texas Cattle.)

SUSSEX CATTLE. Youatt says of the Sussex cattle, undoubtedly a subfamily of the Devons, that the Sussex ox holds an intermediate place between the Devon and Hereford, with much of the activity of the first and the strength of the second, and the propensity to fatten, and the beautiful fine-grained flesh of both. Experience has shown that it possesses as many of the good qualities of both as can be combined in one frame. The Sussex ox is of a deep chestnut-red—some, however, prefer a blood-bay: deviation from this color indicates some stain in the breed. The hide of the true Sussex is soft and mellow; a coarse, harsh, thick hide denotes here, as in every other district, an ill-bred or an unthrifty beast. The coat is short and sleek There is seldom found on the Sussex ox that profusion of soft and wavy, and, occasionally, long hair, which, although it may have the appearance of roughness, is consistent with a mellow and yielding hide, and one of the truest indications of more than usual propensity to fatten. The Sussex cow, like the Hereford one, is very inferior to the ox; she seems to be almost another kind of animal. The breeder has endeavored, but with comparatively little success, to give to the heifer the same points that the ox possesses. The Sussex cow ought to have a deep red color, the hair fine and the skin mellow, thin and soft; a small head, a fine horn, thin, clean and transparent, which should run out horizontally, and afterwards turn up at the tips: the neck very thin and clean made; a small leg; a straight top and bottom, with round and springing ribs; thick chine; loin, hips, and rump wide; shoulder flat—but the projection of the point of the shoulder is not liked, as the cattle subject to this defect are usually coarse; the legs should be rather short; carcase large; the tail should be level with the rump. The Sussex cow does not answer for the dairy. Although her milk is of very good quality, it is so inferior in quantity to that of the Holderness or the Suffolk, that she is little regarded for the making of butter or cheese. There is one great fault about the Sussex cows seemingly inconsistent with their propensity to fatten, and which can not be remedied. Their countenance indicates an unquiet temper; and they are often restless and dissatisfied, prowling about the hedge-rows, and endeavoring to break pasture, and especially if they are taken from the farm on which they were bred. They are principally kept as breeders, all the use being made of them at the same time as dairy cows of which circumstances will admit. And it can not be denied that they are generally in fair condition, even while they are milking: and that no beasts, except their kindred, the Devons and the Herefords, will thrive so speedily after they are dried. The secretion of milk being stopped, the Sussex cow will fatten even quicker than the ox. It must, however, be acknowledged that the Sussex cows are not perfect even as breeders. Some of the ancient Britons sought refuge from the attacks of their invaders, amid the fastnesses of the Weald of East Sussex. Thither they drove, or there they found some of the native cattle of the country; and they anxiously preserved them free from all admixture. The resemblance between the Sussex and the Devon oxen is very great. They unquestionably betray the same origin. The Sussex ox has a small and well formed head, compared with many other breeds, and even with the Hereford, but evidently coarser than that of the Devon; the horns pushing forward a little and then turning upward, thin, tapering and long—not so as to confound this breed with the long horns. The eye is full, large and mild in the ox; but with some degree of unquietness in the cow. The throat clean, and the neck, compared with either the long horns or the short ones, long and thin, yet evidently coarser than that of the Devon.

SPANISH FEVER. (See Texas Fever.)

SPAN WORM. More properly geometers, *geometræ*, from their peculiar manner of moving, by arching the back, while they bring up the hinder part of the body. Attaching themselves, the body is stretched to the utmost length, and so progression proceeds by a series of movements by which they seem to measure the ground. They have only ten legs; six jointed and tapering under the fore part of the body, and four fleshy prop legs behind, the three intermediate pair of prop legs being wanting. They are all destructive insects, feeding on leaves, often defoliating trees and plants. The dreaded canker worm is a true geometer.

SPASMODIC COLIC. (See Blown.)

SPAVIN. Spavin, ringbone, and in fact any enlargement of the bone, by deposit of bony matter, may be referred to similar causes, and should be treated alike, first to allay the inflammation, and then to excite absorption. Firing, (burning the parts,) and all like heroic treatment, should be condemned; and disused, as a barbarous relic of the inhuman past. Bog spavin, and wind galls are produced by the same cause, congestion, inflammation, and resulting enlarged *Bursæ mucosæ*, and are relieved by cooling lotions in their first stages, and followed by bandaging of the parts. Blood spavin is a local venous congestion, and is to be met in the early stages, by cold water, and cooling lotions, later by strong infusions of bayberry bark, or brandy and salt applied through a considerable period of time. Wind galls; are difficult of cure, and do not constitute unsoundness. Of the nature of spavin the late Dr. Dadd says: it is a compound of two diseases, known as *exostosis* and *anchylosis;* the former signifies hypertrophy of bone, (*hyperostosis,*)—morbid enlargement; anchylosis signifies stiff joint—absorption of inter-articular cartilage and substitution of bone. Anchylosis, however, does not take place in what is properly understood as the hock joint, composed of the *tibia* and *astragalus*—although a very common occurrence in the human subject; but it generally occurs beneath the true joint, within its collateral or inferior articulations, known as the tarsal bones. Spavin, therefore, may commence in exostosis and end in anchylosis, and *vice versa*. The seat of spavin, then, is on the inside of the hock, in the region of the tarsal bones, and beneath the true joint, from which point it may both spread and acquire magnitude. Hypertrophy, or enlargement of the bone beneath the tarsal articulations, occurring on the upper part of the cannon, does not constitute spavin. Spavin has two origins, hereditary and exciting. Facts have proved conclusively that spavin, as well as predisposition, morbid tendency to the same, is transmitted from parents to offspring. It is probable, however, that predisposition is more frequently transmitted than actual disease; for the latter does not make its appearance so early as it otherwise would were it transmissible. Spavin is not peculiar to colthood, but to adult life, and even then can often be traced partly to an exciting cause, strain, injury, over-work, etc. Predisposition may not always have an hereditary origin; still it will not differ in its mode of action from the former; for all predisposing causes produce in the economy certain changes which may be said to prepare it for disease; and therefore, predisposition, whatever its source, may be considered as the incubative stage of disease. Exciting causes are those from which this disease seems to have direct origin, such, for example, as strain, injury, overwork, etc.; yet these fail to produce spavin in a great majority of cases; in confirmation of which we have only to look into the history of our truck horses, particularly those used for several years in the shafts. The herculean strength necessary to back a load which requires the united strength of two or three to draw would, one would think, be likely to produce spavin; yet a great proportion of such are exempt from this disease; therefore we may infer that exciting causes are in some cases inoperative, unless conjoined with predisposition. Unfortunately for the poor brute, lameness is not generally of that character which incapacitates him for work; and thus he is urged to the performance of his duties, the disease progressing, and his sufferings increasing, until at last the owner sees that the lameness is not to be driven off. The generality of non-professional men are unwilling to believe in the existence of spavin, unless they can both see and feel it, and are therefore more prone to refer primary spavin lameness to some other joint, until, after a few months of intermittent lameness, they are, by ocular demonstration, convinced. Spavin commencing in inter-articular cartilage is not demonstrable in this manner; there is no circumscribed tumor, nor irregularity; our diagnosis must, therefore, be made up from the signs revealed—from the heat and tenderness about the part, of a subacute character—from the absence of tumor—from the manner of catching up the limb—and from the intermittent nature of the lameness, which is progressive, yet fluctuating. The history of the case, also, must be considered. If a sort of irregular lameness has existed for some months, referable to no other joint than the hock, and the difficulty has of late gradually increased, so that the joint appears stiff, all doubts are set aside, for anchylosis is hastening toward completion; after which we may expect to observe a tumor on the inside of the hock. A tumor once formed in the region already referred to needs no wise man to point it out; it can be both seen and felt; and this, accompanied with hock lameness and ligamentary tumefaction, is the diagnostic symptom of spavin in its exostotic stage. In illustration of the subject of bony formation we shall find that original inflammation of the bony tissue is comparatively rare, while that of the periostial investment of the bone is quite frequent. A variety of causes may account for this. Perhaps the most common is the evil of overwork. Hard driving on a hard road, as on a plank road, on the frozen ground, or on the ice, or the strain of draft, as too heavy a load, may excite periostial inflammation, and from this as a commencement we may have splint, spavin, ringbone, nodes, etc. Splint (Fig. 1 *a*) is a bony tumor at some point about the cannon and splint bones. The knee-joint is formed at its inferior part, between the lower row of carpel bones and the cannon and splint bones, the two latter forming a considerable portion of the joint. As the leg is flexed these bones slide upon the cannon bones, contributing to the elasticity of the step. When the motion is violent and long continued, especially with striking upon a hard surface, irritation first and inflammation afterward may be produced in the periostial membrane covering these bones. Bony matter is thrown out in the immediate vicinity of their adjacent surfaces, and the result is a sealing together of the bones and the formation of a bony tumor. Unfortunately the condition is frequently overlooked until the change is complete and the disease beyond a remedy, for when the bony union is thoroughly consolidated it can not be remedied. For a time, while the deposit is fresh callus, and the circulation active, measures to abate the inflammation and to excite the absorption of the deposit may restore the integrity of the part. In the pathology of the disease, (Fig. 1 and 2) splint and ringbone, as before stated, are the same. They have the same causes, and are preceded by the same stages of morbid action; but, from the relation of parts, ringbone, at its forming stage, gives rise to earlier and greater lameness. Attention is earlier called to the disease, and treatment is usually sooner applied. Splint may go on to its final stage of bony consolidation without giving rise to much lameness and without attracting attention to the diseased part, which may escape observation unless the hand is passed over the small tumor; but in ringbone usually the lameness appears with the inflammation, and the earliest effusion over the region calls attention to the seat of the disease. Spavin, (Fig. 4, 5 and 6,) when it consists in the deposit of bony matter about the hock joint, and the consequent cementing together of the tarsal bones, or the destruction of the tarso-metatarsal joint, is a similar disease, having essentially the same causes. This form of disease may exist in every degree, from a slight exostosis near the joint to such an amount as will entirely destroy the joint, and so invade the soft tissues that the slightest movement is productive of great suffering. Fig. 7 and 8 shows, in spavin, the lower tarsal bones, cementation by the deposit of bony matter. In the treatment of spavin, ringbone, splint or any disease of the joints or limbs involving inflammation, rest is absolutely necessary. If the disease has progressed, and bony matter has formed, there is absolutely no cure. Pain, however, will not be severe after the bony process is completed. Hence the wonderful cures, by various nostrums, applied at such stage, and which would have resulted naturally in a so-called cure. The treatment is, in the first stage of the inflammation, cold water applications thoroughly applied, as for any other inflammation. Then to cause absorption. A good resolvent is four ounces mercurial ointment, one half ounce of powdered cantharides, and two drachms of oil of rosemary. Triturate these thoroughly together, and use daily. Thoroughly rubbing the part with oleate of mercury, from day to day, will soon dissipate whatever has not already become bone. If before these are applied, when bony formation has commenced, it would be well to insert a narrow bladed bistoury under the skin and scarify the seat of the spavin freely.

SPAYING. Spaying is extracting the ovaries of female animals, for the purpose of fattening. If operated on about the season of periodic heat, and when in full flow of milk, spaying prolongs indefinitely the period of giving milk and increases the flow. Thus cows have been known to continue in milk for years, and, of course, without subsequent period of heat. Experiments with twenty-seven cows varying in age from six to fifteen years, showed an increase in milk of thirty-three per cent. Spaying does not so much depend upon the instruments used, as upon the skill of the operator. It should never be undertaken until the operator first makes himself acquainted with the anatomy of the parts, or until he has had instructions from an experienced operator. Then the operation may be safely performed with a common knife, a crooked needle, and some waxed silk thread. Yet the regular instruments are better. The cow should be cast, securely fastened, and her head held firmly down by an assistant; an incision is then to be made through the muscles, skin and peritoneum large enough to admit the hand, which seizing the ovaries, in turn, they are brought up as far as possible, severed, and the wound closed with four or five interrupted sutures; that is the edges of the wound to be brought together, and pierced, through the lips, with a threaded needle, and tied, each stitch separately, and and the ends of the threads left three or four inches long, and the wound properly dressed. If the animal subsequently is irritable and refuses her food, prepare the following drink: two ounces of valerian and two quarts of water; when cool, strain, and add one quart infusion of marsh mallow, and give a pint every two hours. If the wound shows signs of pus, and does not heal kindly, wash with two ounces of pyroligneous acid, in two quarts of water. It is also well to prepare the animal by giving a scalded bran mash every night for a few days before the operation. M. Morin, a French surgeon, operated as follows: The eyes of the cow are covered, one strong man holds her by the nose and another by the horns. Her hocks are tied together and held by another assistant, who also holds the tail and pulls when the cow attempts to move. Then, says M. Morin, the cow being conveniently disposed of, and the instruments and appliances, such as curved scissors, upon a table, a convex-edged bistoury, a straight one, and one buttoned at the point, suture needle filled with double thread of desired length, pledgets of lint of appropriate size and length, a mass of tow (in pledgets) being collected in a shallow basket, held by an assistant, we place ourselves opposite to the left flank, our back turned a little toward the head of the animal; we cut off the hair which covers the hide in the middle of the flanks, at an equal distance between the back and hip, for the space of thirteen or fourteen centimetres (a centimetre is forty hundreds of an inch), in circumference; this done, we take the convex bistoury, and place it open between our teeth, the edge out, the point to the left; then, with both hands, we seize the hide in the middle of the flank, and form of it a wrinkle of the requisite elevation, and running lengthwise of the body. An assistant seizes with his right hand the right side of this wrinkle. We then take the bistoury, and cut the wrinkle at one stroke through the middle; the wrinkle having been suffered to go down, a separation of the hide is presented of sufficient length to enable us to introduce the hand; thereupon we separate the edges of the hide with the thumb and fore finger of the left hand, and, in like manner, we cut through the abdominal muscles, the iliac, (rather obliquely,) and the lumbar, (cross,) for a distance of a centimetre from the lower extremity of the incision first made in the hide; this done, armed with the straight bistoury, we make a puncture of the peritoneum, at the upper extremity of the wound; we then introduce the buttoned bistoury, and we move it obliquely from above to the lower part up to the termination of the incision made in the abdominal muscles. The flank being opened, we introduce the right hand into the abdomen, and direct it along the right side of the cavity of the pelvis, behind the paunch and underneath the rectum where we find the horns of the uterus; after we have ascertained the position of these viscera, we search for the ovaries, which are at the extremity of the *cornua*, or horns, (fallopian tubes,) and when we have found them, we seize them between the thumb and fore finger, detach them completely from the ligaments that keep them in their place, pull lightly, separating the cord, and the vessels (uterine or fallopian tubes) at their place of union with the ovarium, by means of the nails of the thumb and fore finger, which presents itself at the point of touch; in fact, we break the cord, and bring away the ovarium. Again introduce the hand in the abdominal cavity, and proceed in the same manner to extract the other ovarium. This operation terminated by the assistance of a needle, place a suture of three or four double threads, waxed, at an equal distance, and at two centimetres, or a little less, from the lips of the wound; passing it through the divided tissues, we move from the left hand with the piece of thread; having reached that point, we fasten with a double knot; we place the seam in the intervals of the thread from the right, and as we approach the lips of the wound, we fasten by a simple knot, being careful not to close too tightly the lower part of the seam, so that the suppuration, which may be established in the wound, may be able to escape. The operation effected, cover up the wound with a pledget of lint, kept in its place by three or four threads passed through the stitches, and all is completed. It happens, sometimes, that in cutting the muscles, we cut one or two of the arteries, which bleed so much that there is necessity for a ligature before opening the peritoneal sac, because, if this precaution be omitted, blood will escape into the abdomen, and may occasion the most serious consequences. The best time for spaying cows, with a view of making them permanent milkers, is between the ages of five and seven, especially if they have had two or three calves. If intended to be fattened for beef, the operation should not be performed until the animal has passed its first year.

SPEAR GRASS. (See grasses).

SPEARMINT. Common green mint, *Mentha viridis*; also the weed *Mentha tenuis*.

SPECIES. In natural history, an individual or individuals, whether plant or animal separated from others of a genus. Thus, the genus *Bos* embraces the buffalo, the bison and others, the sub-genus, or species *Bos taurus*, being the ox, or the various varieties of our horned cattle. In plants the same rule follows. The genus *triticum*, for instance, contains a number of species among which are wheat, (*T. vulgare*). Thus, individual plants or animals, so much like each other that they may be conceived to have a common origin are species. Below this again are varieties, or sub-species as the varieties of cattle, or of the rose.

SPECTRUM. An image, usually applied to the image of the sun seen through a prism, and which consists of seven colors.

SPECULUM. A reflector or mirror of metal.

SPEEDWELL. The genus *Veronica*, perennial plants, often with beautiful spikes of blue flowers.

SPELT. Spelter wheat. An inferior variety of wheat having the chaff strongly attached to the grain, and requiring milling to separate it. It is cultivated in some parts of Europe not adapted to the growth of the better varieties. In Germany it is called *dinkel*, and is of two varieties both bearded and smooth, one having a smooth, the other a rough berry or kernel. It is one of the oldest varieties and was known to the ancient Egyptians.

SPERMAPHILE. The prairie squirrel.

SPERMATIC ANIMALCULES. Minute, thread-like animacules found in the secretion of the testes.

SPERMATIC CORD. The collection of blood-vessels passing from the abdomen to the testes.

SPERMIDIUM. The same as akenium, a small seed vessel resembling a seed.

SPHACELUS. Mortification, gangrene.

SPHAGNUM. A genus of mosses growing in bogs, and forming a great deal of the peat.

SPHENOID BONE. A bone in the base of the skull.

SPHINCTER. The name of muscles which close the natural openings of the body.

SPICE WOOD. *Laurus benzoin.* An indigenous shrub, four to ten feet high, the wood of which yields an aromatic smell. It grows in damp places.

SPIDER. The whole family of spiders *Arachnida*, except mites and scorpions, are on the whole beneficial to agriculture on account of the insects they destroy. There are some venomous kinds in the South that must be guarded against, as the tarantula. The spiders are between the crustaceans and the insects proper. The body is divided into two parts, the thorax and the abdomen; the head is continuous with the chest and there is no abdomen. The sexes are separated, and the young are produced directly from the egg, without undergoing an intermediate larval state. Spiders are divided into terrestrial and aquatic, species of each being spinning, and sedentary, lying in wait near their nets for their prey, and also predaceous, or hunting spiders. Some of the species have sought to be made available, in thin silk, but so far not success fully. Spiders are eaten by some tribes of savages, including our Digger Indians, and some southern species are large enough to overcome small birds.

SPIKE. 1. Incorrectly applied to lavender. 2. A large nail. 3. An ear of Indian corn, wheat, etc. 4. A shoot. 5. In botany, a species of inflorescence in which sessile flowers are alternate on a common simple peduncle, as lavender, whence the common name of lavender.

SPIKE-LAVENDER. (See Lavender.)

SPIKENARD. A name applied to various plants producing fragrant, essential oils, as *Aralia racemosa*, in the United States, and in England to *Andropogon nardus*; to *Valeriana spica*; to several species of *Baccharis*, *conyza*, etc.

SPINACH. *Spinacia oleracea.* Plants, the succulent leaves and stems of which are used for boiling as greens. The seed should be sown pretty thickly or about four to the inch, in drills fourteen inches apart, early in the spring, and the plants cut at the roots as soon as the leaves are nearly or quite fully grown. The best varieties are the large prickly seeded spinach and the round leaved or summer spinach. South of forty degrees the seed of the first named variety are sown in autumn and the plants covered during winter.

SPINDLE-SHAPED, FUSIFORM. Roots which taper at both ends, as the radish.

SPINDLE-TREE. *Euonymus Europæus.* A small tree or shrub, the wood of which is extremely hard, and used for spindles. It is improperly called strawberry-tree by some nursery men,

SPINE. The vertebrated column of quadrupeds. It is composed of forty or more pieces, or *vertebræ*, articulated by cartilage; through these runs the spinal marrow or pith, which sends off at every bone a pair of spinal nerves, which distribute the sensation of touch and the power of movement to the skin and muscles, over which they are distributed.

SPINES. In botany, imperfect branches.

SPIRACLES. The breathing openings or pores of insects.

SPIRAL VESSELS. In plants, elongated cellules, which contain a delicate internal thread, spirally wound, and capable of being drawn out.

SPIRIT. Any distilled alcoholic product.

SPIT OF EARTH. A spadeful, as dug from the soil.

SPLANCHNOLOGY. An account of the viscera of animals.

SPLAYED. In building, an angle cut off obliquely.

SPLEEN. A spongy viscus, of an oval form, the use of which is not well known; placed in the human subject in the left hypochondrium, between the eleventh and twelfth false ribs.

SPLINT. (See Ringbone.)

SPONGIOLE. The small spongy extremity of the rootlets.

SPORADIC. Springing up singly, or in small numbers. Diseases are sporadic which are not epidemic or endemic.

SPORANGIUM. The case or receptacle containing the spores.

SPORIDIA. The covering of the spores, the spore-like bodies of algæ.

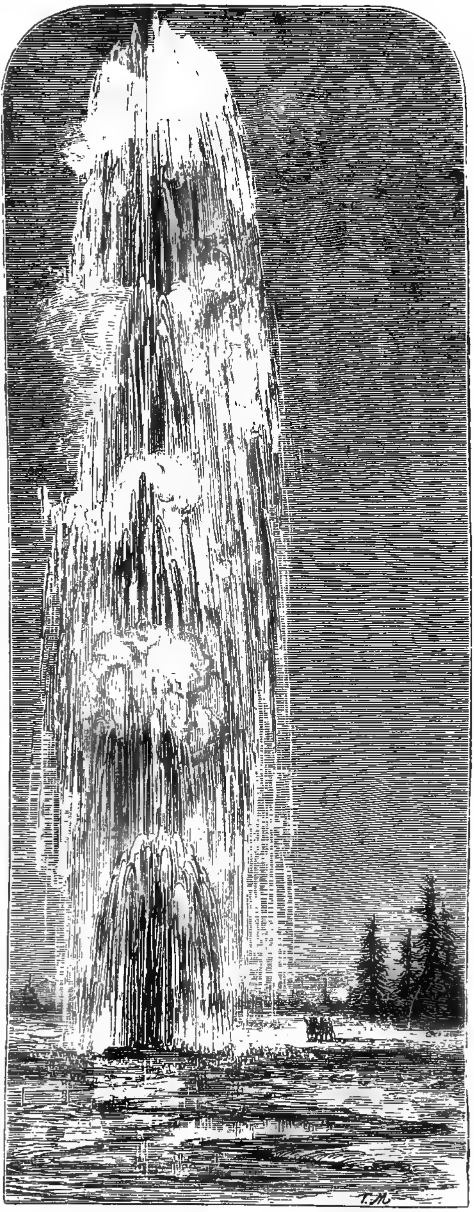
SPORULES, or SPORES. The minute, simple, reproductive grains of cryptogamic plants.

SPRAINS AND STRAINS. These arise from violent exertion severely taxing the muscles or sinews, or even from long continued slight exertion of some particular muscle or sinew. The consequent disuse of the part, as in shoulder lameness, causes a falling away of the muscles, causing what is known as sweeny. This may, indeed, continue so long that the muscles from permanent disease become atrophied. If this continue, after acute lameness has ceased, mild blisters, and a long rest at pasture are the means of cure. Those who claim to cure sweeny in any other way, and especially by the application of secret specifics, are charlatans, and should be avoided. In the treatment of sprains or strains the first thing is to reduce the inflammation. This is best done by the application of cold water faithfully applied or by hot fomentations, perfect rest being ot course understood, until the animal is again sound. The next step is firm and steady pressure of the parts by bandaging, with cooling lotions, until the inflammation is entirely passed. Next counter-irritations and gentle, regular exercise to avoid stiffness and wasting of the muscles (sweeny). A good, cooling lotion is one ounce of acetate of lead, one pint of vinegar, and one pint of rain water. For stiffness, pain and swelling, after the inflammation has passed, one-half ounce of iodine, two ounces each of glycerine and mercurial ointment and six ounces of olive oil will be found excellent. It will also be found good for chronic rheumatism, enlarged glands, goitre, and the slow form of strangles.

STRAIN OF THE BACK. Strain of the back or lumbar region arises from causes very evident to those who pay attention to the anatomical structure of the horse. The symptoms of this strain are: pressure over the lumbar region elicits symptoms of pain; the part feels hot and the horse shows great pain. The proper treatment is rest, application of cold water, light diet, and cream of tartar water as a drink. The day of plasters, in human as well as veterinary practice, has gone by; they are now only used by those who have never taken the trouble to understand the exhalatory function of the skin—which plasters obstruct; the wet sheet next the skin, and a blanket over it, will be more likely to do good than a plaster. Should the horse show more than ordinary symptoms of pain, a fomentation of hops should be resorted to; if, after a day or so, the pain is still manifest, the trouble is something more than mere strain, and the owner had better consult a veterinarian.

SPRAY. The young branches or twigs of trees.

SPRINGS. The usual acceptation of the word spring, is a bubbling fountain of water at the surface of the ground; yet, in digging, if a vein of water is met that rises in the well, it is quite as truly a spring as that other one that seeks the surface through a natural fissure in the soil or rock. So, also, those jets of water, rarely found, that, from the pressure on the reservoir below, spout into the air, are as truly springs as those which bubble gently at the surface, or which simply ooze slowly to the surface and pass slowly away. Among the more noted springs of the globe are those, hot and cold, which, containing mineral matter of real or supposed utility, are sought by invalids for the cure of diseases, or else as places of fashionable resort during the hot season of the year. Spouting springs are termed geysers. As illustrating this class, we give a cut of the great geyser of the National, or Yellowstone Park, in the Rocky mountains, one of the most remarkable on earth. In the endeavor to get a permanent supply of water at or above the surface, large outlays are often made, either in the erection of wind or steam power for pumping, or else, when feasible, in boring to a depth



GREAT GEYSER OF THE YELLOWSTONE.

sufficient to find water, the natural pressure upon which is sufficient to force it to or above the surface. These are termed artesian wells, and are of incalculable value in many regions, which without them would be uninhabitable.

SPRING BEETLE. (See Elater.)

SPRUCE. Fir. *Abies.* The spruces proper are plentifully distributed in the Northern States, and also found in northern Europe and Asia. In ornamental planting they are useful, combining a regular conical form with a more or less drooping habit. The Norway spruce, *Abies excelsa*, and the Hemlock spruce, *A. Canadensis*, are the two most valuable for planting. The first succeeds in a great variety of soil and climate, and is the favorite for general planting and windbreaks. The Hemlock is one of the most beautiful of evergreens. Unfortunately it does not succeed generally in the West when transplanted.

SPUD. An implement used in cutting up weeds, as dandelion, burdock, etc., in sward or turf. A chisel-formed tool, about two inches wide on the cutting edge inserted into a handle of four or six feet in length.

SPUR. The short, fruit-bearing branches of apples and pears. The hind toe of gallinaceous birds. A well known implement used by horsemen. In botany, an elongated appendage of the corolla.

SPURGE. The genus *Euphorbia*, the juice of which is usually acrid. Many species are ornamental.

SPURGE LAUREL. *Daphne laureola.*

SPUR OF RYE. Ergot. (See Rye.)

SPURRED RYE. Ergotted rye. (See Ergot.)

SPURRY. *Spergula arvensis.* An annual plant in considerable repute in Germany and France as a forage plant, being well adapted to soils, especially sandy land, too poor and thin to bear clover. It has been called the clover of poor sands, and it is said will, if sown in March, May, and July, and the three crops plowed in, fit a barren soil for clover. In France, Belgium, Germany and the North of Europe it is used not only as a fertilizer, but as a forage crop, both green and dry. Spurry is a native of America as well as Europe, being indigenous to the Middle States. In the United States it has not met with favor and is treated as a weed.

SQUAMA. A scale; rudimentary scale, like leaves or other parts of a plant. *Squamous* is scaly, or scale-like.

SQUARROUS. Ragged in appearance.

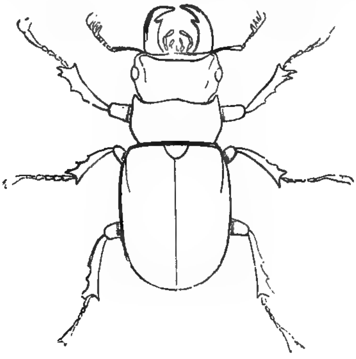
SQUASH. Squashes as generally cultivated in gardens are divided into three classes. The Summer or bush squashes, the Autumn Squashes, and the Winter or late keeping varieties. Of the bush varieties, the Summer Bush, Warted Crookneck, and the Early White Bush Scalloped Squash, are the varieties most cultivated. Of these the latter is the earlier and the former the best. Of the autumn varieties the Autumnal Marrow, sometimes called Boston Marrow, and the Turban are superior. The former being the best variety for steaming, and the latter one of the best of all the squash tribe for baking. The Autumnal Marrow will keep until about January, and the Turban until February. There are late winter varieties which keep until spring with proper care, on shelves in a perfectly ventilated cellar, dry, and not sinking below about 50° Fahr. A room that will not freeze is still better. Of these our preference for quality is, first, Hubbard, and second, Marblehead. This latter variety is variable in quality, like the so-called Sweet Potato Squash. If but one variety is cultivated for autumn and winter use, cultivate the Improved Turban by all means. The squash requires the whole season in which to mature. If started in six inch pots in a gentle hot bed and transplanted when in the rough leaf, the ravages of the striped bug may often be entirely avoided. They will scarcely feel the check of the removal if watered when transplanted. We have transplanted large fields of them, from troughs made by nailing sections of six inch siding upon sections of fencing each three feet long. Thus the back of one trough makes the front of another, and the plants may be carried any distance in them without danger. In transplanting break apart into six inch squares, as they were planted. A warm, rich, dry soil must be given to the whole family of squashes, and in addition they must be liberally manured in the hill, with rich compost manure. The hills for summer squashes are made four feet apart, and those of the autumn and winter varieties twelve feet apart.

SQUILL. *Scilla.* An extensive genus of interesting bulbous plants. A light soil is most suitable for them; and they are readily increased by offsets from the bulbs. The leaves are radical, linear. The flowers in clusters, blue, purplish, or white.

STABLE. The proper site for stables is as necessary as care in construction and ventilation. They need not necessarily be hidden entirely from view from the house, even in suburban places of the more pretentious order. Neither on the farm, need they be necessarily posted in the same yard with the house; or, if so, they should be at such distance as to be somewhat hidden by planting, and a separate entrance to them from the road is especially essential where they are intimately connected with the storage of grain and forage. Every quarter-section farm should have the horse stable a separate building from the barn. The cattle stable may occupy the basement of the barn when a side hill basement is practicable. In the article Farm Buildings, we have treated of the subject of stables in general. In this article it will not be necessary to do more than indicate what is necessary in the economy of space to be considered, leaving the details of construction to the architect, and the good sense of the builder and the owner. The cost of a stable will of course be indicated by the taste and wealth of the master. Nevertheless no stable can be economically complete if it be not comfortably warm, and well ventilated, and this can be measurably well secured in a comparatively cheap structure, if not quite as well as in the most costly one. To illustrate as to the value of warmth and ventilation in the case of cattle, (and with horses the rule will apply with greater force), the following from a German experiment will give a good idea of our meaning. Cows were placed in a stable that could be artifically heated, and fed on hay. The temperature of the stable was changed at intervals of ten days, the changes ranging from 41° Fahr. (nine degrees above freezing point) to 65.75° During the ten days at the lower temperature the hair became rough and without gloss; the skin was drawn close and occasional shiverings were observable, and there was a loss of twenty-two pounds in the total weight of the two cows. At 54.5° to 59° the hair became smooth and the hide attained its former luster, softness, and looseness. The effects of unfavorable temperatures were also visible in diminished appetite and in variations of the milk product. The heat of the animal system is thrown off principally from the body, and not as many suppose from the breath expired from the lungs. The heat thrown off from the body does not necessarily injure the animal unless the ventilation of the stable is so bad that the vapor given off from the lungs can not be passed away. The ventilation therefore, must have reference to the animals kept, horses requiring more air than cattle. It must also become a question whether fuel or increased grain feed may be cheapest, in cold countries. This being settled, the question of the height of the stable walls must be considered. Less than eight feet for horses is not admissible; ten feet is better, since in a low stable the vitiation of the atmosphere is more than counterbalanced by the increase of heat from the animal's body. A cool, still air is better than a warm, close, moist atmosphere. It should be dry enough to readily pass off the insensible perspiration, and warm enough to dry a horse easily when sweated, and under the hands of the person who is rubbing the animal. There should also be abundant light by means of windows. These, if tolerably high, may be a part of the system of the ventilation employed. The floor of the stable of whatever material it be made should not soak up the urine. A floor composed of small broken limestone, say of one inch diameter, filled with cement, and covered with the fine material left in breaking, forms an excellent floor. A hard dry earth floor is altogether better than plank or cobble stone, since on the farm there is an abundance of straw for bedding by which the animals may be kept dry. This understood, the following will give a most excellent arrangement for farm or draft horses. The stable should not be less than eighteen feet wide, the stalls of such length as will allow six feet standing for each horse, and five feet in width. The walls should be eight feet high. The horses stand in a single row, and the harness is hung on pegs in the wall behind them. This width admits of thorough ventilation to the stable without subjecting the horses to drafts. Each standing should be parted off by an upright post reaching from the ground to the ceiling rafter, placed three feet from the wall at the horse's head. The partitions should be closely boarded up three feet above the manger and hay-crib to prevent the horses quarrelling about the food and biting each other. To each of the posts a bale, eight feet long and twenty inches wide, should be hung by a strong chain to divide the standings and suspended by another strong chain at the hinder end from the ceiling rafter. Each chain should have a hook and eye within reach that may be readily unfastened. This arrangement will leave the whole space opposite the head of each horse available for feeding purposes. The manger for grain and chaff (cut feed) may be two and a half feet long. It should be two feet wide at the top, one foot two inches at the bottom. The hay and straw, need a larger receptacle, which should be three feet six inches long, two feet wide at its upper part and half that width below. It should be so constructed that while it is even with the manger above, it should reach to the ground, two feet above which should be fixed to the wall a bottom, sloping to one foot above the ground in front, where some upright opening should be cut to allow the escape of seeds and dirt. At the top of this hay and straw crib, an iron rack with bars six inches apart, should be so hung as to open up and fall back against the wall to let the fodder be put in, and then be put down upon it for the horse to eat through. It should be so much smaller than the opening that it can fall down with the fodder as it is consumed, by which means not a particle is wasted. The manger may be constructed of yellow pine one and a half inches thick for the front, back, and ends; the bottom of iron, or if of wood, two inches thick. The top of the front and ends should be covered with half round iron, two and a half inches wide, screwed on to project over the front, a quarter of an inch outside and three-quarters of an inch inside the manger. This prevents the food being tossed out and the manger being gnawed. A short post must be put up as near the centre of the standing as possible to support the manger, into which a large screw ring must be put to let the chain or rope of the headstall pass freely up and down without constant friction. The manger may be three and a half feet from ground to top; the hay-crib of course the same height. The paving of the standings to three and a half feet from the head, should be flat, then with a fall from both sides to the centre, where an angle iron drain of four inches wide from end to end, with a removable flat iron cover fitted to the inside of it, should be placed straight down the standing, with a fall into another larger cross main drain ten feet six inches from the head, so placed as to carry away the urine from all the smaller drains into a tank outside the stable. This main drain so placed, takes the urine from the mares, and has a loose cover also fitted to it, easily removed for sweeping out when necessary. In the article Barns, the subject of stable economy is quite fully treated, and if the reader will refer thereto, excellent illustrations will be found showing both horse and cow stables, simple and of modern construction,

STAG. In natural history the stag is the male of the red deer or hind. It is also sometimes applied incorrectly, to a colt or filly. As we understand the term, it is only used to denote a male animal castrated after he has attained near or full maturity. Frequently applied to animals of the ox kind, which are castrated at such an age as to preclude their gaining the full size of an ox. In commercial parlance used to designate an outside irregular dealer in stocks, not a member of the exchange.

STAG BEETLES. These are closely allied to the lamellicorn beetles, and they may be easily recognized by the cut we give of *Lucanus dama*. The late Dr. Le Baron says: Notwithstanding their conspicuous size, but little is known of the habits of the perfect insects. The few observations on record go to show that their ordinary food consists of honey dew, or the exudations of the leaves and bark of trees, which last they are said to pierce with their pincer-like mandibles, but the force with which these organs are brought together does not seem to be sufficient for this purpose. They have been known to feed readily, in confinement, upon moistened sugar. The larvæ are found in rotten wood, and some of them have been known to bore into the solid roots of trees. But in the United States they have never been known to be seriously injurious.



STAG BEETLE.

STAGGERS. (See Indigestion.)

STALL FEEDING. The stall feeding of animals intended for human consumption is the natural outgrowth of the massing of populations in cities, and the accumulation of wealth. In England the stall feeding of sheep is regularly practiced. In this country the feeding of sheep, fat, is yearly increasing near all the great centers of population. Cattle and swine will undoubtedly long continue to be the chief source of meat supply, or at least until the population shall approximate in density that of England, a contingency yet in the somewhat far future, since there are yet vast areas of land in the United States to be settled and brought under cultivation. Until within the last ten years, the stall feeding of cattle—that is, their confinement in restricted areas, where the light was restricted, and exercise could not be taken—was almost unknown. Even to-day the great bulk of our fat cattle in the West are fed in open lots more or less protected by timber. The best feeders, however, are careful to give shelter from snow and rain. It is simply a question of cheapness of food as against shelter. There are still large areas in the West where feeding in confined stables will not soon give place to feeding in open lots from the cheapness of grain. Under this system, however, animals can not be made what is called ripe. They attain a certain degree of fat, and are undoubtedly the best beef that can be made, lacking only that degree of succulence combined with tendernesss, attainable when they are fed in stables. In the article Stable we have noticed the importance of ventilation, warmth and cleanliness. In the stall feeding barn less ventilation is necessary; warmth up to 60°, and not below 45° is essential to success. Ease of cleaning the stable and means to keep the animals from being soiled, are of fully as much importance. Standing places so arranged that the urine may flow easily into gutters, is also essential. The stanchions or other means of securing cattle, will easily suggest themselves, as will also the most economical feeding places, according as whole grain, ground feed, roots, steamed food, or a combination of a part or the whole is intended. In removing cattle to the stables for feeding, it should be done before there is any shrinkage from the drying up of the herbage. So long as the grass is good the cattle should have it, if they can be comfortable at night and be protected from cold storms. The best feeders prepare their cattle during the previous summer for stall feeding, by allowing them grain or meal whenever the pasture is not flush, and especially do they give additional feed during the autumn before they are finally removed to the barns. This not only keeps the steers growing, but it tends also to harden the flesh, so they do not shrink so much when first put up. It also gradually enures them to the change from succulent to dry food, not the least of the several points to be considered. The subject is beginning to be of sufficient importance in the West, so that a careful study of the subject will well repay every intelligent farmer. Cost of buildings, price of labor, facilities for watering in the stable, the grinding and hauling of grain, and many other minor considerations must be carefully considered. With corn at twenty-five to thirty cents per bushel, and help scarce and high, the experience of our best experimental farmers would seem to be in favor of feeding in well sheltered lots, therefore, except in the case of animals intended for special markets or for exhibition, as prize animals, stall feeding has not been much practiced in the West. In other sections of the country the case is different. It will be but a comparatively short time, in the older settled regions of the West, when stall feeding will also have become profitable there.

STAMENS. The male apparatus of a flower. They are situated immediately within the petals, and consist each of a filament, the anther, and the pollen; of which the two latter are essential, and the former not. They are a modified form of the petal, and are placed next it on the inside, towards the center of the flower. Independently of their physiological importance, they are much used as good marks of discrimination in systematical botany.

STAMINATE. Having stamens only.

STARCH IN PLANTS. The principal constituent in plants is carbon in some of its many forms. Starch is present in notable quantities in all that class most useful as food for man and farm animals. The source of alcohol in plants is primarily starch. Thus any plant which either in its seeds or fiber contains notable quantities of starch, may be economically used in the production of alcohol, by first changing the starch to the peculiar substance, called fructose or glucose according to the source from which it was obtained. So also the starch producing grains and vegetables, as corn, potatoes, etc., are the source of the starch of commerce. In chemical composition starch and cellulose are identical. So also is dextrine, and may be artificially manufactured from starch. The chemical composition of starch is as follows:

Carbon	44.44
Hydrogen	6.17
Oxygen	49.39
	100.00

Gum is another substance closely allied to starch. So is sugar, and all the substances herein named are mutually convertible in nature and to a considerable extent in the laboratory of the chemist, of the manufacturer. Thus we find in germination that the starch of the seed is converted into dextrine and glucose, and passing into the young plant is changed into cellulose and starch. In the sugar beet, under certain diseased conditions, the sugar is changed to starch, but being originally true sugar, this can not be again converted from starch to sugar, but may be converted into glucose or starch sugar. In the work How Crops Grow the average amounts of albuminoids and carbo-hydrates in various vegetable substances is given. The carbo-hydrates are composed of carbon, oxygen and hydrogen, and are subdivided into woody fiber, starch, sugar, gum, oil, and jellies; they are all near enough alike, so far as the animal economy in feeding is concerned, to be included here. The carbo-hydrates and albuminoids are the most important, the first furnishing heat and fat, and the second important in connection with the formation of muscle, have been compiled as given below:

Substances.	Albuminoids.	Carbohydrates.
Wheat	13.0	67.6
Indian Corn	10.0	68.0
Oats	12.0	60.9
Rice	7.5	76.5
Rye	11.0	69.2
Millet	14.5	62.1
Peas	22.4	52.3
Beans	25.5	45.5
Wheat Straw	2.0	30.2
Rye Straw	1.5	27.0
Barley Straw	2.0	29.8
Oat Straw	2.5	38.2
Pea Vines	6.5	35.2
Bean Vines	10.2	33.5
Corn Stalks	3.0	39.0
Pea Hulls	8.1	36.6
Potato (Irish)	2.0	21.0
Beets (common)	1.1	9.1
Rutabagas	1.6	9.3
Turnips (white)	.8	5.9
Wheat Bran	14.0	50.0
Wheat Flour	11.8	74.1
Wheat Chaff	4.5	33.2
Linseed Cake	28.3	41.3
Hay.		
Lucerne, in blossom	14.4	22.5
Red Clover, in blossom	13.4	29.9
Vetches, in blossom	14.2	35.3
Orchard Grass, in blossom	11.6	40.7
Tall Meadow Oat Grass, in blossom	11.1	35.3
Blue Grass, in blossom	8.9	39.1
Timothy, in blossom	9.7	48.8
Average of all the Grasses, in blossom	9.5	41.7
Green Fodder.		
Grass, before blossom	3.0	12.9
Grass, after blossom	2.5	15.0
Red Clover, before blossom	3.3	7.7
Red Clover, in full blossom	3 7	8.6
White Clover, in full blossom	3.5	8.0
Lucerne, very young	4.5	7.8
Lucerne, in blossom	4.5	7.0
Oats, in early blossom	2.3	8.8
Rye	3.3	14.9
Corn Forage	1.0	9.8
Peas, in blossom	3.2	8.2

The principal grains contain the following amounts of starch:

Barley contains starch	57.5
Corn " "	59.0
Oats " "	46.6
Rye " "	59.7
Wheat " "	59.5

Thus we see why Indian corn is found to be practically one of the best as it is the cheapest of our cereal grains for fattening purposes.

STAR-WORTS. Composite plants of the genus *Aster*.

STATICE. (See Grasses, ornamental.)

STATION AGRICULTURE. (See Agricultural Education.)

STAVES. Staves for spirit puncheons are of white oak, for sugar hogsheads of red oak, but ash and white oak are also used. They are cut of several lengths to make into hogsheads, puncheons, and tierces. The largest size is seventy-two inches long, seven inches wide and three inches thick; for puncheons, tierces, brewer's casks, pipes, etc., staves are thirty-three, forty-two, forty-five, fifty-four inches long, and from three-quarters, one and one-quarter, one and one-half, two and one-half, to three inches thick. The most usual dimensions are seventy-two, forty-two, and thirty-three inches, with three, one and one-half, and one inch thickness; these measures are exclusive of sapwood. They are now exclusively made by machinery, any width and length, and dressed ready for use.

STEAM PLOWING. The cultivation of the earth, both as respects the cultivation before, and subsequent to plowing has for many years occupied the attention of the best agricultural inventive talent both in England and the United States. The solution of the problem has been fairly accomplished in England, so that plowing, as well as some of the processes of subsequent cultivation, has become an economical fixture, where the nature of the land, and peculiar conditions required to be brought about, might be fairly met by the agency of steam. In the United States, although our abundant prairies are admirably adapted to steam cultivation, no machine has yet been brought out that could successfully compete with horse power, partly from the fact that it requires skill not possessed by the ordinary farm hand to run the engine and operate the machinery, but principally because our soil is so easily plowed, not requiring to be worked to the depth at which the steam machines are most economically worked. Nevertheless, it is certain that before many years certain crops may be economically prepared for by means of the steam plow. Therefore something of the history of steam plows, and steam plowing will be pertinent. The history of attempts to introduce the use of steam in cultivating the soil, is really of considerable antiquity. The sixth patent granted in England, and the first in which the power of steam was sought to be used in cultivating the soil, was January seventeenth, 1618, over 250 years ago, and was originally described as follows: Newe, apte, or compendious formes or kinde of engines or instrumente and other pfitable invencions, wayes and meanes for the goode of our commonwealth, as well as to ploughe grounde without horse or oxen, and to enrich and make better and more fertill as well barren peate, salte and sea sande, as inland and upland grounde within our kingdomes of England and Ireland, and our domynyon of Wales, as also to rayse waters from anye lowe place to highe places for well watering of cittyes, townes, noblemen's and gentlemen's houses, and other places nowe much wanting water, with lesse charges than ever hath bene heretofore; and to make boates for the carryage of burthens and passengers runn vpon the water as swifte in calmes, and more saff in stormes, than boate full sayled in greate wynes. The history of steam plowing has been written by Prof. Brainard, Examiner in the United States Patent Office, up to the year 1865. From it we extract the salient points: The hauling plow, so called because the engine that operates the plow is placed upon one side of the field, and moves along a headland; the plows, generally a gang with two sets, turn furrows in the same direction in moving back and forth over the field. Upon the opposite side of the field is placed a movable capstan or windlass, which is moved forward upon a headland, and the plows are drawn back and forth by means of wire ropes or chains, as shown on page 747. At each set of furrows the engine is moved forward upon the headland upon one side of the field, and the capstan upon the other, the width of a set of furrows, when the plows are drawn again across the field. This method of cultivating or working the land by steam power, was first patented in the United States by E. C. Bellinger, of South Carolina, November 19, 1833, but from some cause the invention never went into general use. About the year 1854 John Fowler, of England, improved upon this general plan of Bellinger's, and was so far successful that a number of machines were put in operation. In 1856 and 1857 Fowler took out patents in the United States for his improvements, but up to this date but two of them have been brought into use in this country. As a special encouragement, Congress was induced to pass a bill allowing the introduction of steam plows free of duty. Another method of steam culture has been attempted, in which the engines are designed to travel over the field, drawing the plows behind them, usually in gangs, and many patents have been granted for alleged improvements in this mode of culture. Among the earlier of these adventurers may be named Henry Corning, 1850; David Russell, 1855; Judd Stevens, 1858; J. D. Howell, 1859; B. Crawford, 1857, and many others. Their efforts at improvement have been directed chiefly to the construction of an engine that was capable of traversing the field, and drawing a gang of plows; but hitherto insurmountable difficulties have been experienced. It has not been found impracticable to construct an engine capable of running over a common road, but in a cultivated field, where the soil is soft and yielding, it has been found that nearly the entire power of the engine has been expended in its own propulsion, and hence its inability to overcome the resistance of the plows. The cause of the failure of traction engines to perform their work in plowing can be explained upon the following hypothesis: We will suppose that an engine of ten-horse power, fully equipped for the field, will weigh eight tons. If it has four driving wheels one-foot tread each, there will be forty-eight inches of effective contact with the earth. Now, a single furrow, twelve inches wide and ten inches deep, will present a resisting surface of 120 square inches; consequently the resistance, even with a single plow, would be greater than the applied traction power of the engine. But a team of ten pairs of oxen would be able to turn a furrow of prairie turf of the width and depth named, say at the rate of an acre a day for a single plow. Ten pairs of oxen would be equal to a ten-horse power engine, and their united weight, when fitted for service, would equal that of the engine—say eight tons. The foot of an ox has an effective contact with the earth of about eight inches, and we may safely estimate that one-half the number of feet while under draft will be constantly in contact with the earth; hence we have 40 × 8 = 320 inches; that is, the eight tons' weight of the team is distributed over a surface of 320 inches of contact of balance against 120 inches of resistance in the furrow. An acre of land contains 43,560 square feet. A team turning a single furrow twelve inches wide and ten inches deep will, upon an average, travel one mile in an hour. A furrow one mile long and twelve inches wide contains 5,280 square feet of surface, and hence it follows that the distance traveled by a team in plowing one acre with a width of furrow of twelve inches, will be a little over eight miles, which is about a fair day's work. A steam engine of a stationary power equal to that of ten pair of oxen must, to be equally effective for draft, have a corresponding amount of contact with the earth; that is the weight of the engine must be distributed over 320 superficial inches of surface in order to be equal to a team of the same weight with the same amount of earth contact. But an increase of surface contact would give a corresponding increase of power within certain limits —say to double the amount; that is, if an engine could be so constructed as to have 640 inches of traction surface for eight tons' weight, it would be capable of doing twice the amount of draft labor that it would with half that amount of surface. A team needs care and feed when it is of the least service. The short duration of animal life, and the risk of premature death, add not a little to the cost of animal power. Mr. J. Boydell, of England, in 1846, constructed an engine that laid its own track as it traveled over the ground. This he accomplished by hinging together a number of stout, flat, wooden rails, so that they would form a polygon outside, and in the same plane with the driving wheels. These hinged rails were so attached to the wheels that they revolved with them. each rail in turn being laid down in front and taken up behind its proper driving wheel, thus forming a track, composed of an endless belt of short rails hinged end to end. By means of this ingenious expedient Mr. Boydell was able to get traction, but, unfortunately, at the sacrifice of a great amount of power. In 1854 Mr. Boydell made considerable improvement in his machine, but for some cause it has never been introduced into general use, but, like many others of its kind, has been laid aside. About the year 1858, Mr. Thomas H. Burridge, of St. Louis, Mo., a man of remarkable genius, invented and built a traction steam engine, intended chiefly for field culture It consisted of a large cylinder, about ten feet in diameter and ten feet in length, and made of heavy boiler iron. A shaft was supported in the centre by means of rods or spokes at each end, and at equal distances from each end was secured an interior cog gear. In 1851, Messrs. Calloway and Purkis, of England, with a view to improvement in steam culture, constructed a neat locomotive, with two main traction wheels of eighteen inches' tread, with a truck forward for a steering apparatus. One patent has been taken out in the United States, by E. G. Otis, for improvements in this steam plow, but it has never been put in successful operation. The plan invented by Bellinger, commonly called cable traction, and subsequently improved upon by Fowler, consisting chiefly in his balancing gang plow frame, has undoubtedly been received with more favor, and has gone more extensively into use than any other in England. Among the steam plows invented in this country, that of John W. Fawkes, of Lancaster, Pa., has attracted the greatest attention. Fawkes's locomotive was of the high-pressure kind, and carried two steam cylinders of nine inches diameter each, with fifteen inches stroke, consequently the maximum force was about eleven horse-power. The weight of the locomotive was seven tons, about five of which rested upon the journals of a traction cylinder six feet in diameter and six feet in length. The amount of effective earth contact was, therefore, seventy-two inches. Eight yoke of oxen, weighing in the aggregate eight tons (much below the standard weight), are capable of plowing eight furfows of the width and depth named, at the rate of eighty-eight feet per minute, or one mile per hour, and in doing this they have a traction contact with the earth of 256 inches. Now, without allowing any deduction for the consumption of power by the increase of speed from one to four miles per hour, it would require 1,024 inches of contact, or thirty-two pairs of oxen, to drive eight plows at the rate of four miles an hour. The resistance offered by one plow, in sward ground like that upon which Fawkes's plow was tried, is about 400 pounds. It requires one horse power to raise 33,000 pounds one foot per minute; therefore, to raise 400 pounds (the draft of a single plow) one foot in one minute will require one eighty-second (1-82) of a horse power. Now, 3,200 pounds is eight times 400 pounds (the draft of Fawkes's eight plows), hence it will take eight eighty-seconds (8-82) to move 3,200 pounds one foot per minute. Fawkes's plows were said to move at the rate of four miles per hour, which is 352 times one foot per minute; therefore it will require three hundred and fifty-two (352), times eight eighty-seconds (8-82) of a horse power to drive his eight plows four miles per hour, which is thirty-four and a half horse power, about twenty-three more than the maximum of Fawkes's engine, and this without subtracting anything for propelling his engine of seven tons weight. It therefore follows that Fawkes's engine, in order to come up to the standard of an ox team of equal tons weight, should have had an increase of traction contact of 184 inches over the seventy-two of the driving wheel, thus equaling 256 inches (which is that of the team under draft), about a hundred less than the estimated power of Fawkes's engine required to develop its full working capacity of eleven horses. Hence it follows that Fawkes's locomotive should have had a traction surface of 352 inches, instead of seventy-two, and to this deficiency may be attributed his want of success. Among the various appliances to overcome the difficulties from want of traction may be mentioned the revolving screw, operating not unlike the screw propeller in steamships. But experience has shown that the friction of the blade upon the soil consumed too much of the power of the engine to make its use successful as a means of propulsion. A patent was granted to J. R. Gray, in 1857, for a machine of this character. In 1863, A. W. Hall, of St. Louis, Mo., was granted a patent for a steam plow, so nearly allied to cable traction as to render it worthy of notice. in which the points of novelty were directed to means for overcoming the hitherto almost insurmountable difficulties experienced from want of traction. The locomotive, consisted of a framework, supported upon four wheels, of suitable strength to bear the weight of the boiler and other parts of the machine. As he did not depend upon the weight of his locomotive for traction, it was built as light as was consistent with the required power. There are two sets of rollers placed horizontally in pairs, transversely to the frame of the machine, and rotated in opposite directions at a uniform speed, by means of two sets of cog gears, which are driven by two reciprocating engines, located upon opposite sides of the boiler. The rollers are grooved in the center to receive a rope which passes between them, and is held from slipping by the strong bite of the rollers. The rope is anchored at each side of the field to be plowed, the anchors being moved forward from time to time on head lands as the plowing progresses. In 1868, P. H. Standish, of California, invented a novel steam cultivator or triturator. The peculiar features of this apparatus consisted in the manner of cutting or breaking the ground; it is not done by shares turning furrows, nor by spades lifting and dumping the earth; but by four knives, or spits, set at right angles vertically in a head-block of cross-bars, revolving horizontally in a perpendicular shaft, tearing and stirring the earth in a transverse direction to the movement of the machine, something in the manner of a rotating harrow. Two or three, or more, of these implements are worked, and follow the engine according to its power, and as may be desired. In 1869 there were patents issued for five steam plows. The same year the plow of Mr. Minniss of Pennsylvania was tried in Iowa, which revolved upon an endless chain track. It plowed five furrows at a time, but failed, as all others had before and since, in doing the work economically in comparison with horses. As we remarked in the beginning of this article, steam plowing probably will not supersede the use of horses, except the time come, requiring extraordinary deep plowing. Then if inventions can overcome some of the chief difficulties of traction, steam plowing practically considered may become a fixed fact on our prairie soils. Within the last ten years other patents have been issued either on steam plows or improvements in steam plowing. Yet the feeling that success was to be met with was dying out. It is needless to say that none of them showed development that would supersede horse power, and they were short lived. That the large amounts of money spent in this direction have been entirely sunk, except to the parties directly interested, it would be wrong to say. Perhaps some future inventor profiting by the failure of his successors, may hit upon an idea that may make steam plowing a practical success, on the broad prairies, and, in the hands of the half section farmer. In conclusion we would call attention to the articles, Plows, Plowing, Cultivating, etc., and also to the illustration of the operation of steam plowing, on page 747, as practiced in Great Britian.

STEARIN. The solid part of fats. Stearate of glycerine.

STEARIC ACID. The acid obtained by saponizing stearin, and decomposing the soap by a dilute acid. It is a brilliant white, soft body, insoluble in water.

STEATITE. Soapstone.

STEATOMA. A fatty tumor.

STEER. (See Ox.)

STELLATE. Star-shaped, resembling a star.

STEM. In botany, the upward prolongation of the axis of a plant. It is distinguished from all other parts by bearing buds.

STENELYTRANS. A family of coleopterous insects, many of which have the elytra narrow at the posterior part.

STEREOMETER. An instrument for taking specific gravities.

STERNUM. The breast bone, to which the ribs are attached.

STETHOSCOPE. An instrument used to assist the ear in determining the character of the sounds of respirations and other functions occurring within the body, to form an opinion of the disease.

STHENIC DISEASES. Those of increased action or inflammation.

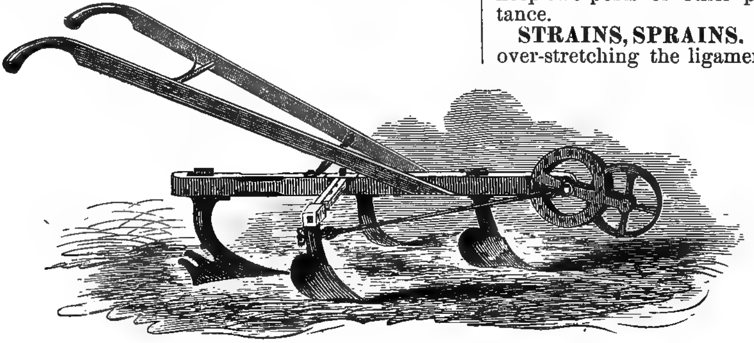
STIGMA. The upper extremity of the style, or female organs of plants: it has almost uniformly a humid surface. It is the part upon which the pollen falls, and where it is stimulated into the production of the pollen tubes, which are indispensable to the act of impregnation.

STILE. In building, an upright piece in framing. A set of steps, to allow the passage of men, but not of animals.

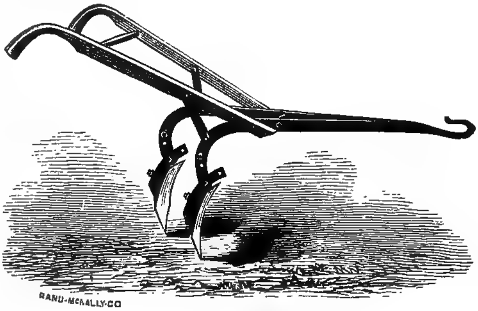
STIMULANTS. Substances which produce increased circulation or heat, as alcohol.

STIPULE. A small leaf or scale situated at the base of the leaf-stalk (*petiole*) of some plants.

STIRRING OF THE SOIL. In the articles Cultivation, Plows, Plowing, and Harrowing, this subject has been fully treated, in so far as relates to the preparation of the soil, and also partially so in relation to implements for keeping it clean. The present article, therefore, will only treat upon stirring the soil, for the eradication of weeds springing up in a crop, and also as a means of keeping the land in the best condition for the nourishment of the roots. The three implements in general use are the harrow, the single and double shovel plow, the five tooth cultivator, and what is now known as the two-horse or straddle row cultivator. Harrowing is used for preparing a tilth, and for covering the seed, and also for stirring the surface of the land before rowed crops are up, or soon after, as in the case of corn, potatoes, etc. The five toothed cultivator and horse hoe are used by passing up and back, between rows so narrow that the straddle cultivator can not work, but generally in garden crops where the two-horse implements are not used. The double shovel plow is used when a deeper tilth is required, and when considerable earth is to be cast to the crop, and the single shovel plow, with wings, when still more hilling is necessary. For corn and field crops generally, the principal implement now used is the two-horse cultivator, which may be used either riding or walking. The cut on the next page shows one of these modern implements adapted either for walking or riding.



HORSE HOE.



DOUBLE SHOVEL PLOW.

STOCK. Live stock, or animals of the farm.

STOLON, STOLE. A running stem which throws off young plants at certain points, as the strawberry. Stoloniferous is a derivative.

STOMACH. The cavity or pouch in which food is digested. In most animals there is one stomach only, but in ruminants there are four. In the stomach, properly so-called, a fluid termed the gastric juice is secreted, which serves to digest the food.

STONE CLOVER. (See Rabbitfoot.)

STOVER. Coarse fodder.

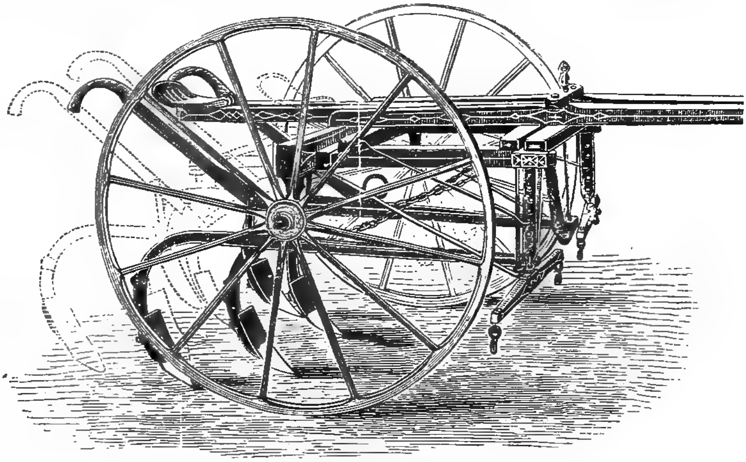
STRAINING PIECE. A timber intended to keep two posts or other pieces at a certain distance.

STRAINS, SPRAINS. Injuries produced by over-stretching the ligaments or muscles; they are often very severe, and require cupping and leeching. Occasionally fomentations are sufficient, with rest, and bandaging the part tightly. (See article Sprains.)

STRAMONIUM.—*Datura stramonium.* This plant is known under a number of popular names, as the Jamestown weed, Stink weed, and thorn apple, and in the South, and even south of 40°, is as troublesome as it is a noxious weed. There are two varieties, one with green and the other with purple stems, tender annuals, but the seeds surviving and growing freely in favorable situations as far north as, even well up into, Wisconsin in the West and to the New England

States in the East. Both the leaves and seeds are violent poisons, and hence should be destroyed wherever found. As a medical remedy it is valuable, and the chipped root has been smoked as a palliative in asthma. It has been planted to some extent, for poisoning the moths of the tobacco worm, poisoned honey being dropped into the open blossoms, which are attractive to the moth. This, however, is not safe where there are children, and would also be fatal to bees. There are other ways of killing the moth, as by lighted fires in the evening, and if the poisoned flowers of Stramonium are used, they should all be cut and burned at sunrise. There are a number of ornamental varieties, which are started in the greenhouse or hot bed for summer decoration, but they are hardly to be commended unless sparingly used.

STRANGLES. This is a disease prevalent in young horses, under the common name of distemper. It used to be thought that horses must at some age have the distemper. The same thing used to be held in regard to measles in the human family. Both are, however, fallacious. The disease is highly contagious, and hence when an animal in a stable is affected, all are liable to attacks. The liability depending on the more or less virulence of the attack. M. Reynal, professor at the Alfort School, submits a number of observations corroborative of the contagious character of Strangles. He states that young horses having strangles, put into stables with horses of adult age, doing regular work, have communicated the disease to those of the latter who have stood in adjoining stalls, though some few have only exhibited the disease in a catarrhal form. Even the foal has been known to suck the disease from its dam. Experiments have been had recourse to, to inoculate for strangles. M. Damalix smeared with a sponge, impregnated with matter taken from the abscess of strangles, twice daily, both sides of the pituitary membrane and the internal surfaces of the linings of the eyelids, in a sound horse, about to be cast for spavin. This was continued for seven days. On the eighth, he remarked, the horse had lost his appetite, had commenced running from both nostrils, coughed softly and loosely, had swelling under the jaw, which ended in resolution; all the symptoms terminating eight days from their commencement. It has been remarked that strangles is more surely communicated at an early than a late stage, and in a certain form more readily than in others. Strangles will assume the herpetic character, will simulate farcy and glanders, will settle in the mesenteric glands, or may follow castration. In regard to contagion may be mentioned, as most readily communicable, that form of strangles, which assumes the character of eruptions on the lips, nose, and pituitary membrane. Strangles usually commences like a common cold. There is a cough, sore throat, the animal is dull, loses appetite, and swallows with difficulty. Then there is quickened pulse, rapid breathing, and running at the nose. A hot, tender swelling will appear within the lower jaw bone, sometimes on one side and sometimes on both, in which latter case the whole cavity is filled. If the attack is virulent, the swelling is sudden and great, filling up the mouth, and the animal shows those signs of strangulation from which the disease takes its name. There is great distress, the breathing (difficult) is accompanied with a loud blowing noise, and unless the animal soon gets relief, it dies of suffocation. If the attack is light, but little will be required, except to keep the animal warm, and to apply warm fomentations and poultices to the swollen glands, allowing an ounce of saltpetre to the pail of water, night and morning. Give soft, easily eaten, and digestible food. When the tumor comes to a head and bursts, keep it poulticed to induce suppuration. If it seems indolent, put on a fly blister to bring it to a head, when it may be opened with the knife. Again, if the swelling is languid and does not come to a head, it may be painted with iodine, or it may be rubbed with iodine. In the treatment of strangles, the condition must be kept up with good food and stimulants, if necessary. Avoid medicines which deplete the system. If suffocation is imminent, the windpipe may be opened and a silver, or even a tin tube may be inserted as a last resource, to enable the animal to breathe. (See Tracheotomy.)



RIDING AND WALKING CULTIVATOR.

STRANGURY, or SUPPRESSION OF URINE, INCONTINENCE OF URINE, BLOODY URINE. Strangury may arise from an injury done to the kidneys, or to the bladder, by strains, or by the absorption of irritating matters. Allow the horse absolute rest; give mashes, gruel, and other soft food; give tepid water to drink. Bloody urine should be treated in the same way. Some horses have such a natural or acquired weakness of kidneys, as to stale blood with their urine on every occasion of over-exertion. The means frequently used for relief are such as aggravate the complaint, and, indeed, are often the occasion of it, which are diuretics. Strong diuretics injure horses more than strong physic, and benefit them less than any other of the popular means made use of. In retentions of urine, but particularly in the case of bloody urine, they are absolutely improper.

STRATH. A small valley.

STRATUM. A bed of rock, or other deposit.

STRAW. The value of straw in the economy of the farm, will depend upon a variety of circumstances, as nearness to a market, where it may be sold for bedding, packing, the stuffing of articles of use, filling mattresses and the various uses to be found for it in and near large cities. The burning of straw as practiced in all new settlements should never be allowed, at least, not after stock can be procured. Then it may be liberally thrown about the yards to be trampled down and thus converted into manure. As a rule, one ton of straw will make three tons of manure. It is true, the want of manure is not seriously felt in countries where the soil is virgin, yet, the time will come when it will be felt, and the farmer who saves and applies his manure, finds himself still with a soil rich in all the elements of plant growth, when his more indolent neighbor is lamenting that his farm is run out. As a feeding material, wheat straw dried at 212 degrees, contains in 100 parts 2.05 muscle forming substances, and 35.06 of heat producing substances. The first representing nitrogenous matter; the second, carbon in a state for assimilation; the balance, is woody fiber 56.87, and mineral substances 6.02. Yet straw alone will never support the life of an animal during the winter season, yet, if properly saved, and fed in connection with grain and hay, it is a most valuable adjunct thereto. In seasons of a scarcity of hay or where hay is wanted for sale, and corn is cheap, horses, cattle and mules, may be brought through the winter in admirable condition on straw fed in connection with corn. As illustrating this we quote a statement of a farmer in New York, in feeding wheat straw to cows in connection with wheat bran and corn meal. Commencing the middle of December, his cows being then in fine condition, and drying off, he fed six quarts of wheat bran daily, with all the straw the animals would eat, giving two meals per day and continuing this treatment six weeks. Afterwards he changed the bran feed to corn meal and bran, one measure of the former to two of the latter giving four quarts of the mixture daily. This grain feed was gradually increased toward calving, and a small allowance of hay was given in the morning after the straw and before the grain feed. Under this treatment the animals maintained a good appetite and were kept in thriving condition. The experiment is quoted as an illustration of the advantages which would result from a judicious use of good bright wheat straw in times of high prices of hay. Though the experiment was confined to cows not in milk, he considers it as pointing to the more limited availability of straw in winter feeding of cows in milk and beef cattle. With these classes of stock more grain should be given. And with any description of stock there should be proper discrim-

Number.	NAMES.	DESCRIPTION.							I.—			
		Size.	Sex.	Color.	Form.	Flesh.	Season.	Origin.	Nova Scotia.	New Brunswick.	Maine.	New Hampshire.
1	Agriculturist	l.	P.	d. c.	r. c.	f.	M.	Am.				
2	America	l.		d. c.	r. c.	f.	E.	Am.				
3	Burr's New Pine	m.	P.	b. r.	r. c.	s.	E.	Am.				
4	Boston Pine	l.	H.	d. c.	r. c.	f.	M.	Am.	*			
5	Black Defiance	l.	H.	d. r.	r. o. c.	f.	M	Am.				*
6	Charles Downing	l.	H.	d. s.	c.	f.	M.	Am.	*			
7	Col. Cheney	l.	P.	b. s.	r. ov	f.	M.	Am.	*		*	
8	Downer's Prolific	m.	H.	b. s.	r. c.	s.	E.	Am.				
9	Early Washington	m.					V. E.	Am.				
10	Fillmore	m	P.	d. s.	o. c.	f.	M.	Am.				
11	Forest Rose	l.	H.	b. s.	c.	f.	M.	Am.				
12	French's Seedling	m.	H.	b. s.	r. c.	s.	M.	Am.				
13	Green Prolific	l.	P.	l. c.	r. o. c.	s.	M. L.	Am				
14	Hovey's Seedling	l.	P.	b. s.	r.	f.	M.	Am.	*		*	
15	Jenny Lind	m.	H.	d. c.	c.	f.	E.	Am.				
16	Jucunda	l	H.	b. s.	o. c.	f.	L.	Am.	**			
17	Kentucky	l.	H.	b s.	r. c.	f.	L.	Am.				
18	Large Early Scarlet	s.	H.	l. s	r. c.	s.	E.	Am.				
19	Lennig's White	l.	H.	w. t	r. o. c.	s.	M.	Am.				
20	Longworth's Prolific	l.	H.	l. c.	r.	f.	L. M	Am.				
21	Mary Stewart											
22	Monarch of the West	v l.		b. r.	r. o. c.	f.	M.	Am.				
23	Nicanor	m.	H.	b. s.	r. o. c.	f.	E. L.	Am.			*	
24	President Wilder	l.	H.	b. s.	r. o. c.	f.	M.	Am.			*	
25	Russell's Prolific	l.	P.	r.	g.	s.	M.	Am.	*			*
26	Seth Boyden	l.	H.	r.	o. c.	f.	M.	Am.	*			
27	Sterling	l.	P.	b. s.	c.	f.	M.	Am.				
28	Triomphe de Gand	l.	H.	l. c.	o. c.	f.	M.	F.	*		*	
29	Victoria	l.	H.	l. c.	r. c.	f.	M.	F.				
30	Wilson's Albany	l.	H.	d. c.	r. c.	f.	E. L.	Am.	**		*	*

ination in management—feeding the straw chiefly in early winter, and from time to time making some variations in the food given. We have wintered work horses and mules almost entirely on straw and grain without any apparent diminution of their working powers, nevertheless, except in times of scarcity, should not advise more than half a ration of straw a day. To return to straw as manure, very few farmers are liberal in the use of straw for bedding. It is poor economy, with straw as plenty as it is, to allow any of the farm animals less than will completely soak up all the urine. Even when bedding is scarce, it takes no more straw to furnish a liberal bed than half enough, since none of the straw need be thrown away except that which becomes soiled, and even in this case it may be dried and used again.

STRAWBERRY. It seems strange that a fruit so well adapted to a variety of soils, so easily cultivated, if in long rows where horse implements may be used, which children would gladly gather if the head of the family would only plant and cultivate, should scarcely ever be found in abundance upon the tables of our farmers. Yet such is the fact, while our cities are now fully supplied with the finest fruit, and at a cost to the consumer often as low as eight cents a quart for good, and five cents for ordinary, and this at a profit, including setting, picking, boxing, transportation, and commissions. The reason probably is that when planted, in a majority of cases, like the rest of the garden, strawberries are allowed to take care of themselves. One other reason is that many varieties are planted, it not being generally known that the strawberry is peculiar as to varieties adapted to the soil, the Wilson, perhaps, only excepted. The cost of picking well cultivated strawberries will not exceed from one to one and one-half cents per quart where girls are hired. Industrious girls, when the berries are properly grown, have averaged eighty quarts a day, and in some instances 130 quarts per day. With such berries the cost of picking need not be more than three-quarters to one cent per quart. Hence it is that good cultivators make money, while poor cultivators condemn the cultivation of strawberries as a trifling business. The yield of strawberries under good cultivation, and in good soil is enormous. There are plenty of instances on record of crops of 150 up to 200 bushels, and even to over 260 bushels per acre. Mr. O. B. Galusha, secretary of the Illinois Horticultural Society, has given special and successful attention to the cultivation of this crop for market. In his elaborate report to the Society in 1879-80, he says: The plants set in spring should be about eighteen or twenty inches apart in the rows, which should be three feet apart. Thorough cultivation should be commenced early and be continued well through autumn, running a narrow shovel-plow deep in the center of the space, and pulverizing and leveling with cultivator, leaving the row of plants from one foot to eighteen inches wide. At first hoeings the plants should be layered along the row within this limit, and all others treated as weeds. In late autumn, and after the ground has frozen so as to bear a team, the mulch may be put on, which may consist of

Number.	NORTHERN DIVISION. Between 42° and 49°.															II.—CENTRAL DIVISION. Between 35° and 42°.																				III.—SOUTH. DIVISION. Between 28° and 35°.										
	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	Ontario.	Michigan.	Wisconsin.	Minnesota.	Dakota.	Montana	Wyoming.	Idaho.	Washington.	Oregon.	Pennsylvania.	New Jersey.	Delaware.	Maryland & D. C.	Virginia.	North Carolina.	Ohio.	Indiana.	West Virginia.	Kentucky.	Tennessee.	Illinois.	Iowa.	Missouri.	Nebraska.	Kansas.	Colorado.	Utah.	Nevada.	California.	South Carolina.	Georgia.	Alabama.	Florida.	Indian Territory.	Arkansas.	Mississippi.	Louisiana.	Texas.	New Mexico.	Arizona.
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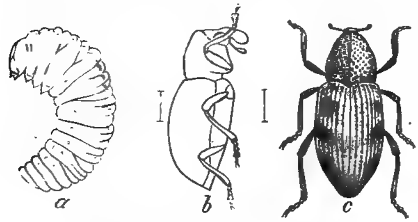
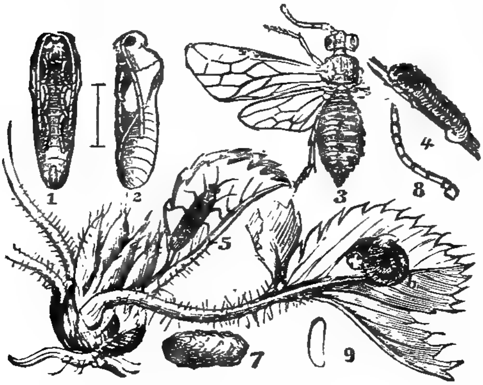
horse-stable litter—using only that made where prairie hay is fed. Where this is not obtainable, planing chips, cut corn stalks, slough grass, whole corn stalks, or oat straw can be used. He uses corn fodder cut short with a horse-power cutter. Shaken from large baskets over the plants, it settles into the spaces between the leaves and gives sufficient protection without smothering the plants, and does not require removal in spring, but remains as a summer mulch to keep the vines fresh and the fruit clean, and as it gradually decays gives stimulus to growth and fruitage. In addition, sow along the rows a mixture of ashes, plaster, and hen-manure, adding a little salt—using six to eight bushels of this mixture per acre. This is applied early in spring, and sometimes a slight sprinkling, thoroughly pulverized and mixed, is again applied just at blossoming time. After the crop is harvested—as soon as condition of soil will admit—plow the spaces with a one-horse moldboard plow, turning two furrows together, and harrow the entire ground level. The runners will then occupy the spaces, and early in autumn they may be again plowed, or, if it is desired to renew the plantation, the old strips may be plowed under and leave the young plants only for next year's fruiting. Where uncut mulch is used it is opened from over the rows in spring and left in the spaces until after the crop is gathered. Treated in this way a half dozen or more successive crops may be taken from the ground. The strawberry-worm should be carefully hand-picked, and killed by crushing, from the vines several times during the season of cultivation. This practice, which costs but little, will if carefully and persistently carried out, keep these pests well in check. The strawberry-leaf folder is almost everywhere present among the vines, and sometimes so numerous as to almost entirely defoliate them. His attacks, unlike those of the strawberry-worm, are not made until after the crop is gathered; and hence he can be more surely destroyed. It has been recommended by some writers, and practiced to a small extent in the West, to cover the vines during a dry time and just before the earliest leaf-folders change from the larval to the pupal state by spreading straw over the plants, and burn straw, plants and insects together. This seems harsh treatment. It would not seem safe to practice this destructive cultivation during a drought, but only when the condition of the soil is such as to insure a quick succeeding growth. He finds with nearly all varieties the best fruit is obtained from rows not more than eighteen inches wide; and where the best berries will command extra prices. He would confine them to one foot in width, so as to give more light and a better circulation of air for the fruit and foliage. With such rank, dense growers as Crescent, Windsor Chief, Miner, Crystal City, Centennial Favorite, Sharpless, Duncan, Glendale, Cumberland Triumph and Star of the West, full exposure in narrow rows is essential to secure large fine fruit; while Wilson, Kentucky, Downing, Pioneer, Duchess, Col. Cheney, Durand's Beauty, Cinderella, Continental, Seth Boyden, Forest Rose may be grown with profit if planted three and a half to four feet apart and allowed to occupy strips two to two and a half feet. There is no species of fruit grown in our country of which there is such a diversity of opinions in respect to the real or comparative value of varieties as the strawberry; and it is safe to say that nine-tenths of this difference is due to the fact that this fruit is more capricious or rather more particular and discriminating as to soils and modes of culture than any other. This holds good in respect to nearly all vareties in cultivation. Varieties of first berries ripened in central Illinois as follows; but the first general picking of each was five or six days later: May 26, Charles Downing; May 27, Crescent, Black Defiance; May 28, Cumberland Triumph; May 21, Prouty, Duchess; June 1, Capt. Jack, Champion, Duncan, Cinderella, Col. Cheney, Monarch of the West; June 4, Centennial Favorite, Wilson; June 5, Continental, Forest Rose, Springdale, Windsor Chief; June 7, Great American, Miner's Great Prolific; June 8, Kentucky. Cowing's Seedling, Sterling, Pioneer, Star of the West, and Seth Boyden ripened their first fruit about medium season. The following varieties, in the order named, will generally be found valuable in the West. For strong clayey, Loess and rich prairie soils, for near market and home use: Crescent, Miner, Charles Downing, Duchess, Windsor Chief, Cumberland Triumph, Sharpless, Champion, Captain Jack, Duncan, Continental, Seth Boyden, Great American, Prouty. For sandy-loam soils, near market and home use: Crescent, Charles Downing, Windsor Chief, Duchess, Black Defiance (home use), Centennial Favorite, Miner, Kentucky, Sharpless, Cinderella, Champion, Crystal City, Capt. Jack, Col. Cheney, Seth Boyden, Cowing's Seedling. For distant market: Sharpless, Capt. Jack, Chas. Downing, Wilson, Continental, Prouty. For high cultivation in hills or single rows for home use and for fancy berries: Sharpless, Great American, Crescent, Seth Boyden, Miner, Monarch of the West, Essex Beauty, Centennial Favorite. There are other varieties which produce large, fine fruit, and have high local reputation; among which are Pioneer, Star of the West, Springdale, Sterling, Forest Rose, etc. The tables, pages 914 and 915, show varieties in general cultivation in the several States of the Union as reported at a late meeting of the American Pomological Society: The columns explain: Size—l., large; s., small; m., medium. Sex—H., hermaphrodite; P., pistillate. Color—d. c., deep crimson; d. s., deep scarlet; b. s., bright scarlet; w. t., whitish tinted with red; l. c., light crimson. Form—r. c., roundish conical; o. c., obtuse conical or coxcomb form; c. conical; r., roundish; r. o. c., roundish obtuse conical. Flesh—s., soft; f., firm. Season—E., early; M., medium; L., late; E. L., early to late. Origin—Am., American; F., foreign. *, signifies doing well; **, great superiority and value; †, new and recently introduced for trial. The strawberry of late years, especially where cultivated extensively for market, has been subject to very numerous insect enemies, among the most destructive of these is the Strawberry Crown Borer, *Analcis fragaria*, see cut, *a*, larva; *b*, beetle, side view; *c*, beetle, back view, the hair lines showing the natural size of the insect. As the name indicates, it bores into and kills the plant by destroying the crown. The best remedy is to dig out infested plants and burn them. Another injurious insect, and much more widely distributed than the crown borer is, what is familiarly called the Strawberry worm, *Emphy-*

tes maculatus. The cut shows, at 1, ventral or lower side of pupa; 2, side view, hair lines showing natural size; 3, perfect fly enlarged; 4, larva, natural size; 5, perfect fly, natural size; 6, larva on leaf, at rest; 7, cocoon; 8, antenna enlarged, showing joints; 9 egg, enlarged. The flies gather over the vines in the spring, the female deposits the eggs in the stems of the plant, and when hatched, the young feed on the leaves, making innumerable small holes, the maggots often changing their skin four times; and when fully grown, measuring three-quarters of an inch in length.



STRAWBERRY CROWN BORER.



STRAWBERRY WORM.

STRAWBERRY WINE. (See Gallizing.)

STRENGTH. In mechanics, is used in the same sense as force or power. Thus, strength of animals is the muscular force or energy which animals are capable of exerting; strength of materials is the resistance which bodies oppose to a force acting upon them. It is obviously a matter of much importance to be able to estimate with tolerable accuracy the efforts which an animal of the average strength employed in labor is capable of exerting, and accordingly, very numerous observations have been made on the subject; but this species of force is subject to variation from so great a number of circumstances, both physical and mechanical, that the results given by different authors present very little agreement with each other, though they are of great value as affording data for determining the modes in which animal labor is most advantageously employed. Of all animals employed as first movers, the horse is, beyond question, the most useful, and that whose labor is susceptible of the most numerous and varied applications. For the purpose of determining his muscular power, the dynamometer may be conveniently used; but, as the action of the animal is very quickly reduced by continued exertion, it is more usual to estimate it according to the amount of daily labor performed. Desaguliers and Smeaton estimate the strength of a horse as equivalent to that of five men; the French authors have commonly stated it as equal to seven men; and Schulze makes it equal to fourteen men in drawing horizontally. According to Desaguliers, a horse's power is equal to forty-four pounds, raised one foot high in one minute. Smeaton makes this number 22.916; Hachett 28; and Watt 33. The last estimate is commonly understood by the term horse-power as applied to steam engines. The quantity of action which a horse can exert diminishes as the duration of the labor is prolonged. Tredgold gives the following table, showing the average maximum velocity with which a horse unloaded can travel according to the number of hours per day:

Time of March in Hours.	Greatest Velocity per Hour in Miles.	Time of March in Hours.	Greatest Velocity per Hour in Miles.
1	14 7	6	6.0
2	10 4	7	5.5
3	8 5	8	5.2
4	7 3	9	4.9
5	6 6	10	4.6

STRENGTH OF MATERIALS. There are four different ways in which the strength of a solid body may be exerted: first, in resisting a longitudinal tension, or force tending to tear it asunder; secondly, in resisting a force tending to break the body by a transverse strain; thirdly, in resisting compression, or a force tending to crush the body; and, fourthly, in resisting a force tending to wrench it asunder by torsion. Mr. Hodgkinson gives the following results of his experiments on the resistance of a crushing force of short pillars of some of the most common descriptions of wood, the force being applied in the direction of the fibers.

Description of Wood.	Strength per square inch in pounds.
Alder	6,831 to 6,960
Ash	8,683 " 9,363
Bay	7,518 " 7,518
Beech	7,733 " 9,363
English birch	3,297 " 6,402
Cedar	5,674 " 5,863
Red deal	5,748 " 6,686
White deal	6,781 " 7,293
Elder	7,451 " 9,973
Elm	10,331
Fir (spruce)	6,499 " 6,819
Mahogany	8,198 " 8,198
Oak (Quebec)	4,231 " 5,982
Oak (English)	6,484 " 10,058
Pine (pitch)	6,790 " 6,790
Pine (Red)	5,395 " 7,518
Poplar	3,107 " 5,124
Plum (dry)	8,241 " 10,493
Teak	12,101
Walnut	6,063 " 7,227
Willow	2,898 " 6,128

STRINGHALT. This is a name given to a sudden jerking up of one of the hind legs, or of both, in the act of walking or trotting. In mild cases the paroxysm passes off after the animal has got fairly under way. Sometimes it shows itself only when the animal is turned to one or the other side, or when unduly excited. It is a nervous disease and the cause of its origin is obscure. It increases with age and if pronounced is an unsoundness. There is no known cure; but its paroxysms may be in a measure alleviated by any means used to prevent undue excitement.

STRIPED MAPLE. (See Maple.)

STRONGYLUS. A genus of parasitical intestinal worms.

STRONTIA. An alkaline earth, very similar to lime.

STRUMA. A swelling.

STRYCHNIA. An extremely poisonous vegetable alkaloid, obtained from the nux vomica and other strychnous plants. It produces violent convulsions and death.

STUBBLE. The roots and stems of grain plants left in the soil after harvest.

STUD. A post or upright in a building; an establishment for horses.

STYLE. The stem which supports the stigma; it is the upper portion of the carpels.

STYLOBATE. An uninterrupted base common to many columns.

STYPTICS. Substances which when applied to small wounds, restrain the flow of blood, as alum. The word scarcely differs from astringents.

SUBCLAVIAN. Any part under the clavicle or collar bone.

SUB-EARTH VENTILATION. (See Ventilation.)

SUBERIN. The substance of cork. By digesting it with nitric acid, it is converted into suberic acid.

SUBLIMATION. A process by which solids are by the aid of heat converted into vapor, which is again condensed, and often in the crystalline form. This operation is frequently resorted to for the purpose of purifying various chemical products, and separating them from substances which are less volatile.

SUBLINGUAL. The parts lying under the tongue.

SUBSOIL. The earth immediately below that which is tilled. The value of land depends almost as much on the subsoil as the tilth; if it be wet and full of stagnant water, it must be underdrained; if it be hard and rocky, the surface soil dries readily to a dust; if it be deep and too light, water and fluid manures may drain away.

SUBSOILING. Loosening the subsoil by a plow without any mold-board to turn it. A heavy plow is first run along the field some six or eight inches deep, and a subsoil plow follows in the bottom of the furrow, deepening it to fourteen or sixteen inches in all. This differs from trench plowing, in which the subsoil is cast up and mixed with the surface, by which the soil is either benefited or injured, according to the nature of the subsoil. The principal effect of subsoil plowing is, that the earth is deepened to a considerable depth, and root culture is much improved; in loose, gravelly or sandy soils subsoil plowing is often very injurious. By the tillage of years, the treading of cattle, and the pressure of the sole of the plow and rolling, the surface soil becomes compact, and holds water and manure sufficiently for the crops; but by subsoiling these advantages are thrown away, and a thirsty, loose soil again established.

SUBSOIL PLOW. An implement used to follow in the furrow after a turning plow, to loosen the subsoil without inverting it, thus leaving it directly in the bottom of the furrow. Trench plowing is sometimes erroneously called subsoiling. (See articles Plowing and Trench Plowing.)

SUBSTANTIVE COLORS. Coloring matters which stain the texture or yarn permanently, without the necessity for a mordant; the latter being called adjective colors.

SUBSTITUTION. In chemistry, the doctrine advanced by Dumas, that, in many organic and complex compounds, one element can take the place of another without changing the relations of the others.

SUBSTRATUM. The stratum of a different geological kind immediately below the surface.

SUBULATE. Awl-shaped, round, and tapering to the end.

SUBULICORNS. A family of neuroptera, with awl-shaped antennæ.

SUBULIPALPS. A section of caraboid beetles, some of which have the exterior palpi awl-shaped.

SUCCORY. (See Chiccory.)

SUCCULENT. Fleshy, full of water.

SUCKERS. The shoots from the roots of trees or plants near the stem.

SUDORIFICS. Medicines which produce increased perspiration.

SUET. Fat which contains a large proportion of stearin, from the loins or kidney of the sheep and the ox.

SUFFOLK CATTLE. Of this once famous breed of cattle, Youatt says: The Suffolk Dun used to be celebrated in almost every part of the kingdom, on account of the extraordinary quantity of milk that she yielded. The dun color is now, however, rarely seen in Suffolk, and rejected as an almost certain indication of inferiority. The breed is polled. The Suffolk, like the Norfolk beast, undoubtedly sprang from the Galloway; but it is shorter in the leg, broader and rounder than the Norfolk, with a greater propensity to fatten, and reaching to greater weights. The prevailing and best colors are red, red and white, brindled, and a yellowish cream color. The bull is valued if he is of a pure unmingled red color. Exaggerated accounts have been given of the milking of the Suffolk cow, and she is not inferior to any other breed in the quantity of milk that she yields. In the height of the season some of these cows will give as much as eight gallons of milk in the day; and six gallons is not an unusual quantity. The produce of butter, however, is not in proportion to the quantity of milk. The bulls are rarely suffered to live after they are three years old, however excellent they may be, for the farmers believe that if they are kept longer they do not get a stock equally good, and particularly that their calves are not so large after that period. Nothing can be more erroneous or mischievous. A bull is never in finer condition than from four to seven years old. Having obtained, by accident or by exertion, a good breed of milkers, the Suffolk people have preserved them almost by mere chance, and without any of the care and attention which their value demanded. The Suffolk cow, poor and angular as she may look, fattens with a rapidity greater than could be expected from her gaunt appearance. Whence she obtained the faculty of yielding so much milk, is a question that no one has yet solved. Her progenitor, the Galloway, has it not. The Holderness could scarcely be concerned; for more than a hundred years ago, the Suffolk dun was as celebrated as a milker as the breed of this county is at present, and the Holderness had not then been introduced into the county of Suffolk. The fattening property derived from the northern breed is yet but little impaired. The cow is easily fattened to 500 to 600 pounds, and the quality of her meat is excellent.

SUFFRUTEX. An under shrub, a small bush, a portion of whose annual stems die away. *Suffruticose* is like an under shrub.

SUGAR. By the term sugar is usually meant cane sugar. Before the war this industry reached (in 1861) a total in Louisiana of 528,321,500 pounds. In 1862 and 1863 it dwindled to nothing In 1864, 7,668,200 pounds were manufactured, which in 1870 reached 166,613,150 pounds, then again running down until in 1876 the production was 190,672,570 pounds; in 1877, 167,101,941 pounds; in 1878, 250,094,160 pounds, the total consumption being about 1,731,573,553 pounds. Since this time these figures have not varied materially, so it will be seen that the consumption of sugar is seven times greater than the home production. Even supposing that the yearly sugar production will again reach the figures before the war, we shall with our increasing population have to import three, four or five times as much as we produce, unless the difference can be made up by the production of sugar from sorghum, maize or beets, or all combined, since the production of maple sugar can not possibly be extended, and this from the increasing scarcity of maple trees. If the better cultivation of cane and improved processes for manufacture could be backed up by capital, then indeed there is no doubt but the sugar producing district of the South, narrow as is the strip along the Gulf, might easily be made to produce sugar enough to supply the wants of the nation. The northern limit of cane sugar production in the United States, may be given as belonging to Florida and the gulf region of Georgia, Alabama, Mississippi, Louisiana and Texas. It is true that cane sugar has been made in Arkansas, and even in Missouri, yet the manufacture can never be profitably carried on outside the Gulf States. Even Louisiana gives only 1,200 to 1,800 pounds of sugar per acre, while in the West Indies, 3,000 and even 5,000 pounds per acre is produced, and in the Mauritius, and in the East Indies the product sometimes runs up to 7,000 per acre. Australia is earnestly pushing her young sugar industry and if we may credit reports from there, her lands are but little if any less productive than the more favored regions of the West Indies. The sugar production of the world has not kept pace with the increasing wants of the population; yet there are twenty-four principal sugar countries in the world, six of these are European ones in which are produced beet sugar to over one-half the amount of the entire cane sugar production of the whole world. The real difficulty in the way of the production of cane sugar in the United States does not really lie so much in the want of land available for sugar, so much as in the fact, that laborers will not work in a climate so unhealthy as a cane sugar climate must necessarily be, so long as they can find more congenial labor. Where slave labor is employed, the case is different. If they die others can be bought, and, revolting as is this system of labor, it is the only one yet found except that of peonage, serfdom, caste, and that other one of enforced labor from superabundant population, where sugar making has really given steadily large profits to the planters. The following table will show the countries of the world producing cane sugar and also those producing beet sugar. It will be seen that the great cane sugar producing countries are those where the labor is either owned or enforced by means entirely beyond the control of the laborers. The tables give the yield for the year 1875, which for all practical purposes may be taken as an average one of the productions of the world. The first table shows crop of cane sugar in round numbers and the second that of beet root sugar. We may therefore assume that the South will not again be a great producer of cane sugar without a change in the present labor system. It is true, she has land enough, so has every other country where sugar is produced, and in the most of which the annual yield per acre is double that of the South. Yet even there, with the yearly increasing price of sugar, there is not the expansion one might expect. The risk to health is too great except in those cases where the labor is enforced. The steadily growing feeling in all enlightened communities against this system of labor, would alone prevent great expansion in sugar production if other disabilities did not exist. There seems but one way in which the South can extend the area of cane cultivation and largely increase her production of cane sugar. This is by allotting land to tenants,

Country.	Tons.
Cuba	700,000
Porto Rico	80,000
British, Dutch, and Danish West Indies	250,000
Java	200,000
Brazil	170,000
Manila	130,000
China	120,000
Mauritius	100,000
Martinique and Guadeloupe	100,000
Louisiana	75,000
Peru	50,000
Egypt	40,000
Central America and Mexico	40,000
Reunion	30,000
British India and Penang	30,000
Honolulu	10,000
Natal	10,000
Australia	51,000
Total tons	2,186,000

Country.	Tons.
German Empire	346,646
France	462,259
Russia and Poland	245,000
Austria and Hungary	153,922
Belgium	79,796
Holland and other countries	30,000
Total tons	1,317,623

and with the aid of owners of small tracts of land, raise the cane to be carried to central factories to be worked up, at an agreed price, or on shares, as has of late been done to a considerable extent with sorghum cane in the North, and which system has proved valuable in the French West Indies. Where capital can be secured in legitimate investment it is not slow to seek remunerative channels, and plenty of it might be forthcoming to put the sugar lands of the South on a paying basis if first there could be an assurance that the cane sufficient would be grown from year to year; and second, that capital might be secure from destructive influences. How well this system works in the French West India islands, the following synopsis of a communication to the Department of State, of the United States, will show. It is as follows: A system of central factories has been adopted in the French West India islands of Martinique and Guadeloupe, for the manufacture of sugar. The system is a substitute for the long practiced method of making the sugar by individuals upon the plantations where the cane is produced. The design is to separate agriculture from manufacture, and by a concentration of capital, somewhat upon the co-operative system, to accomplish what the isolated planter was unable to do. The experiment, made upon a large scale during a series of years, it is maintained, has fully demonstrated the soundness of the principle. The central factories, or *usines*, as they are called, are owned by joint-stock companies, by which the sugar cane is taken from the plantation and transported to the mill upon railroads, or tramways, constructed by those companies, a certain per cent. of the value of the cane being allowed the planter, the price being regulated by the market at Point-à-Pitre at the time the cane is delivered. The system seems to have proved a success, affording to the manufacturing interest a handsome profit, and, by leaving the planter free to devote himself to his peculiar vocation, largely increasing the cultivation of the cane. The government of the island of Jamaica recently appointed a commission to visit the French islands and inquire into the working of this central sugar factory system. The Department of Agriculture has received, through the Department of State, the report of these commissioners. Their examinations were made during the last summer, and the results, as stated by them, are not without interest and value to the sugar-producers of the United States. The largest central factory in the French islands is that which is commonly called the Usine d'Arboussier, at Point-à-Pitre (Saint Louis), the chief commercial station of the island. The factory is in the suburbs of this seaport, and is constructed upon the grandest scale, having all the improvements in machinery and manufacture of sugar devised by modern science. The cost of it was upward of a million of dollars, and its capacity of manufacture is equal to 10,000 tons of sugar during the first six months of the year, which is the manufacturing season. The process of manufacture, as described by the commissioners, is as follows: The canes are brought by the planter to a siding of the main tramway on his estate. The wagon generally carries two tons of canes, and one mule on a good level ordinary tramway can draw easily two wagons. The wagon, when brought to the mill itself, conveys the canes to the rollers. The bagasse being elevated by power to a platform over the boilers, the juice, on leaving the mill-bed, falls through three strainers into a tank, which has a double bottom, heated by steam. It is treated here with a little bisulphite of lime, and is then run into a montejus. This montejus, by steam, sends the juice up to the clarifiers, where it is heated in the ordinary way and tempered with lime properly. From this it is passed to the charcoal filters, through which it gravitates, and then passes by a gutter into a receiver. From this it is passed to a montejus and is thrown up by steam into a cistern over what is known as the triple-effet. From this cistern it gravitates into the triple-effet, passing from the first to the second, and from the second to the third boiler, as the attendant wishes. When it leaves the boiler it is immediately passed over new reburned charcoal. It gravitates through this and falls into another receiver, from which the vacuum-pan takes it up and boils it to sugar. The first-quality sugar is generally crystallized in the pan, and then is dropped into sugar-boxes, which stand seven feet from the ground; under these boxes a little charging-vessel runs on a railway that is hung from the bottom of the said boxes, and this vessel conveys the sugar over the centrifugals, where it is cured, the molasses from this being boiled up, when found in good condition, with the syrup of the following day. When this molasses is thick and clammy it is boiled into a jelly by itself and dropped into sugar boxes, where it is allowed to granulate for a number of days. This makes the second-quality sugar, and the molasses from this, along with the skimmings and subsidings of clarifiers, goes to make rum. The juice that leaves the clarifiers does not pass over fresh charcoal, but follows the syrup from the triple-effet, thus assisting to wash out the sweets which may have been left by the syrup. The weight of canes delivered at the factory last year was 75,000 tons, although it was a season of drought. The factory can receive 100,000 tons a year. Last year 5,325 tons of sugars were obtained from 68,725 tons of cane, or about seven and three-quarters per cent. In April last the factory company declared a first dividend of twenty-four per cent. In other words, a net profit of $181,585 was made upon the manufacture of 68,745 tons of sugar and 182,798 gallons of rum. The processes of manufacture in all the factories, both in Guadeloupe and Martinique, are identical, the only difference being the adoption in the new factories of the appliances of modern science, and improved mechanical and other arrangements. The clarification of the juice, its reduction to a syrup at a low temperature, the perfect crystallization and color of the sugar, and a maximum return, are obtained by repeated filtration through animal charcoal, the triple-effet and vacuum-pan processes, and, last of all, centrifugal machines. In Martinique the mean weight of canes was found to be equal to twenty-eight tons per acre, producing, say two and a quarter tons of sugar, and the sugar sells at $200 a ton. The central factories, or usines, are represented as in the highest popular favor. Capital, both local and in France, is freely subscribed to establish new usines upon a large and extensive scale. Eight of the factories, at considerable cost, have been erected within the last few years, and others are now in process of erection. They seem everywhere, by increasing the facilities of manufacture, to have stimulated the planters to increased production of the cane. In speaking of the difference between the tillage of those who sell their canes to the usines and those who manufacture at home, it is remarked that in the one case the canes are no sooner out of the fields than the gangs and stock are at work preparing the land for the next crop, and all the fields are tidy and clean. In the other case, fields are left to take care of themselves until the crop season is over. Estates which, before the establishment of the usines, were in debt, are now said to be in a flourishing condition, and others which had almost fallen out of cultivation are now making excellent crops. In most of the factories hydraulic or other presses are employed for extracting the remnants of juice from the skimmings.

SULCATE. Marked with furrows, or parallel deep lines.

SULPHATES. Salts of sulphuric acid. The principal in agriculture are the sulphate of lime, (see Gypsum) the sulphate of soda, (Glauber's salt); and the sulphate of potash, serviceable as a steep, or as a manure in gardens for the cruciferous plants. The chief value of the sulphates as manures arises from the necessity for sulphur in plants, especially the cruciferous and leguminous families.

SULPHITES. Salts of sulphurous acid.

SULPHOCYANATE OF POTASSIUM. A solution of this body is used to protect iron, with which it forms a brownish-red color.

SULPHOSINAPISIN. A pungent body obtained from mustard, containing both sulphur and nitrogen.

SULPHUR. Brimstone. A solid, fusible, insoluble, yellow elementary body, it is a non-conductor of electricity, and powerfully electro-positive in its compounds. It is very inflammable, uniting with oxygen, and forming the white, suffocating vapors of sulphurous acid. With three equivalents of oxygen it forms sulphuric acid, or oil of vitriol, a dense, oily acid, of great causticity, and well known in the arts. Sulphur unites directly with metals at a heat below redness, forming sulphurets. The gaseous compound of one equivalent of sulphur with one of hydrogen, or sulphuretted hydrogen, is remarkable for its great fœtor; it is given off by decaying organic matters containing sulphur, and, with the sulphuret of ammonium, constitutes the principal cause of the stench of putrefying animal matters. Sulphur is abundant in the mineral kingdom about volcanoes. It is present in all vegetables, existing in albumen, caseine, and analogous bodies. It has been used to destroy insects. When burned, the pungent, sulphurous acid destroys life, but is also injurious to vegetation. It has the property of bleaching many colors, and especially that of straw. A solution, formed by boiling equal parts of quicklime and sulphur in twenty or thirty times their weight of water, is extremely fœtid and poisonous to insects, it is called the hydrosulphuret of lime and cheaper bought than made at home.

SULPHURETS. Compounds of sulphur with metals.

SULPHURETTED. Containing sulphur chemically united. A solution of sulphuretted hydrogen gas in water is much used as a test for metals in solution.

SULPHURIC ACID, OIL OF VITRIOL. It should be colorless, but is often brown; is caustic, destroying the skin instantly. When water is added, the mixture becomes quite hot. It combines with all oxides, forming sulphates. It is used to dissolve bones, but is inferior to muriatic acid. One hundred pounds of the best acid dissolve, after much time and with repeated stirrings, about 200 pounds of fine bone dust, converting it in part into sulphate of lime (gypsum), and into superphosphate of lime, which is soluble.

SULPHURIC ÆTHER. Common ether.

SULPHUROUS ACID. It is composed of sulphur 16.1, oxygen 16. It is a gas readily condensed, soluble in water, and very sour, with the odor of sulphur. In contact with oxygen and moisture it readily becomes changed into sulphuric acid.

SUMACH. *Rhus.* This family of plants has of late years attracted attention from the amount of superior tannin contained in the dried leaves and young stalks of the current year's growth. In Sicily, which has long furnished the greatest amount of sumach, used for tanning morocco and other fine leather, the leaves are said to be discarded, and only the twigs and bark are used, after grinding fine in a mill adapted to the purpose. Why the leaves should be refused it is difficult to understand, since analysis shows them to be valuable in tanning material. The family Rhus contains some poisonous species. These, however, are but two, the Poison, Elder, or Dogwood Sumach (*R. venenata*) and the Poison Oak or Ivy (*R. toxicodendron*). The other northern species, and those valuable for their tannin, are Staghorn

CUT LEAVED SUMACH.

Sumach (*Rhus typhina*), Smooth Sumach (*R. glabra*) and Dwarf Sumach (*R. copallina*). There is another variety, a low, straggling bush, known by its aromatic leaves, the Fragrant Sumach (*R. aromatica*). The two first named of the sumachs furnishing tannin are those most common and most easily gathered for market. Sumach not only contains tannin, but coloring matter, the latter used in calico printing as a substitute for nut galls. The average amount of tannin in European sumach from six analyses, as stated by Gauhe, is thirteen per cent. Though fine samples of Palerma will yield twenty-two to twenty-four per cent. of tannin, several samples of sumach, gathered in from different localities in Virginia, gave according to the analysis of the chemist of the Department of Agriculture respectively, in 100 parts, 20.80, 18.25, 23 50, and 28.20, or an average of 22.68 per cent. A sample of Missouri Sumach gave tannin 28.20, so that it will be seen that the idea prevalent that European Sumach is richer than ours is not only erroneous but that our varieties are even richer in tannin. Wagner has given the average for European Sumach respectively at 16.50 per cent. for first quality, and 13.00 per cent. for second quality. Where sumach is plenty, it is prepared for market by cutting the twigs of the current year's growth, together with the leaves, drying them, without being wetted by rain, running them through a cutting machine and pressing them in sacks for market. The price paid varies from twenty to fifty dollars per ton. The valuable southern species, not heretofore mentioned, are *Rhus pumila*, a dwarf species of the pine barrens from North Carolina to Georgia, *R. metopum*, found in Florida, growing fifteen to twenty feet high, *R. cotinoides*, found in Alabama, and supposed to be allied to the Venetian or exotic species, *R. cotinus*. *R. glabra* is the variety used as a mordant for red colors, the bark of which contains the essential elements. This and *R. typhina* are the varieties most used for tanning. The cut, page 921, shows an ornamental variety of *Rhus glabra*, or cut leaved sumach, sometimes grown for ornament. Until within the last fifteen years, almost the entire amount of sumach used for tanning in the United States was imported. Since that time the value of American sumach has been better understood. The difficulty has been that it has been gathered wild in the woods, no attempts at cultivation having been made. Until within five years, almost the entire amount of sumach used in this country was imported from Europe, and still the larger proportion in use is of foreign growth and manufacture. It has been supposed that the American species were deficient in tannic acid, this opinion being the result of the want of care and skill in gathering the leaves, and their preparation at the manufactories. More care having been used in gathering and preparing sumach, it was long since demonstrated, and acknowledged by consumers in our own country, and dealers in Europe, that American sumach, from the best mills, excels in quality and equals in preparation any in the world. An importing house, having branches in New York, Philadelphia, and Savannah, impressed with the importance of further developing the native Sumach interest in this country, and being convinced of the value of our native species, by actual investigation, determined to moot the question of home production and in a circular to the trade, as long ago as 1869, said:

> We would call the attention of the trade to a very fine Virginia sumach now being received, equal in every respect to the finest Sicily. We recommend its use from the following comparison in the analysis:
>
> FINEST SICILIAN.
>
> Lead Seal, Pojero, and Ne plus ultra.
>
> | | |
> |---|---|
> | Tannin | 23.65 |
> | Sand | 1.00 |
> | Vegetable fiber | 75.35 |
> | | 100.00 |
>
> FINEST AMERICAN.
>
> Virginia.
>
> | | |
> |---|---|
> | Tannin | 30.00 |
> | Sand | .50 |
> | Vegetable fiber | 69.50 |
> | | 100.00 |

This would seem to set at rest the idea that the American article is inferior. In fact, all the analyses we have found show it to be superior to the best imported. The gathering and shipment east of western sumach, and thence out of the country, in connection with that gathered east, is not inconsiderable; Iowa and Missouri being the principal States from which shipments have been made. The first shipment was made from Missouri, in 1872, consisting of 12,000 pounds, going to New York, and thence to St. Johns, New Brunswick. It would seem to be an interest that ought to bear the test of experiment in cultivation. One curious feature in connection with sumach is that manufacturers, usually so alert, have not taken hold of the matter with the view of cheapening the principal agent in tanning morocco, now one of the important industries of the North, and especially of the West.

SUMMER FALLOW. A fallow made during the warm months to kill weeds. A green fallow.

SUNFLOWER. *Helianthus annua.* This well known plant of many gardens, generally grown for its immense head of flowers would seem to have capabilities not generally estimated by the mass of cultivators. The seeds are excellent for fowls, and valuable for their oil, the dried leaves are reported to be useful in pulmonary diseases when smoked from a common pipe. The leaves and stalks contain a large per cent. of potash, and the uses of these plants when grown in masses should be better known than they are for their value in warding off the effects of miasma, being only second in this respect to the Australian gum tree; unfortunately these trees are not hardy north of Louisiana, except in some parts of California. In some sections of Europe where the sunflower is extensively cultivated for its oil product, especially in Russia, the yield is fifty bushels per acre, average. The oil is palatable—as it is well known the seeds are clear and flavorless, and is extensively used in adulterating olive oil. The seeds of native species, are used by many barbarous and semi-barbarous tribes, and also by the American savages, as food, either eaten raw or boiled.

SUPERPHOSPHATE. (See Phosphate.)

SUPPOSITORY. A solid medicine introduced into the rectum to produce purgation.

SUPPURATION. The common healthy termination of inflammations of the cellular tissues, in which pus is formed. It should be thoroughly evacuated as soon as formed.

SUPRACRETACEOUS. The formations above the chalk, now called tertiary.

SURVEYING. In agriculture, the determination of the contents of any piece of ground or estate; it is usually done in a rough way by a compass with sights, or a plane table and chain of 100 links, or twenty-two yards. The external boundaries of the field are measured by the chain along straight lines determined by setting up the compass, level, and a staff. The distance between these is ascertained in chains and links; every turn or angle of large size is determined by its bearing with the compass and staff, and a measurement of the length of the straight line, made as often as there are sides or angles. In this way a plan is obtained, giving the angles, bearings, and lengths of the sides bounding the field. This is plotted and a calculation made of the contents by the ordinary rules of mensuration. For this purpose the contents are divided into triangles, the side of any of which can be measured on the ground, to assist or correct the reckoning. The chain contains 100 links of 7.92 inches. A square chain forms the tenth of an acre; the calculation is therefore made in links, which are a decimal portion of the acre; and the resulting area being reduced by three figures, gives the number of acres in a field. But in better examinations the theodolite is used, and the distances determined by trigonometrical observations, and not by measurements with a chain.

SUTURES. Wounds or incisions after having been cleansed and prepared have their edges brought together and fastened, by means of stitches through the lips of the wound. These are called sutures, and are of two kinds, the interrupted and the twisted suture. In the case of the interrupted suture the needle is passed through the two edges of the wound, the ends tied and cut close to the wound. In the twisted suture, pins are run through the lips of the wound, and thread or horse hair, dipped in the blood, or fine wire is then woven back and forth to hold all firmly. As a rule they may be removed in four or five days or as soon as the parts are united. To promote this they should be bandaged to prevent tearing. All wounds should be closed with sutures, since the operation is so simple that any intelligent person may easily understand the operation. Our preference is for the interrupted suture for extensive lacerations, pins generally being used only for more shallow and short wounds.

SWAMP. A low place or morass in which trees grow.

SWAMP MAPLE. (See Maple.)

SWAN. As an ornamental bird, in the ponds and lakes of parks and large private grounds, the Swan has been universally admired. Their snow white color, and easy grace in the water, making them great favorites wherever introduced. Like the goose, they are long lived, sometimes, it is said, attaining the age of a hundred years. They breed readily in confinement, laying seven or eight white eggs, which being incubated, produce young birds, ash colored at first and for some months, until they have attained their first molt. When incubating they are sometimes dangerous to approach, since they fight desperately, and a blow from their wings has been known to fracture the leg of a man. There are now introduced a number of ornamental varietes, among others, the black-necked swan from Chili. The head and neck jet black, and the body, wings and tail pure white, the bill having a red knob or protuberance. The black swan is from Australia.

SWARD GRASSES. A name given to the genus *Poa,* which forms the best natural meadows.

SWATH. Grass cut in mowing.

SWEATING HAY. The slight fermentation which occurs when fresh grass, clover, etc., are placed in heaps. It is attended with considerable heat if the quantity is great, and should, therefore, be looked after. Fruits and grain also undergo a sweating process, if heaped soon after collection. It is the best method to prepare the different kinds of hay.

SWEENY. (See Sprains and Strains.)

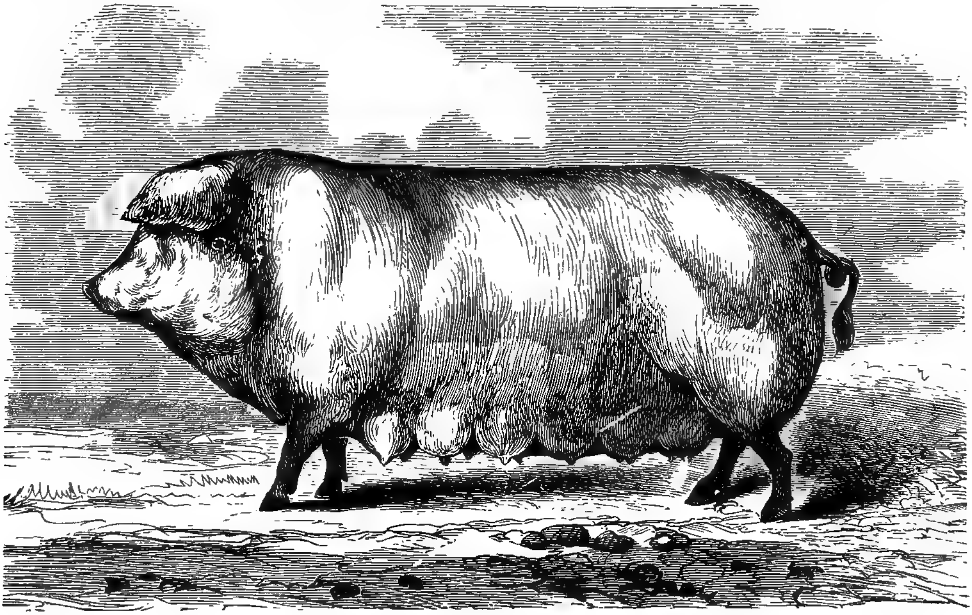
SWEET BRIAR. *Rosa rubiginosa.* A plant hardy everywhere in the United States, and well known for its fragrant foliage. In many places it is so well naturalized as to have run wild, and to become troublesome from its half climbing habit and its sharp spines.

SWEET FLAG. *Acorus calamus.* The root is pleasantly aromatic.

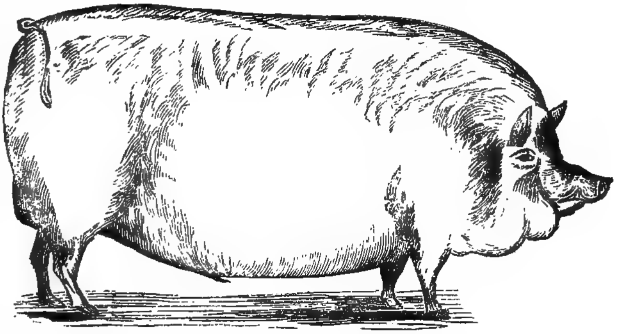
SWEET-SCENTED SHRUB. *Calycanthus Floridus.* A pleasant, fragrant shrub with dark flowers.

SWIFT. (See Swallow.)

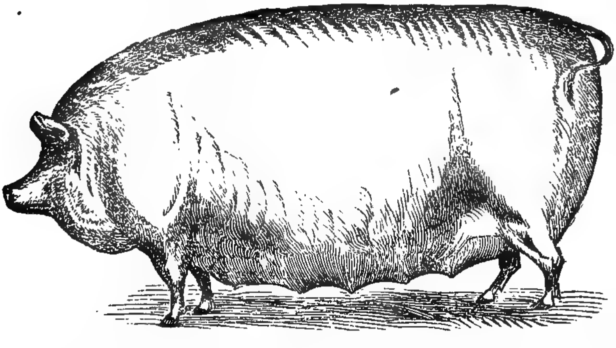
SWINE. *Sus scrofa.* The origin of the domestication of swine, like that of the horse, cattle and sheep, is lost in obscurity. In a wild state, however, it has been known from the remotest times in Europe, Asia and Africa. The great fecundity of the species, its well known character of being fully able to protect itself against animals of prey; its strong gregarious habits and determined courage, and the added fact that it can live in any country where it may find nuts, plants, or roots during the winter, would easily account for its being found universally almost in the countries named. In America, Australia and the islands of the southern Pacific, however, swine were unknown until introduced after the discovery of these countries by white men. Once introduced, however, they quickly increased and spread, so that that there are few timbered regions of America where swine have not run wild, attaining all the characteristic ferocity of other wild races. That the swine of Europe, Asia and Africa have a common origin is evidenced from the fact that all the species breed together, the progeny propagating the species, with unimpaired vitality. In fact the greatest improvements introduced into our native breeds, is the result of crossing with the domestic hog of China, of Italy, and probably, those of Turkey. Thus the three great continents of the East have contributed to the improvement of our modern domesticated swine. In England the wild species has long been extinct, and it is only in some parts of Germany, Denmark and the mountainous and sparsely settled districts of southern Europe, in Asia Minor, and Africa, where they are now met. The teeth of the hog number forty-four, and may be represented by incisors, six upper and six lower; canines or tusks, two upper and two lower; molars, including what were formerly called wolf teeth, fourteen upper and fourteen lower. Fustenburg, a well known German authority, has given the means of determining the age of swine by their teeth, as follows: Born with eight teeth, four corner incisors and four tusks, on the eighth or tenth day the second or third temporary molars appear. The four nippers, two on the upper and two on the under jaw, appear at four weeks old. At the fifth or sixth week the first temporary molars appear in the upper and lower jaw. At the age of three months, the intermediary incisors appear. At the sixth the so-called wolf teeth are seen, and also the third permanent molars. At the ninth month the permanent corner incisors, the permanent tusks, and the second permanent molars will be seen. At twelve months the permanent nippers will have appeared, and by the thirteenth month, the three temporary molars will have been shed, and the permanent ones will be seen; at fifteen months these will be fully up. At the age of eighteen months the permanent intermediary incisors and the permanent rear molar will show, and at the twenty-first month these will be fully developed, thus completely finishing the permanent dentition. The three great swine producing States are Illinois, Ohio and Iowa. In 1878, Illinois produced 3,355,500, Ohio, 2,341,411, and Iowa, 2,224,800 head, or nearly one-quarter of the production of the United States, which was 32,362,500 head of swine. Of this vast number there were packed at Chicago over 5,000,000, or one-sixth of the whole number contained in the United States. In 1879-80, from November 1, to to March 1, 6,946,151 hogs were packed at the principal receiving centers of the United States. Each section of the United States and Canada has its favorite breeds of swine, though representatives of all the reputable breeds may be found in every State. Thus, in the East, the Suffolks, Berkshires, and Chester county breed seem to meet with the most favor. In the great pork producing region of the West, the great bulk of the swine raised are Berkshires, and Poland China, and their grades among large breeds and among the small breeds the Suffolk and Essex. In relation to the various reputable breeds created here or introduced, the second session of the National Swine Breeders, through an appropriate committee fixed upon the following as characteristic of the breeds. The history of the breed of swine known as the Poland-China breed is as follows: In the early history of swine breeding in the Miami Valley, in Ohio, it is clear from the best written authorities available, and from oral testimony, that there were two breeds which, to a great extent, had been profitably crossed with the common bristled breed of the country. These were the Russian and Byfield breeds. The Bedford breed is also named in connection with the other two; to what extent it was used can not now be readily determined. In 1816, we have positive proof from an unquestioned source that the Shakers of Union Village, situate in Warren county, O., and being four miles from Monroe, in Butler county, purchased at Philadelphia one boar and three sows, of what was, at the time, believed to be pure China. They were represented to be either imported, or the immediate descendants of imported stock. They were called Big China hogs. These animals were the first China hogs ever brought into southwestern Ohio. Subsequently other China hogs were introduced and extensively used. The Shakers and other judicious breeders in Warren and Butler counties continued to use the breeds at command, and produced, by repeated crosses, a hog of exceedingly fine qualities for that period, which was generally known as the Warren county hog. These hogs, continually increasing in good qualities, were bred in both counties, and the very best specimens were carefully and interchangeably used, so as to make the best crosses. Such was the progress that had been made in forming the ground work of a good specimen of a hog. This condition of the breed continued until about


CHESTER COUNTY SOW — BREEDER.

the year 1835 or 1836, when Mr. Munson Beach, of Warren county, first introduced the Berkshires, which were obtained from C. M. Bement, of the State of New York. Other lots of Berkshires continued to flow into the Miami Valley, until about 1841. The Berkshire blood was liberally infused into the stock existing not only in southwestern Ohio, but in Kentucky also. Crossing with the Berkshires was almost exclusively done until about 1838 or 1839, when Mr. William Neff, of Cincinnati, imported some choice specimens of the Irish Grazier. This breed soon grew into high favor, and, as a consequence, was liberally used in making crosses with the best specimens of the crosses previously made. This intermingling of blood—this crossing of breeds—continued for some time. In a few years, however, the use of the pure blooded Berkshire was entirely discontinued, and there were no further importations made of the Irish Grazier. The breeders of swine in the Miami Valley settled down to the conviction that the basis of a good breed of hogs had been established, and that in the future judicious and discriminating breeders could use and, if necessary, modify the material furnished, so as to meet the highest demands of the public. For more than thirty years no new blood has been introduced into this breed, and no effort made to obtain a new supply of the blood of either breeed previously used. While this is true, the breeders have not been indifferent to the further improvement of the breed. Stimulated by their success, they have perseveringly aimed to improve what they had been so successful in forming. The best points or qualities have been preserved, and when practicable, have been made even more excellent. All defective points or undesirable qualities have been corrected or improved by the care, skill, and judgment of experienced breeders. The best specimens have good length, short legs, broad, straight backs, deep sides, flanking well down on the leg, very broad, full, square hams and shoulders, drooping ears, short heads, wide between the eyes, of spotted or dark color; are hardy, vigorous, and prolific, and when fat are models, combining the excellences of both large and small breeds. The Chester Whites, as a breed, originated in Chester county, Pa. The first impulse to the improvement of swine in this county was given by the introduction of a pair of fine pigs, brought from Bedfordshire, England, by Capt. James Jeffries, and placed upon his farm near the county seat, in 1818. Some of the enterprizing farmers of the neighborhood were encouraged to commence the improvement of their swine; and by crossing these pigs upon the native white hog of the county, their progeny with the best specimens attainable, and by a course of careful and judicious crossing and selection for many years, the present valuable breed of well formed, good sized, easily fattened hogs, known as Chester Whites, was produced and made an established breed. Some twenty-five years ago an attempt was made to introduce into that county the Suffolk and also the Berkshire breeds of swine, and a few of the Chester Whites were crossed with them; but after a few years' trial both were rejected, not being considered any improvement upon the Chesters. The following may be given as characteristics of these hogs. Head, short and broad between the eyes; ears, thin, projecting forward, and lopping at the point; neck, short and thick; jowl, large; body, lengthy and deep; back, broad; hams, full and deep; legs, short and well set under the body for bearing the weight; coat, thin, white, and straight; (if a little wavy it is no objection). Small tail and no bristles. The family of pigs known as Victorias originated in Saratoga county, N. Y. They were made by crossing the Byfield hogs with the native, in which there was a strain of the Graziers, Subsequent crosses were made with the Yorkshire and Suffolk, the result being a purely white hog of medium size. These pigs, if pure bred, should all have a direct descent from a sow called Queen Victoria, which may be said to be the mother of the family. She was pronounced by good judges to be almost perfect, and was the winner of a number of first prizes. Breeders in the Eastern States have long felt the need of a medium sized white hog, with all the good points of the English breeds without their objectionable features, a breed which would mature early, and be covered with a good coat of hair to protect it from the cold in winter and the heat in summer. The color is pure white, with a good coat of fine, soft hair. The head thin, fine, and closely set on the shoulders. The face slightly dishing. The snout short. The ears erect, small, and very light or thin. The shoulders bulging and deep; legs short and fine. The back broad, straight, and level, and the body long. The hams round and swelling, and high at the base of the tail, with plaits or folds between the thighs. The tail fine and free from wrinkles or rolls. The skin is thin, soft, and elastic. The flesh fine-grained and firm, with small bone and thick side pork. The pigs easily keep in condition and can be made ready for slaughter at any age. Cheshire hogs, it is said, originated in Jefferson county, N. Y., and it it is claimed by some of the breeders that they started from a pair of hogs bought of Mr. Wolford, of Albany, N.Y., which were called Cheshires. However that may be, there is no such distinctive breed of hogs known as Cheshires in England, and there is no record of any hogs of this name having been imported into this country. Yorkshires have been imported into Jefferson county from time to time, and the so-called Cheshires have been improved by crossing with them and hogs bought in Canada. This family of hogs are pure white, with a very thin skin, of pink color, with little hair. They are not uniform in this respect, as pigs in the same litter differ widely in the amount of hair. The snout is often long, but very slender and fine. The jowls are plump, and the ear erect, fine, and thin. The shoulders are wide and the hams full. The flesh of these hogs is fine-grained, and they are commended on account of the extra amount of mess-pork in proportion to the amount of offal. The tails of the pigs frequently drop off when young. The positive origin of the Jersey-Red and Duroc swine is unknown. They have been bred in portions of the State of New Jersey for upwards of fifty years, and with many farmers are considered to be a valuable variety. They are of large size and capable of making a heavy growth, 500 and 600 pounds' weight being common. They are extensively bred in the middle and southern portions of New Jersey. In neighborhoods they were bred quite uniform, being of a dark red color; while in other sections they are more sandy and often patched with white. They are probably descended from the old importations of Berkshires, as there is no record of the Tamworth, the red hogs of England, ever having been brought into this country; nor is this likely, as the Tamworth were not considered a valuable breed, and were confined to a limited breeding. The Reds resemble the old Berkshires in many respects, but are now much coarser than the improved swine of this breed. A good specimen of a Jersey-Red should be red in color, with a snout of moderate length, large lop-ears, small head in proportion to the size and length of the body. They should be long in the body, standing high and rangy on their legs; bones coarse, hairy tail and brush, and hair coarse, inclining to bristles on the back. They are valuable on account of their size and strong constitutions, and capacity for growth. They are not subject to mange. There is another family of sandy hogs called Durocs, bred in Saratoga county, N. Y., which are finer in the bone and carcase than the Reds. They have have been bred with their crosses in that region of country for about twenty years; are extremely hardy and ultimately attain a large size. Berkshires have been bred in Berkshire, England, from a very early period. The family which was the basis of this breed was of a sandy or buff color, about equally spotted with black, of large size, a slow feeder, maturing at two and a half to three years. It was esteemed for a comparatively greater proportion of lean to fat, and the superior weight of its hams and shoulders, and for the superior fitness of the whole carcase for smoking. Some time during the past century, as tradition affirms, the Siamese boar, then recently imported into England, was fixed upon for the purpose of improving the existing Berkshire. The Siamese is described as varying from a clear jet-black to a dark-slate or rich plum. It was of medium size, quick to mature, fine in all its points, short legs and head, thin jowls, a dished face, slender ears, compact body, well ribbed, extra heavy hams and shoulders, slender tail, thin skin, and firm flesh. The following standard of characteristics is given of the Berkshires: Color black, with white on feet, face, tip of tail, and an occasional splash of white on the arm. While a small spot of white on some other part of the body does not argue an impurity of blood, yet it is to be discouraged, to the end that uniformity of color may be attained by breeders. White upon one ear, or a bronze or copper spot on some part of the body, argues no impurity, but rather a re-appearing of original colors. Markings of white other than those named above are suspicious, and a pig so marked should be rejected. Face short, fine, and well dished, broad between the eyes. Ears generally almost erect, but sometimes inclining forward with advancing age; small, thin, soft, and showing veins. Jowl full. Neck short and thick. Shoulder short from neck to middling deep from back down. Back broad and straight, or a very little arched. Ribs long and well sprung, giving rotundity of body; short ribs of good length giving breadth and levelness of loin. Hips good length from point of hips to rump. Hams thick, round, and deep, holding their thickness well back and down to the hocks. Tail fine and small, set on high up. Legs short and fine, but straight and very strong, with hoofs erect, legs set wide apart. Size medium. Length medium; extremes are to be avoided. Bone fine and compact. Offal very light. Hair fine and soft; no bristles. Skin pliable. The following standard of characteristics of Suffolks is given: Head small, very short; cheeks prominent and full; face dished; snout small and very short; jowl fine. Ears small, thin, upright, soft, and silky. Neck very short and thick, the head appearing almost as if set on front of shoulders; there is no arching of crest. The chest wide and deep; the elbows standing out; the brisket wide, but not deep. Shoulders and crop: shoulders thick, rather upright, rounding outwards from top to elbow; crops wide and full. Sides and flanks: ribs well arched out from back, good length between shoulder and ham; flank well filled out and coming well down at ham. Back broad, level, and straight from crest to tail, not falling off or down at tail. Hams wide and full, well rounded out; twist very wide and full all the way down. Legs small



SUFFOLK BOAR.



SUFFOLK SOW.

and wide apart, in sows just keeping the belly from the ground; bone fine, feet small, hoofs rather spreading. Tail small, long, and tapering. Skin, hair, and color: skin thin, of a pinkish shade, free from color; hair, fine and silky, not too thick; color of hair pale yellowish white, perfectly free from any spots or other color. Size small to medium. The Essex is a black hog, originating in the south of England, small or medium in size, with small soft ears; carcase long, broad, and deep, hams heavy and well let down, bone fine, hair thin. They are remarkable for easy fattening, and are great lard producers. They are fair nurses and prolific breeders. The Neapolitan is distinguished as the basis of improvement of several of the best breeds of English swine, and produces that striking uniformity of characteristics among different individuals which marks a long-established breed as well as good breeding. Martin credits the great improvement of English swine, during many years, chiefly to the agency of the Neapolitan and Chinese breeds. Like the thorough-bred horse, the Neapolitan has a delicate look, a peculiar grace and stylishness, a look of intelligence, with a vivacity and sprightliness unusual in swine, and which in this breed do not seem to be incompatible with surprising aptitude to lay on flesh, or to grow rapidly on a small amount of food. In the vicinity of New York many gentlemen, who in their travels have eaten the pork of Naples and vicinity, have imported Neapolitans and bred them for their own use, on account of fine grain and delicious flavor of the pork. The breed is of great antiquity, and imparts its peculiarities with great uniformity. This is one of the purest and most valuable of known breeds—easily kept, but difficult to keep down in good breeding condition; one of the gentlest and most easily managed, and least fastidious in its food; the sows are good mothers, furnishing abundance of milk, and reasonably prolific; they furnish juicy hams and shoulders, well marbled and not coated with masses of fat, abundance of leaf-lard, and the most delicate of side-pork for family use, while the offal is a minimum quantity. Their characteristics are: Head small; forehead bony and flat; face slightly dishing; snout rather long and very slender; ears small, thin, standing outward and forward nearly horizontally, and quite lively; jowls very full, but not large; neck short, broad and heavy above, with a small dewlap; trunk long, cylindrical, and well ribbed back. Back flat, and arching even in low flesh. Belly horizontal on the lower line. Hind-quarters higher than the fore, but not very much so. Legs very firm, the bones and joints being smaller than those of any other breed. Hams and shoulders well developed and meaty. Tail fine, curled, flat at the extremity, and fringed with hair on each side. General color, slaty or bluish plum-color, with a cast of coppery red. Skin soft and fine, nearly free from hair, which when found upon the sides of the head and behind the forelegs is black and soft and rather long. Flesh firm and elastic to the touch.

SWING PLOW. The plow without a wheel under the beam.

SWINGLE-TREE, WHIPPLE-TREE. The bar of wood or iron to which the traces of each horse are fastened, and which are hitched on to the vehicle, plow, or other implement to be drawn.

SWISS CATTLE. Aside from an occasional importation by curious amateurs, the Swiss cattle have never gained a foothold in our country, and yet they bear a high reputation in many parts of Europe. In France, especially, they are much esteemed, and at the agricultural school of Grignon their performances at the pail are said to compare well with those of the common short-horns, which were considered the best milkers in the establishment. An accurate observer says they are robust, hardy animals, usually of a dun color, or dun and white, with medium heads, hanging dewlaps, rather coarse shoulders, and broad hips and quarters, with well-developed udders. Removed from their native mountains, they manifested little impatience at the change, and though kept in stables and soiled, they seemed to thrive, and carried a good coat of flesh; when dry, they are said to fatten readily. In Switzerland they are wintered in the valleys, on the coarsest food, and as soon as the snow melts from the southern slopes of the mountains are driven to their pastures, which, as the season advances, are gradually changed for the higher ranges. For four months in the year they are kept on the most elevated feeding grounds, and there, attended by a single man, uniting in his person the offices of cow-herd and dairy-man, they feed on the close, sweet herbage, often at the very edge of the snow fields, till their short summer is over, and they are driven by the autumn storms to the more sheltered pastures again. Cheese is the chief product, and its manufacture is conducted in the lonely chalet, perched on the mountain side, in the most primitive manner. A few pails and tubs and an iron kettle are the only utensils required. The best cows yield from ten to twenty quarts of milk daily, and each cow produces, by the end of the season of four months, on an average, 225 pounds of cheese. The best cheeses are made upon pastures 3,000 feet above the sea level! How far the introduction of these cattle into our country might be of advantage is a question; but there are districts which, though not absolutely alpine in their character, are sufficiently rugged and bleak to require for their profitable occupation a breed of this kind, especially as with better keeping and a milder climate they proportionably improve in both milk and form.

SWITCHING HEDGES. Cutting off the year's shoots. This is done with a sharp hooked blade called a switching-hook, or with large hedge shears.

SYCAMORE. *Platanus occidentalis.* Western sycamore. Button wood. Plane tree. This is one of the most majestic of western forest trees, delighting in rich alluvial soils. It is not much valued for timber, though it is sometimes used for posts, etc. The Greater maple, *Acer Pseudo-platanus,* sometimes called sycamore, is an introduced tree, but less handsome than our sugar maple or the Norway maple.

SYCON, SYCONUS. A fruit consisting of a fleshy disk or hollow receptacle, as in the fig.

SYENITE. A granite with black spots of hornblende, which takes its name from Syene in upper Egypt.

SYMBOL. In chemistry, the abbreviation used to distinguish an element or chemical body. It usually consists of the initial letter, sometimes of the first and second.

SYMPATHY. A veterinary and medical term used to express the existence of certain symptoms in a disease which are remote from the parts injured.

SYMPATHETIC NERVE. A grand connection of nerves from one end of the body to the other, furnished with nervous centres or ganglia, by which some physiologists suppose a uniformity in the operations of the different viscera is maintained. It is also called the trisplanchnic nerve.

SYMPIESOMETER. A kind of barometer.

SYN. A common prefix in descriptive words, meaning united.

SYNAPTASE. The white matter of almonds freed from oil, albumen, and other matters.

SYNCARPOUS FRUITS. Such as contain several carpels united, as the apple, pear, etc.

SYNCHONDROSIS. The junction of bones by a cartilage.

SYNCOPE. Fainting, whenever the circulation and respiration become feeble for a time.

SYNGENESIA. The composite family of plants, in which, according to Linnæus, the anthers are united into a tube, the filaments being usually separate and distinct.

SYNOCHA. Continued inflammatory fevers.

SYNOVIA. The albuminous or serous fluid secreted in the joints, to diminish the friction of the extremities of the bones; it is poured out from little pouches, called synovial bags.

SYNTHESIS. In chemistry, the production of a compound body by a union of its elements or parts.

SYRIAN GOAT. (See Goat.)

SYRINGE. A small cylinder with an air-tight piston or sucker, which is moved by a handle The lower end of the cylinder terminates in a small tube, through which a fluid is forced into the body of the cylinder by the atmospheric pressure when the handle is drawn up, and then expelled in a small jet, by pushing the handle in the opposite direction. The syringe acts on the principle of the sucking pump. The syringe is also used as a pneumatic machine for condensing or exhausting the air in a close vessel, but for this purpose it must be furnished with two valves. In the condensing syringe the valves open downward and close upward; in the exhausting syringe they are closed downward and opened upward. The garden syringe, useful for watering plants, and removing caterpillars, red spiders, and other insects, is a large syringe of a quart size or larger, which discharges fluid from a rose or perforated end instead of a point.

SYRPHUS FLY. Beneficial insects, which deposit eggs upon plants infested with lice, which hatching into larva, subsist thereon. The grub is blind and discovers its prey by means of its feelers. The parent fly is two-winged, about seven-tenths of an inch across them. It has a curious habit of hovering, stationary, over or near flowers during the day, darting away if disturbed, but soon returning and resuming its former attitude. They should be seduously preserved, since they tend to keep down the spread of plant lice, both the woolly ones and others, which sometimes swarm by millions.

SYRUP. A thick solution of sugar, as the boiled down juice of vegetables and plants containing saccharine, as the beet, watermelon sorghum, Indian corn, sugar cane, etc., which see. The juice evaporated to a thick consistency becomes a syrup, also called molasses. This latter term is not, however, correct, except as applied to the drippings or uncrystallizable syrup of sorghum sugar, beet sugar, sugar cane, and other true sugar producing plants.

SYSTOLE. The contraction of the heart, the diastole being its dilatation. These two alternate movements produce the beating.

T

TACAMAHACA. The *Populus balsamica* of Canada, which yields a resinous, balsamic exudation in the spring.

TAG. Tags are the masses of dirt that accumulate on the wool of the tail; the process of removing them is called tagging, and sometimes, when they cause the tail to be fastened to the body, that state is called tagbelt or pinning.

TAGLIA. A combination of pulleys, a tackle.

TAGLIACOTIAN. Any operation in which the skin is nearly cut from one part and made to cover another.

TAIL DRAIN. The main drain, which receives the water of the lesser drains.

TALC. A mineral closely resembling mica, but not elastic.

TALLOW. The melted or rendered fat of the ox or sheep. The fat of bones, amounts to eight or ten per cent. Its composition is similar to that of oils, but the stearine is in excess.

TALLOW-TREE. *Croton sebiferum.* A large lauraceous tree of China, the seeds of which, when pressed, yield a fatty body very similar to tallow. Some specimens of this tree are found growing in the shrubberies of the Southern States.

TALUS. A heap of rubbish accumulated at the foot of a cliff or steep rock.

TAMARAC. (See Larch.)

TAMARIND. *Tamarindus Indica.* A large tree of the leguminous family, native of the tropical East and West Indies. The prepared pods are preserved in sugar.

TAMARIX. The genus *Tamarix;* small, ornamental shrubs.

TAMPING. In blasting, filling the hole with sand and pieces of rock after a cartridge has been introduced.

TANAGER. *Pyranga rubra.* This is a well known summer visitor in the Atlantic States north, but more sparingly seen as yet West of the Alleghanies, an active insect destroyer, delighting in copses near swamps.

TANK. In gardening a cistern or reservoir used for collecting and preserving water during a scarcity or drought. They are sometimes built in the ground, and lined with cement. Where wells can not be sunk, and water is scarce, at some seasons, tanks are necessary appendages to a house. A current of air is said to promote the purity of water in tanks, which is easily effected by the earthenware or other pipe which conveys the water from the roof being of six or eight inches in diameter, and an opening left for the surplus water to run away; and where the prevailing winds do not blow soot and leaves on the house, the water remains good, even for drinking, without clearing out the rubbish more than once a year; but, in some cases, filtering by ascension may be found useful, and effected by the water being delivered by the pipe at the bottom of a cask or other vessel, from which it can not escape till it has risen through the holes in a board covered with pebbles, sand, or powdered charcoal.

TANNIN. The astringent principle of galls, sumach, catechu, and numerous barks. It is very soluble in water, and possesses the property of uniting with albuminous matters, and forming tanno-gelatine, or leather. When separated from the other substances in bark, it is found to be a white, astringent powder, with acid reaction, and known as tannic acid; by the action of moisture and air it absorbs oxygen, and becomes converted into the insoluble gallic acid. It is tribasic, and its salts are called tannates. The value of any specimen of bark for tanning and certain dyes is ascertained by the amount of tannic acid they contain. The amount, in 480 parts, in the barks mentioned is:

Varieties.	Pounds.
Oak bark contains	29
Spanish chestnut	21
Leicester willow (large)	33
Elm	13
Common willow (large)	11
Ash	16
Beech	10
Horse-chestnut	9
Sycamore	11
Lombardy poplar	15
Birch	8
Hazel	14
Blackthorn	16
Coppice oak	32
Inner rind of oak bark	72
Oak cut in autumn	21
Larch cut in autumn	8
Sicilian sumach	78
Nut galls	127
Catechu	261

TANSY. *Tanacetum vulgare.* A well known garden plant, cultivated for its bitter aromatic properties. Escaping from cultivation, it has become a common, but not an essentially troublesome weed.

TANYSTOMES. A family of dipterous insects, most of which have a projecting proboscis.

TAPETUM. A coat of the eye under the black pigment, and peculiar to quadrupeds.

TAPE WORM. This is the mature form of an entozoa, the cysts in measly swine being an immature stage of the worm. The parasites in their mature state may inhabit the intestines of any of the vertebrate animals. In their transition or immature state they occur as cysts in the tissues of such animals as feed upon those which bear them. They have peen produced in many carnivorous animals to which the encysted forms had been artificially fed. The eggs of the mature worm being set free, are carried into water, manure, etc., and may be taken into the system on grass, by animals, or on salads by man. The eggs taken into the stomach produce the encysted state, as measles in swine, or as the trichina. Dogs are the most prolific source of spreading the eggs of the tape worm, so also are all animals which feed upon flesh that may contain the encysted worm. (See Measles in Swine.)

TAPIOCA. A starchy farina from the root of the *Jatropa manihot.* There are two varieties; one with a bitter, poisonous root; the other with a sweet root.

TAP ROOT. The main root which descends vertically from trees.

TAR. A dark-brown, viscid liquor, obtained by charring the wood of the pitch pine tree. It consists of resin, empyreumatic matters, and acetic acid. When inspissated by boiling, it is converted into pitch. The manufacture is simple; a conical hole, usually in the side of a bank, being made, roots and billets of pine are let into the cavity, and the whole is covered with turf, which is beat firmly down above the wood. The wood being kindled, a slow combustion takes place. A cast-iron pan at the bottom of the cavity receives the fluid, and has a spout which projects through the bank and carries the tar into barrels. As quickly as the barrels are filled they are closed with bungs, when the material is ready for exportation. This manner of preparing tar has been derived from the earliest ages. Tar is a very compound substance; it contains modified resin, and oil of turpentine, acetic acid, charcoal, water, etc. Tar is used in medicine as well as in the arts. It is an excellent topical stimulant, when made into an ointment with lard, in dry skin diseases. These two substances, tar and pitch, are of extensive use in the arts.

TARES. Corn Spurry. Devil's Flax. *Spergula arvensis.* This plant is cultivated in Europe as fodder, cattle and sheep being fond of and thriving on it. It is there credited with enriching the milk of cows fed on it, and of making superior mutton. Here it is a weed and should be so treated. The vetch (*vicia sativa*) is also called tare, and is prized in Europe. We have so much better plants that it is here regarded as a weed.

TARO. A cultivated *Arum* of the Columbia river.

TARRAGON. *Artemesia dracunculus.* A bitter pot-herb, of the same genus as the tansy.

TARSUS. The bones articulated to the tibia, and forming the upper part of the foot.

TARTAR. The sediment of wine casks.

TARTAR, CREAM OF. Supertartrate of potash, obtained by purifying tartar.

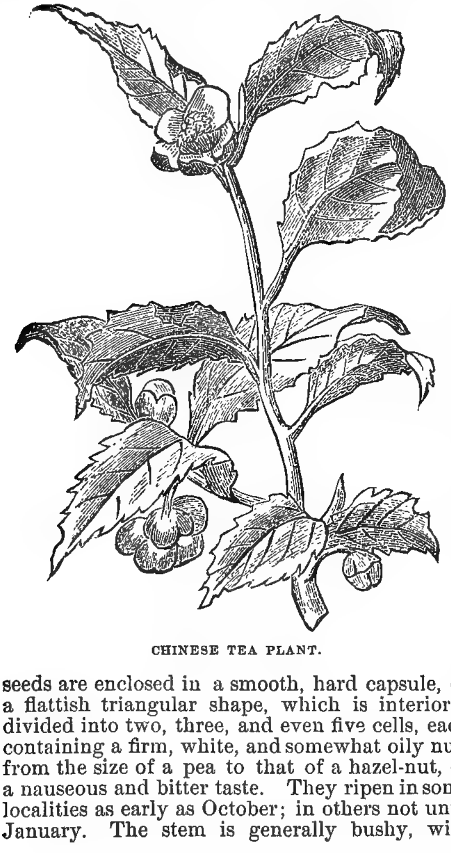
TARTAR EMETIC. Tartrate of potash and antimony, a powerful emetic, sedative, and expectorant.

TARTARIC ACID. The acid of grapes or of tartar.

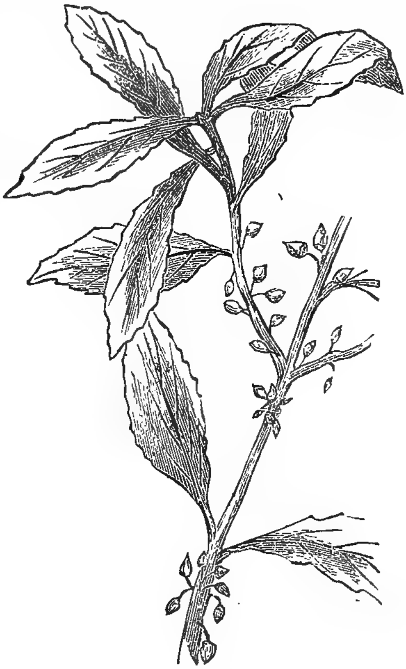
TAXICORNS. A family of coleopterans, in many of which the antennæ enlarge towards the upper ends.

TAXIS. The replacement of parts by the hand.

TEA. *Thea viridis.* A plant belonging to the *camelliaceæ,* and known wherever civilization extends as the source of the green and black tea of commerce. It is indigenous to many portions of China and is reported to have been introduced to Japan by a Buddist priest in the sixth century. Its native country is unknown, the only country where it has certainly been found wild is Assam. Tea has been grown in the Southern States, in a small way for many years, the leaves being gathered for the family beverage, and said to be superior to that imported. Within the last few years its cultivation has been attempted under the patronage of the government, large quantities of plants having been propagated and sent out (20,000 in 1876) with a view of making it a national industry. This, however, will hardly be accomplished until machinery can be invented to compete with cheap East Indian and Chinese labor. Tea was first imported to Europe by the Hollanders in the seventeenth century. In 1661 it was introduced into England, and came to America as soon as the wealth of the settlers enabled them to buy it. The Chinese tea-plant —*Thea viridis*, Linn.; *Camelia therifera*, Griff. (Chinese, *Chak;* Assamese, *Phalap*) is described by botanists as a polyandrous plant, of the natural order *Ternstrœmiaceæ*. The flowers, which open early in the spring (appearing upon the plant about a month), are smaller in size and much less elegant than those which render some species of the *Camelia* so attractive. They are slightly odorous, and of a pure white color; they proceed from the axils of the branches, and stand on short foot-stalks, or at the most two or three together, but usually solitary. There are five or six imbricate sepals or leaves supporting the blossom, which fall off after the flower has expanded, and leave from six to nine petals surrounding a great number of yellow stamens that are joined together in such a manner at their bases as to form a sort of floral coronal. The seeds are enclosed in a smooth, hard capsule, of a flattish triangular shape, which is interiorly divided into two, three, and even five cells, each containing a firm, white, and somewhat oily nut, from the size of a pea to that of a hazel-nut, of a nauseous and bitter taste. They ripen in some localities as early as October; in others not until January. The stem is generally bushy, with numerous branches bearing a very dense foliage, and in its general appearance not unlike the myrtle, though not so symmetrical as that plant. The wood is light-colored, close-grained, of great comparative density, and when freshly cut or peeled gives off a strong smell resembling that of the black currant bush. The leaves are alternate, on short, thick, channeled foot-stalks; coriaceous or leathery, smooth and shining; of a dark green color, and a longish elliptic form, with a blunt or notched point, and serrated except at the base.

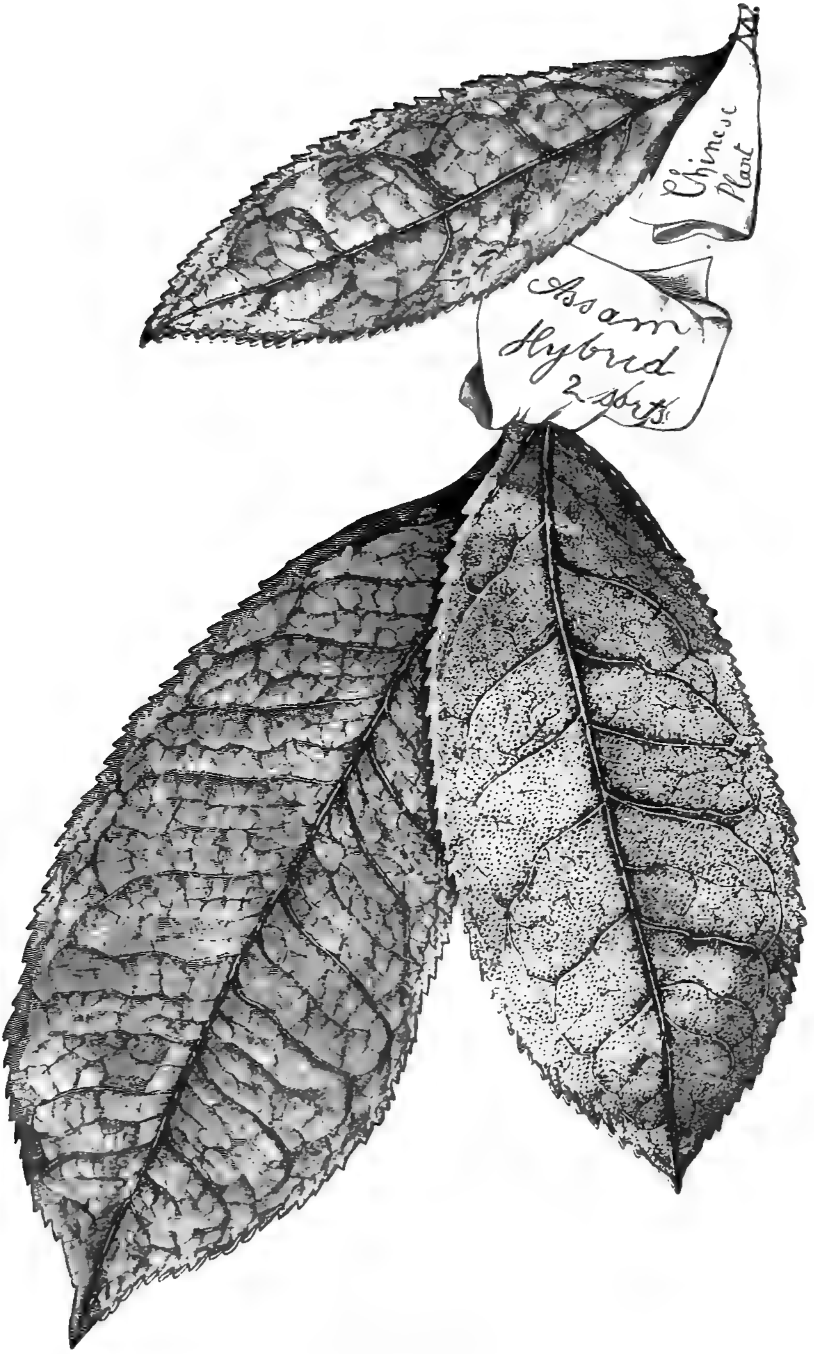


CHINESE TEA PLANT.

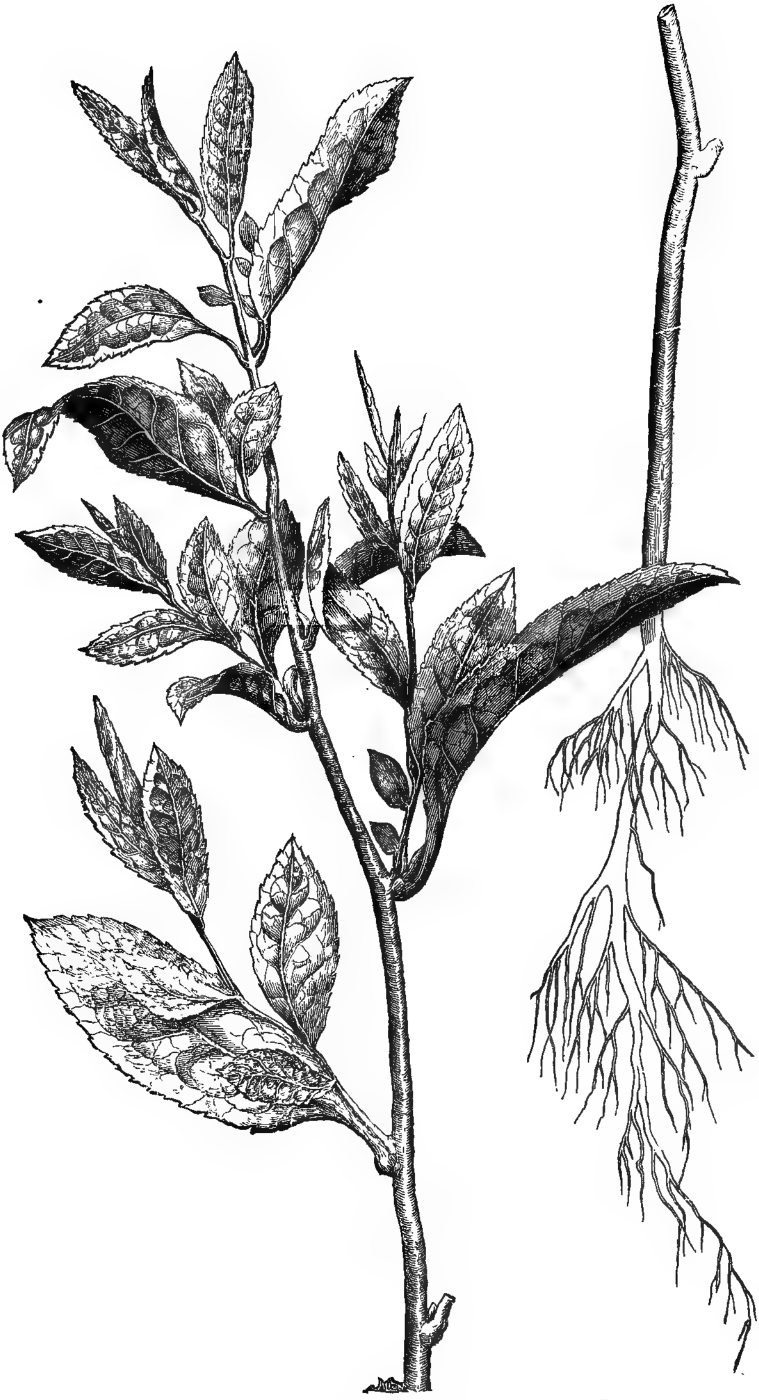


MATE. PARAGUAY TEA.

The black and green teas of commerce are produced from this plant. The opinion was at one time quite prevalent that there existed several species of *Thea*, but it is now known that the different sorts in market are indebted to artificial manipulations for much of their apparent variety and distinctive qualities. Many of the names attached to teas are merely descriptive of the locality or country where they are produced, the condition of the leaves when gathered, and the mode of preparing them for market. Thus there is Java tea, Japan tea and Assam tea; bohea tea, from coarse leaves; gunpowder tea, made from the small, close-curled young leaves; and green tea, colored to suit its name. In the preparation of black tea, the freshly gathered leaves, being partially dried by brief exposure in the open air, are thrown into round, flat iron pans, and exposed to a gentle fire heat for five minutes, which renders them soft and pliant, and causes them to give off a large quantity of moisture. They are then emptied into sieves, and while hot they are repeatedly squeezed and rolled in the hands to give them their twist or curl. They are next placed in the open air, in the shade, for a few days, and finally they are completely dried in iron pans over a slow fire. Green tea, when genuine, is prepared in a



LEAVES OF TEA.



YOUNG TEA PLANT AND ROOT.

similar manner, except that it is dried with more care, and by a slower process, but the greater part of the green tea consumed in Europe and America is colored by the Chinese to suit the demands of foreign trade. There are about a dozen varieties of tea in commerce, but, besides the preceding distinction of color, they consist merely of different sizes obtained by sifting. The active principles in tea are theine and a volatile oil, to the latter of which its flavor and odor are due, and which possesses narcotic and intoxicating properties. It also contains fifteen per cent. of gluten or nutritious matter, and more than twenty-five per cent. of tannin. On page 932 will be found a cut of the young plant and root. Every civilized nation, and some barbarous tribes, have plants the infusion of which is drank. Among the more noted of these we find the following: Paraguay tea, or *Yerba de mate, Ilex Paraguayensis*, (*Aquifoliaceæ.*)—The leaves of this South American tree are used in furnishing the beverage, yerba mate. They yield the same active bitter principle called theine which is found in the leaf of the Chinese tea plant, and form a commercial product that occupies the same important position in the domestic economy of South America as the famed China plant does in this country, and is consumed to the extent of several thousand tons annually. The leaves are prepared by drying and roasting, not in the fashion of making Chinese teas, but by cutting large branches from the trees, which are placed on hurdles over wood fires, and kept there until the leaves are sufficiently roasted, when they are removed and placed on a hard floor, and the dried leaves knocked off by beating the branches with sticks. The leaves are then gathered up, reduced to powder in wooden mills, and packed for market. This tea is often packed in sacks made of raw hides, which are sewed together in a square form. The powdered leaves are pressed into the sacks with great force, and when full they are sewed up and exposed to the sun, where the hide dries and tightens over the contents, forming a package nearly as hard and heavy as stone. There are several grades or sorts of mate tea in the South American markets, valued according to the age of the leaf and the modes of preparation. It is prepared for use by placing a small quantity of the powder in a cup, and pouring boiling water over it; the decoction is quaffed or sucked through a *bombilla*, or tube having a bulb perforated with minute holes. It has an agreeable, slightly aromatic odor, rather bitter to the taste, but very refreshing and restorative to the body after undergoing great fatigue. It is highly relished by travelers, and it is almost impossible for those who become accustomed to its use to discontinue it. It acts in some degree as an aperient and diuretic, and, if taken in over-doses, it occasions diseases similar to those produced by strong liquors. It is supposed that there are several species of Ilex, the leaves of which are gathered for tea; *Ilex theezans, Ilex gongonha*, and *Ilex amara* are known to be used in Brazil and other places. The Yerba, produced by, and known to the Brazilians as Herva de Palmeira, is specially renowned for its excellent qualities. The plant yielding Faham or orchid tea is *Angræcum fragrans*, an epiphytal orchid of the Island of Bourbon, where it is used under the name of Faham. It has been introduced and used as a beverage in France and other European countries. In taste it differs greatly from that of the Chinese tea, having an aroma of great delicacy, and producing quite an agreeable perfume similar to that of the tonka bean. It has tonic and digestive qualities; and it is recorded that in the aromatic principle of the plant there is a diffusible stimulant capable of deadening nervous sensibility; in the bitter principle an excellant stimulant to revive the strength of the nutritive organs; and in the mucilage a demulcent to relax the tissues. Jesuits' tea, is the leaf of *Psoralea glandulosa*, (*Leguminosæ,*) a native of Chili, a small shrubby plant. The infusion of the leaves is slightly aromatic, and is valued more for its medicinal qualities than for its agreeable flavor. It is used as a vermifuge, and is pronounced to be a good remedy for asthma. The leaves are used in Chili for making poultices for wounds, and an infusion of the roots is emetic and purgative. The leaves are also dried and smoked like tobacco. Arabian tea is prepared from the leaves of *Catha edulis*, (*Celastraceæ,*) a small tree or shrub, seldom growing over eight feet in height, native of Arabia. Under the name of cafta, small branches of this plant, with leaves still attached, form a considerable article of commerce among the Arabs, who cultivate the plant to a great extent in the interior of the country. A decoction of the leaves produces effects similar to those following the use of strong green Chinese tea, only that they are more pleasant and agreeable. The leaves are also chewed when in the green state, and are said to have a tendency to produce great hilarity of spirits, and also to act strongly as a preventive of sleep. The use of cafta in Arabia is supposed to be of great antiquity, and to have preceded the use of coffee. Bencoolen tea is a beverage prepared from the leaves of *Glaphyria nitida*, (*Myrtaceæ,*) a native of the Malayan Islands, where it inhabits high elevations and attains a great age. The leaves are eagerly sought for use in the preparation of a kind of tea. Brazilian tea is prepared from the leaves of *Stachytarpha Jamaicensis.* (*Verbenaceæ.*) It is not known that any peculiarly favorable result attaches to the use of this as a tea, but it is known that Chinese tea is frequently adulterated by mixing with the leaves of this vervain. The green leaves are used as an application to ulcers. Bush tea is an infusion of the leaves of *Cyclopia genistoides*, (*Leguminosæ,*) a small bush, native of South Africa. Its use seems to partake of a medicinal character, and is recommended in cases of consumption and chronic catarrh; it has an agreeable tea-like smell, with a sweet astringent taste. Theezan tea is prepared from the leaves of *Sageretia theezans*, (*Rhamnaceæ,*) a Chinese plant of shrubby growth, having smooth shining-green leaves, somewhat resembling those of the true tree, and is employed as a substitute for it by the poorer classes in Southern China. Labrador tea.—A preparation of the leaves *Ledum palustre*, (*Ericaceæ,*) a small spreading shrub, native of Labrador. Mexican tea.—A name applied to the infusion of the young shoots and leaves of *Ambrina ambrosioides*, (*Chenopodiaceæ*). It is entirely medicinal, having antispasmodic, vermifuge, and carminative properties. *A. anthelmintica* is much used as a vermifuge. Mountain tea is the leaf of *Gaultheria procumbens*, (*Ericaceæ,*) a small creeping plant familiarly known as winter green in the United

States and Canada. All parts of the plant possess a pleasant peculiar aromatic odor and flavor, due to a volatile oil, which, when separated by distillation, is known as wintergreen oil. The leaves are used either as a flavor to genuine tea, or an infusion alone, which partakes of an astringent character, and is useful medicinally.

TEASEL. *Dipsacus fullonum*. The teasel of commerce, in the finishing of woolen fabrics, from blanketing to the finest broadcloth, is used for the purpose of raising the knap, for which their hooked spines abundantly fit them. Until about the year 1848 they were imported for use in the United States almost entirely from foreign countries. They began to be cultivated in a small way only, since 1835, in the State of New York. About 1850 their cultivation was extended in New York, and, in 1865, the cultivation, principally in New York and the southern New England States, generally supplied the demand of this country. It is, however, a crop subject to many contingencies, not the least of which is freezing out, being a biennial like our wild teasel. The wild teasel, *Dipsacus sylvestris*, however, has spines straight, instead of recurved; and like the cultivated teasel, should be destroyed whenever found in waste places.

TECTRICES. The small feathers which cover the quill feathers.

TEDDER. The hay tedder is an implement supported on two wheels, with a seat for the driver. The working parts consist of an eccentric crank-shaped shaft, mounted with a series of levers armed with spring teeth, which, revolve on the cut grass, whether in swaths, windrows, or as left by the mowing machine. Thus the grass is tossed into the air, falling again in the lightest possible condition, by which the sun and air is admitted, curing it perfectly in a short time. In good hay weather the horse rake may follow in about two hours, and the hay is ready for the barn or stack the same day. The tedder has not come into general use in the West. The fine harvest weather usually experienced, allowing the hay to be, as a rule, easily cured. There is no doubt, however, that its use would pay on every farm where much hay is cut.

TEETH. (See Horse.)

TEETH, FOUL. (See Lampas.)

TEGMENTA. The scales of winter buds.

TEGUMENT. In anatomy, the general covering of the body. In entomology the term is applied to the coverings of the wings of the order *Orthoptera*, or straight winged insects.

TEMPERATURE. The question of temperature has been somewhat treated of in the articles Earth, Germination, Meteorology and Soil. It is an important subject, for upon temperature, as one of the prime factors, rests the question of the proper ripening of crops. Thus soils, exposed to the rays of the sun, have varying powers of absorbing warmth and holding heat, as a rule, those which absorb fastest, soonest give it up. To ripen the cereal crops an average temperature of 56° Fahr. is required. Yet this rule is not a constant one, for in the Red river country, west of lake Superior, in latitude 50°, the mean annual temperature is 32°, and yet in consequence of a clear tropical heat of sixty days, wheat and other valuable cereals are ripened. So we can not take the establishment of a general rule as correct, for the decrease of temperature as we proceed north, as indicating the climate that may be expected. In central Europe, the change in mean annual temperature is said to be a lowering of the temperature of one degree for every seventy miles of northing. In the United States, in the valley of the Mississippi, it is reported as one degree for every forty miles. Yet in the valley of the Mississippi, in consequence of the great and continued heat of summer, certain crops are ripened perfectly, that can not be ripened in a corresponding latitude in central Europe; but, again, certain crops, as grapes, are ripened as to particular varieties, in Europe, that can not be in a corresponding latitude in the United States. In the planting of crops where special earliness is desired, sandy soils are recognized for their value. Drying easily in the spring, they consume heat, as can not be expected in dark, peaty or stiff clay soils. So the protection of hedges, wind breaks, fences and glass structures are resorted to, to increase and conserve the heat of the sun. Thus the temperature is raised during the day to 70 and 80 degrees in the months of March and April and conserved during the night, through the prevention of radiation, by means of the covering, and by the aid of bottom heat. Thus all the more tender plants such as cucumbers, tomatoes, peppers, egg plant, etc., are forced. The heat to which the soil is often raised by the sun's rays alone is but little understood by the people generally. The range favorable to vegetation is from 34° Fahrenheit to 140°, in like manner, too, the very germination or first vital action of the seed must have between 34° and 40°, so that there be no danger of decomposition, and sufficient warmth to maintain circulation. The common pea, requires at least 40°, and when it is forced for early use the temperature is from 45° to 50°; that of the air to keep it growing healthily is at 60°, and after it has flowered from 52° to 70° is necessary to mature its pods. An ordinary greenhouse, which contains a miscellaneous collection of hardy plants and shrubs flowering in the winter months, may be regulated to advantage, if its temperature be not lower than 45°, but by the sun's rays in the day-time it may rise to 65°, or even higher, to fall again to 45°, or a little below. The cooler temperature of the nighttime is favorable to all plants, inviting them to repose, by diminishing their excitability. Prof. James F. W. Johnston, in one of his lectures on the general relations of science to practical agriculture, delivered before the New York State agricultural society, states that, in this country, the temperature of the earth, five feet below the surface may be warmed by the sun to 100° and a half an inch below the surface sometimes rises as high as 140° Fahr. Such statements seem scarcely credible; yet, according to Dr. Coulter, plants grow on the banks of the Rio Colorado which occasionally endure this intense heat. Sir John Herschel found the soil in his bulb garden at Cape Good Hope, on the 5th of December, 1837, between 1 and 2 o'clock p. m., raised to 159° of heat, and at 3 o'clock p. m., it was 150°, and even in shaded places 119°. The temperature of the atmosphere in the shade in the same garden at the same period was 98° and 92° Fahr. At 5 o'clock p. m. the soil of the garden, having been long shaded, was found to have, at four inches in depth, a temperature of 102°. On the 3d of December, a thermometer was buried a quarter of an inch deep, in contact with a seedling fir of the year's planting, quite healthy, and having its seed leaves, marked as follows: at twenty-five minutes past 11 o'clock a. m., 148.2 ; at forty-eight minutes past 12 p. m., 149.5°; at thirty-four minutes past 1 p. m., 149.8°; at fifty-four minutes past 1 p. m., 150.8°; and at forty-six minutes past 2 o'clock p. m., 148° Fahr. Similar statements were made by Prof. William Henry Harvey, in his lectures on botany before the Lowell Institute, at Boston Massachusetts, in 1849, when he also stated that desiccation of the soil in consequence was so great that severe labor was requisite to lift the bulbs of the amaryllis, gladiolus, and kindred genera from the earth, and that each year's successive decay of leaves formed an envelope around the bulbs which served as protection, and preserved their vegetative powers. From accidental circumstances it has been proved that a similar drying process will not injure the gladiolus in cultivation, but rather seems to serve as a stimulus to activity on application of moisture. Gardeners have long resorted to similar expedients to induce certain succulent plants to flower, by delaying their seasons of repose and rest by heat and dryness. Such well observed facts confirmed the previous statements of Bruce, that the temperature in the sun at Gondar has been as high as 113°; at Benares, 110°, 113°, 118°, according to Harvey; and at Sierra Leone, 138°, according to Winterbottom. In the relation of heat to germination there is a lowest and a highest point, and also a temperature of most rapid germination. This latter is about ten degrees greater, than half the sum of the lowest and the highest temperature of germination and the temperature of healthy germination about ten degrees above the lowest temperature of germination. The range of temperature for agricultural plants in the north, to ensure active and healthy germination, may be stated to be at about 55° for the more hardy to 90° for the most tender. Goppert found no seeds of plants, usually sown, to germinate below 39 , and Sachs gives the lowest temperature at from 41° to 55°, and the highest range at from 102° to 116° So also he found the point of most rapid germination to be between 79 and 93° of temperature. There are, of course, some plants that germinate at a very low temperature and others that require a much higher one. Some arctic plants germinate when the temperature stands at or exceeds thirty-two degrees, and the cocoanut is said to germinate certainly only when the heat of the soil is 120 degrees. What we have been indicating, relates to plants cultivated in temperate and sub-tropical climates. The following table will elucidate our meaning, as showing temperatures of germination:

	Lowest Temperature.	Highest Temperature.	Temp. most rapid Germination.
Wheat and barley	41° F.	104° F.	84° F.
Pea	44.5.	102.	84.
Indian corn	48.	115.	93.
Scarlet bean	49.	111.	79.
Squash	54.	115.	93.

With wheat may really be placed all the cereal grains, peas, and all hardy vegetables, as radish, parsnip, turnip, lettuce, etc. With Indian corn all that class which actual freezing will destroy, including all the dwarf beans. With the squash may be included all the more tender plants, including lima and other running beans, tomatoes, egg plants, etc. Among the cereal grains oats, perhaps, should be excepted. Oats should rather be placed with the pea, and with this, or rather between this class, and Indian corn, all the half hardy plants, as flax, Hungarian grass, celery, beets, onions, etc. Potatoes are susceptible to frost. They require about the same temperature for germination as Indian corn, but they may be planted very early in the season, since until the ground gets warm, germination goes on so slow that they do not appear above ground until all danger of frost is generally over, and if the soil be not sodden with water they will not decay. So, also, the seeds of any grain if sown early, and not exposed to become water-soaked in the soil, they will germinate when the proper temperature is reached, and growing, will be more hardy than when they sprout more quickly after being sown. Thus Haberlandt found that with a temperature of forty-one degrees, rye formed rootlets in four days, the other cereals and clover in from five to seven days, and at fifty one degrees the time was shortened one half. At this latter temperature kidney beans required eight, Indian corn eleven, and tobacco thirty-one days to commence active germination. At sixty-five degrees the cereal grains, clover, flax, and peas, begin to sprout in one or two days; beans, corn, and sugar beets in three days, and tobacco in six days. (See articles Heat, Light, Electricity, Germination, etc.

TEMPERATURE OF ANIMALS. The animal heat (of the body) in health is ninety-eight degrees, and deviation from this heat, even to that of a few degrees, shows good ground for supposing that there is disability present. If the temperature sinks we have a chill, and if it rises we have fever. Thus, an alternate sinking and rising of the temperature gives chills and fever.

TEMPORAL BONES. The temple bones.

TENACITY. Cohesion. The power of resisting a pulling force.

TENACULUM. A simple small hook, used to seize bleeding vessels in operations.

TENDRIL. A clasping stem, as that of the vine, passion flower, etc.

TENESMUS. A straining and ineffectual effort to relieve the bowels; it is a symptom of irritations and inflammations of the bowels.

TENON. The end of a rail introduced into a mortice.

TENSOR MUSCLES. Those which tighten.

TENT. A plug of lint or sponge introduced into wounds to dilate them, or to stop hemorrhages.

TENTACLES. Prehensile, thread-like organs in the lower animals. Usually arranged around their mouths.

TENUIROSTERS. Insessorial birds, with a slender bill.

TEREBRANTIA. A section of hymenopterous insects, the females of which are furnished with a *terebra*, or borer, with which they bore into the bark of trees, or the bodies of animals, to deposit her eggs. The ichneumons, wheat insect, etc., are of this class.

TERETE. A term applied to round stems, antennæ, etc.

TERGUM. In insects, the upper part of the abdomen or back.

TERMITES. A genus of insects inhabiting tropical Africa and America, allied to the ants.

TERRACE. A raised bank, for a promenade and ornamental objects.

TERTIARY FORMATION. Strata situated above the chalk and green sand, disposed in basins, and for the most part sedimentary, but containing some hard rocks. It is divided into three portions, the eocene, miocene, and pliocene.

TESSELATED. Marked into squares, or trapezoids; a pavement laid with square stones of different colors.

TEST. In chemistry, anything by which we distinguish the chemical nature of substances from each other; thus, infusion of galls is a test of the presence of iron, which it renders evident by the production of a black color in water and other liquids containing that metal; in the same way, sulphuretted hydrogen is a test of the presence of lead, and nitrate of baryta, of sulphuric acid. In metallurgy and assaying, the porous crucible which absorbs the liquid vitrifiable oxide of lead and other metals combined with it is sometimes called the test.

TESTA. The shell or integument of a seed.

TESTACEANS. Animals provided with a shell; pertaining to shells.

TESTES. The glands which produce the reproductive secretion of male animals.

TESTUDINATA. A tribe of animals like the tortoise, furnished with a carapace or horny covering. Testudinate, roofed or arched.

TETANUS. Locked jaw.

TETHERING. Fastening cattle or horses by a rope, or chain, to a post or tree, to give them a limited pasturage.

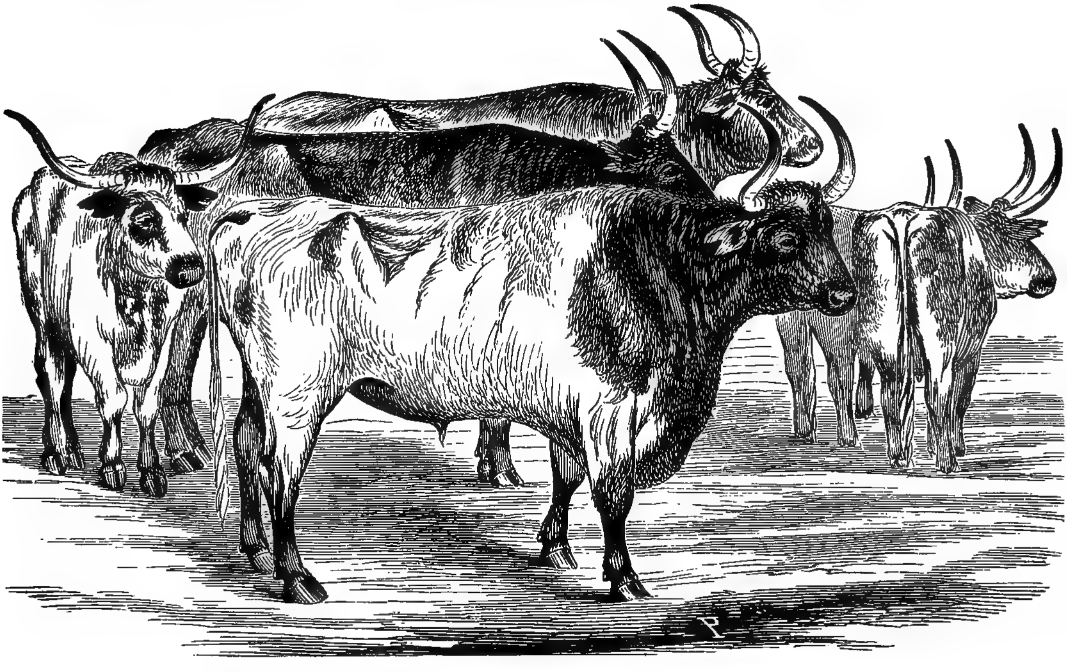
TETRADYNAMIA. Having four long and two short stamens, as the cruciferous plants.

TETRAGONA. The New Zealand spinach.

TETRAGYNIA. Having four pistils.

TETRANDRIA. With four stamens.

TETTER. This is a skin disease in the horse called eczema, a moist tetter, showing red and inflamed, and often torn by the animal. Blisters arise which discharge. Tetter somewhat resembles mange, and is often mistaken for that more serious disease. It differs however, in that it is not produced by an insect, and is not contagious. The remedy is, to open the bowels with a moderate dose of aloes, and if the bowels continue irregular thereafter with fœtid dung, give night and morning a ball composed of one half ounce of powdered gentian and one ounce of bisulphate of soda. As an application for the tetter, good also for other skin disorders, an ointment composed of equal parts of soft soap, tar and alcohol is good. Paint the tetter with this, and also the surrounding parts, twice a day.



GROUP OF TEXAN CATTLE.

TETTIGONIANS. The *Cicadians*, or locusts.

TEXAN CATTLE. Texan cattle are now-a-days too well known in the principal beef markets of the United States and along the lines of our trunk railways to need particular description. Originally derived from the Spanish cattle brought over by early adventurers, they covered all the great grazing plains of Mexico, Texas, and California, becoming to all intents and purposes, feral or wild cattle So that, from the time of their introduction, about the year 1500, notwithstanding the immense numbers annually killed, and until within a few years, principally for their hides and tallow, they had increased in the State of Texas alone, in 1870, to the number of over 4,000,000 head, and at that time constituting about one-seventh of the cattle of the United States and Territories. Impatient of restraint, never becoming really domesticated, they are reared in great herds and within the last fifteen years have been driven north in vast numbers, furnishing cheap, and, when properly fattened, it must be confessed, good beef. A fair estimate of the average of these cattle, as they are sold in our markets, may be put at 1,000 pounds live weight, of which the flesh and bone, as sold to the consumer, may be 400 pounds, the balance being hide, offal, and a very little tallow. Corn-fed for some months, they will come to the average of 1,200 pounds, live weight, with possibly 600 to 700 pounds of marketable meat and bone, as weighed from the butcher's block. They are principally corn-fed in the States of Kansas, Iowa, and Illinois, the plan generally practiced being to feed them in herds in the open fields. Some attempts have been made to stallfeed them, but it has not proved satisfactory. In 1868-69 the editor fed 450 in central Illinois in stables specially prepared therefor, having water conducted in pipes to them, with tramways for carrying grain and hay. They were dragged into the stables with lariats, tied to the stanchions, and remained there until fat, at the end of five months. The stables were kept partially darkened, no strangers were allowed admittance, and every means used to ensure their quiet. They came out ripe, and sold in New York at the very highest price of prime beef; out of the 450 put in, only about thirty being classed lower than fat. The experiment, however, was not repeated, since the larger price required to be paid for good grade short-horns yielded a better profit for the feed consumed. The typical Texan steer is being less and less met with year by year and now the acclimatization of pure bred bulls in Texas is being more and more shown in the improved form and fattening qualities of these semi-wild Texan stock. The most improved plan of acclimating bulls taken from the North and West is to select healthy calves in the autumn after all danger of Texas fever is past. Ship them to the point where they are to be kept, being careful not to crowd too many in one car. Arrived at their destination they are fed meal, bran, and crushed oats, with plenty of corn leaves or good hay, and with access to pure running water to drink. If possible, a run should be allowed on a field of green barley or oats, sown for the purpose. They must also be kept in dry lots and carefully housed from northern and other storms. Prompt attention must be paid to any symptoms of fever. If this is shown, charcoal and ginger may be administered in the proportion of a tablespoonful of charcoal and a teaspoonful of ginger. If they are gotten safely along through January they will generally be safe until the spring rains. During this time and until July they must not be exposed to storms or sun, and must be carefully watched for ticks and other vermin. These must be immediately destroyed by an application of crude petroleum and lard in the proportion of one part of the former to two parts of the latter. Thus, if they are carried safely, until two years old, with proper care, they may thereafter be kept for breeding purposes.

TEXAS FEVER. This is a malignant disease that has been characterized by a number of names, as Spanish fever, Texas fever, Splenic fever, and also by the general name of Texas plague. It is a disease originating in the lowlands of Texas and Mexico, a contagious fever, in some respects said to resemble, in its effects on the system, the rinderpest of Asiatic Russia. It is, however, less destructive and less contagious, since cattle affected in one pasture will not communicate it to those in another pasture, if divided by an impassable barrier. The contagion is communicated by cattle passing over the feeding grounds of Texans, or by traveling over roads infected. It is destroyed by the first frost that occurs, and it is fairly well demonstrated that northern animals affected, do not communicate the disease to others. The organs principally affected are the fourth stomach, the spleen, and the bowels, and the period of incubation varies from four to six weeks. There is slight fever, dulness, drooping of the head, glassy and watery eyes, arched back, loss of appetite, cough, trembling, increased heat of the system, the urine becomes high colored, and then very dark, the mouth and rectum become a dark red or copper color, the dung is hard, and sometimes coated with blood. The animal continues to get worse and worse, and at length dies in a stupor or convulsions. As a rule treatment has not been found effectual. If taken early, and the animals removed to a clean pasture, it is recommended to give them the following dose two or three times a day: One-half ounce chlorate of potash, one ounce tincture of chloride of iron, in a quart of water, and if there is much weakness, to stimulate the system freely with whisky. As soon as the animal begins to mend, light and nourishing food should be allowed, and the following tonic twice a day: one-half ounce of sulphate of iron and one ounce of tincture of ginger, in a quart of water. Prof. Gamgee, who made an elaborate report of this disease to the United States goverment, upon the great outbreak of the disease in the West, in 1868, advises shelter, friction of the limbs, the bowels to be moved by injections and ounce doses of laudanum during the first few days, to be followed by stimulants of one half ounce of sulphuric ether, four ounces of solution of acetate of ammonia, to be given in a quart of linseed tea or water, three times a day. The disease, where spread by Texas cattle, is so deadly that but little can be done, once it makes its appearance, except to prevent its spread. The following, from the proceedings of the National Convention, convened at Springfield, Ill., following the last great outbreak in the West, will serve as a guide, as the proper repressive measures. The action there taken seems to have resulted in the preventing of a repetition of the disease. The report of the action of the convention is taken from the transactions of the Ohio agricultural report of 1868. As early as 1849 a disease was noticed among cattle on the western borders of Missouri, which was attributed to a contagion spread from droves of Texan cattle which about that time began to be brought into the State. For several years the importation of these cattle into Missouri and Kansas steadily increased, while the disease referred to prevailed only in some seasons. In 1858 this cattle trade was greatly extended and the cattle disease increased in proportion. So serious was the evil, and so manifestly did it depend on a contagion spread from imported cattle, that, in 1861, the Legislature of Kansas attempted to stay its ravages by restrictive enactments. The importation of cattle was totally interrupted during the late war, but promptly resumed after its close, and with this resumption there was a return of the disease among the native cattle of Kansas and Missouri. This was followed by protective legislation in Missouri, and additional restrictions upon the trade in Kansas. During the season of 1868 Texas cattle were still more largely imported, immense stock yards had been opened at Abilene, on the Union Pacific Railroad, in Kansas, from which upwards of two thousand car loads of cattle were carried to the grazing States, or to the eastern market. Another route was opened by New Orleans, and up the Mississippi river by steamboat, and still another by land to the mouth of the Red river, and thence up the Mississippi. By these routes not less than 100,000 head of Texas cattle were brought into the State of Illinois, in 1868. With this influx of cattle from Texas the Texas fever appeared with great violence in the States of Illinois, Indiana and Ohio in the months of June and July, and was soon heard of in other States both east and west. The loss to stockholders became ruinous in the extreme, and excitement widely prevailed. In the town of Tolono, on the Illinois Central Railroad, 776 head of native cattle died; in the single county of Champaign, Illinois, there was a loss of 7,000 head, and in the fifth ward of the city of Chicago, the death of cows by this disease amounted to nearly 700. In some herds the loss exceeded ninety per cent., while others were wholly swept off by the pestilence. One of the most marked symptoms of Texas fever is a greatly accelerated pulse, from forty beats in a minute, which may be taken as the average for healthy oxen and cows; in this disease it sometimes rises as high as 120 beats in a minute. Another symptom usually present is a decided increase of the temperature of the animal after the fever is fully developed, but this is generally preceded during the formative stage by a chill. The excretions from the intestines and bladder are diminished in quantity and usually high colored or bloody; the secretion of milk is nearly suspended. A yellow mucous is discharged from the mouth and nostrils; the animal has a dejected look, hollow flanks, an arched back, an unsteady gait, and a rough coat. Many of these symptoms are also common to other cattle diseases. It may be presumed, therefore, that the most expert veterinarian would hesitate to pronounce a case one of Texas fever without taking into account all the attending circumstances. This presents no evidence of disease of the lungs or air passages, but little that is unnatural can be found in the first three stomachs; the fourth stomach usually shows congestion, and the intestines are still more engorged and blood stained. The liver is not often materially affected, but the gall bladder is almost always filled with dark colored and thickened bile. The spleen is always enlarged; in health it weighs in mature animals from one pound to a pound and a half; while in cattle that die of Texas fever it sometimes weighs as much as eight pounds. The kidneys are congested and their secretion in the bladder is bloody or blood stained. The contagious character of the disease is supposed to be established by the following evidence: There is no such disease known in any part of the country through which Texas cattle have not passed, and whenever the disease has appeared among native cattle it is only among such as have pastured upon lands previously grazed or traveled over by Texas cattle, or that have used water running from a field in which Texas cattle were kept or watered. The disease does not appear to be communicated through the atmosphere alone, but only when cattle come in contact with, and can take up with their food or drink the excretions of Texas cattle. When Texas cattle have been brought from their homes during the winter months there is no evidence that the fever has followed in their trail, but when they arrive in the northern States as late as June or July, the native cattle of these States that are exposed, die almost universally. Doubt of the contagious nature of this disease or of the contagion originating with Texas cattle has existed in some minds, because it is an admitted fact that some of the cattle which have been supposed to communicate the disease, have no manifestations of it themselves. Can cattle communicate a disease without having it? is urged as though it were a question impossible to answer in the affirmative. To this it may be replied that the history of some of the diseases affecting the human subject afford cases precisely analogous. Prisoners confined in ill-ventilated dungeons before the days of prison reform, have often given typhus fever to a whole court at the time of trial, while the prisoners themselves had been steeped so gradually in the poisonous atmosphere that their system had become accommodated to it, and hence they have escaped altogether, although the poisonous exhalations from their bodies have spread death all around. A person protected by vaccination from small-pox may have that modified and trifling form of disease known as varioloid, but such a person may communicate fatal small-pox to another person not protected by vaccination. It may therefore be presumed that Texas cattle have come so gradually under the influence of the cause of the mischief or have in some way become comparatively insusceptible to its action so that they escape the deadly form of the malady, and yet can transmit its seeds to more susceptible animals. Others have hesitated to admit the contagiousness of the disease, because the attack does not appear in some cases until a long time after the exposure. This, however, presents no difficulty to persons familiar with the history of other contagious diseases. Many of them require a period sometimes definite, sometimes indefinite, after the exposure, for the incubation of the disease. This period varies greatly, and in Texas fever it may extend to forty days, and even more. The above recital of symptoms, post mortem appearances, and evidence of the contagious character of the Texas fever, the disease must still be regarded as unsatisfactory, without additional light on the true cause and source of the mischief. Happily for us the microscope has done in this case what it has done in so many others, it has brought to view and made us acquainted with very potential agencies which are altogether invisible to the unassisted eye. Dr. M. Morris, of New York, one of the board of health of that city, read to the convention an exceedingly interesting paper, giving the results of examinations with the microscope of both solids and fluids of hundreds of animals that had died or had been killed while laboring under Texas fever. These investigations disclose the fact that the fluids of animals affected with this disease, the urine, the blood, and more especially the bile, are infested and practically destroyed by the spores of a minute cryptogam or fungous plant. These spores which take the place of seeds in more highly organized plants are multiplied by a simple process which admits of unlimited continuation and of almost inconceivable rapidity. They have the form and organization of simple cells, each cell or spore under favorable circumstances would produce the little plant known to microscopists as *Tillesia caries*, the plant in turn would produce other spores but under different conditions, as for example, when immersed in animal fluids the spore does not produce a plant, but multiplies itself after the manner of simple cells. Each spore contracts at the center, then divides, and either end has at once the power and activity of its parent, and the process of multiplication by what is called fission, goes on indefinitely, or so long as the fluid in which it is immersed has fresh organic matter to sustain the life of new cells or spores. In relation to this cryptogam, it was said to be found abundantly in the blood and bile of every animal that died of the fever or that was killed while suffering from its effects. Cattle of the Northern States, while unaffected by Texas fever, have no such cryptogamous parasites in their fluids, but the same parasite was to be found invariably in Texas cattle, although regarded as healthy. It was also stated that this, or at least, allied fungous growths had been observed growing parasitically upon the grasses native to Texas, so that it might readily pass into the bodies of animals with their food. While the vigor of the animals is maintained at a natural standard the growth of the parasite is restrained, but when the animal is subjected to hard driving and scarcity of food and water, all of which diminish his vitality, then the parasite has less and less to overcome, until all the nutritious and recumentitious fluids are destroyed or vitiated. That the animal, while allowed to remain in circumstances where his vital force is unimpaired, should be able to resist the injurious influence of the parasite, but should succumb to its attack when debilitated by hard usage is in correspondence with innumerable facts in the history of other diseases. To some in the Springfield convention it seemed incredible that a minute, and to the unassisted eye invisible organism could, by any possibility, destroy the life of an animal as strong and as large as the ox; the same doubt will probably be suggested to the mind of many who will read reports of the proceedings. It should be borne in mind, however, that what are called the lower forms of life, such as cryptogamia and protozoa, rank lower than other organisms only in regard to some of the manifestations of vitality, their reproductive force is vastly greater than that of more perfect beings. The structure of the cryptogam being very simple, it is almost limited in its functions to the one end of reproduction, and this is carried on with singular energy. Its attack, therefore, is not from without but from within. The nutritious fluids of the animal are assailed, and all appropriated to the uses of the little parasite until the animal that harbors its myriads must ultimately die of starvation, if death, in more violent form, does not sooner occur. Comparatively recent discoveries claim to have established that all epiphytic and epizootic diseases, as well as all contagious epidemics, and many of the endemic diseases to which humanity is liable, are of cryptogamic or protozoic origin. The oidium that has almost destroyed the grape crop of Europe, the potato rot, cholera, small pox, measles and intermittent fever are notable examples said to depend on such causes. Whether these claims be all admitted or not, they open a most interesting field of inquiry for patient and truth loving investigators. It may, perhaps be some relief to timid persons to learn that no facts were presented to the convention by the health officers of New York or Chicago, showing that Texas fever or any other sickness was given to persons who unwittingly used the flesh or milk of animals affected with this disease. Whatever entozoon should conceal himself in our food, so long as that food is properly cooked there is no probability that it can do mischief to the human subject. Carbolic or phenic acid, the product of the distillation of coal tar, is one of the most powerful antiseptics known. It is especially inimical to the lower forms of vegetable and animal life; a solution so dilute as to contain not more than half of one per cent. the acid being sufficient to destroy such organisms almost instantly. It can not be administered to any animal in large quantity, but it has been supposed that it might be administered and taken into the circulation in quantity sufficient to destroy the parasites without materially injuring the health of the animal. The result of the experiment appears to have been in some instances what was desired, and persons have become quite sanguine of the success of this treatment. It is perhaps safer to say that the result is sufficiently favorable to warrant further trial; but the facts thus far observed do not justify us in regarding the carbolic acid or anything else as a specific. This disease affords a marked example of the soundness of the old proverb, that an ounce of prevention is worth a pound of cure. The Texas fever can be effectually kept from any locality only by keeping out the cattle by which it is introduced. There is no disinfectant known that can be absolutely relied on to prevent the communication of the disease. The convention, with entire unanimity, recommended to the legislatures of all States liable to be visited by Texas cattle, to pass stringent laws prohibiting their importation or transportation during the summer months. The recommendation of the convention relative to this subject is in the following terms:

> Whereas, A malignant disease among cattle, known as Texas fever, has been widely disseminated by the transit of southwestern cattle through the Western and Northwestern States during the warm season of the year, occasioning great loss to our farmers, and possibly endangering the health of our citizens; therefore,
>
> Resolved, That this convention earnestly recommend the enactment, by those States, of stringent laws to prevent the transit through their limits of Texas or Cherokee cattle, from the first day of March to the first day of November, inclusive.
>
> Resolved, That the interests of the community require the enactment of laws making any person responsible for all damages that may result from the diffusion of any disease from animals in his ownership or possssion.

In addition to these resolutions, the following draft of a bill was adopted and recommended to such States in the East or on principal routes of transportation as might require its provisions. The first article provides for the appointment of three commissioners, or such other number as may be necessary, by competent authority, to hold their office for five years, and report annually to the legislature. Such commissioner shall have power to watch over the general welfare of animals within the State for which they are appointed, and particularly to prevent the spread of dangerous diseases among them, and to protect the people of the State from the dangers arising from the consumption of diseased meat. They may from time to time appoint such assistant commissioners to aid them in the discharge of their duties, as the public good may require. They should have power to administer oaths, and to prescribe from time to time such rules and regulations as may be necessary to accomplish the object of their appointment. They shall give public notice of the outbreak of any dangerous disease, and such practical directions for its avoidance as they may deem necessary. They may either place such diseased cattle in quarantine or cause them to be killed, as may seem necessary for the public protection; but in the latter case they shall cause an appraisal of such cattle to be made, and the county or State shall pay such proportion of the appraised value as may be provided by law. The second article provides that the commissioners, or any assistant commissioner, located on the frontier of any State, shall have power, at such times as may be prescribed by the commissioners, to inspect all the animals brought into such State, whether by railroad cars, vessels or common roads, and shall have power to detain such railroad cars, vessels and drovers of animals on common roads, long enough to make a proper investigation of them, for the purpose of ascertaining their sanitary condition. No animal shall be permitted to enter the State which shall be deemed by such assistant commissioner to be capable of diffusing dangerous diseases, or of injuring the health of the inhabitants. No train shall be allowed to proceed unless the animals contained therein have been supplied with food, water and rest within twenty-four hours next preceding the time of such inspection. All animals shall have rest and have access to food and water for twenty-four hours after having traveled a similar period. The railroad companies shall provide the suitable yards for feeding, watering and resting animals traveling on the trains, and for quarantine purposes, which shall be kept cleanly and in wholesome condition, to the satisfaction of the commissioners. Each train, on leaving its point of departure, shall have certificates, signed by an assistant commissioner, which shall certify that all the animals therein contained were in a healthy condition at the time of its departure, and also the exact time of leaving; and such certificates and endorsements thereon of the time of resting and time of departure of the train at subsequent resting and feeding places, shall be exhibited to the proper authorities whenever required. Proper penalties should be inserted to prevent the bribery of officers charged with the execution of these provisions; and also for those who interfere with or resist the officers charged with the execution of these duties.

TEXTILE CROPS. The principal textile crops produced in the United States are cotton, flax and hemp. Flax indeed can hardly be ranked as a textile crop, since the fiber is only considered a secondary product anywhere. Generally it is regarded simply as a waste product. Jute and ramie are still in the experimental stage of progression. Among the plants the cultivation of which has been undertaken in the South and abandoned, sisal hemp *Agave sisalana*, and the pulque plant, *Agave pulque*, may be mentioned. The first is used exclusively for its strong fiber, and the latter furnished the Mexican liquor pulque and its fiber the paper of the ancient Aztecs. So also the attempt to introduce the cultivation of the Indian mallow *Abutilon avicenna* in Illinois is worthy of mention. It was hoped that this plant, which has become a noxious weed might be allowed since the method of preparation of the fiber was very much similar to that of flax. Yet the cultivation did not prove remunerative. Among the textile and cordage fibers not generally known, and mostly the production of tropical and subtropical countries may be noticed. *Agave Mexicana*, or aloe; the *Heliconea Caribea*, or Brasilier; *Musa textilis*, or abaca; hemps of Saigon, a species of *Urtica*, or nettle, from Cochin China; also string made from the fiber; *Coir*, or cocoanut fiber, of which a coarse rope is made; fiber, of the *Ananas*, or pineapple, apparently very good; *Battenbang* and *Suntang*, hemp-like fiber from Cochin China—very fine and apparently strong; fiber made from the stalks of the *Hibiscus esculentus*, or the common okra of our gardens; also fiber made from the *Bromelia karatas* (?) and banana. A curious kind of fibrous cloth is also made by beating the inner bark of the *Broussonetia papyrifera*, or paper mulberry in Tahiti, as likewise from the Dawron bark and *Ficus prolixa* from New Caledonia. As showing the annual production of textile fibers in the United States, including wool and silk, the following table for three decennial periods will be interesting as evidencing the status of these products:

Year.	Cotton.	Hemp.	Flax.	Wool.	Silk cocoons
	Bales.	Tons.	Pounds.	Pounds.	Pounds
1850	2,469,093	34,871	7,709,676	52,516,959	10,843
1860	5,387,052	74,493	4,720,145	60,264,913	11,944
1870	3,011,996	12,746	27,133,034	100,102,387	3,937

In 1878 there was produced, cotton, 5,200,000 bales of 450 pounds each. Flax, fiber, hemp and silk have grown less, though the acreage and yield of flax for seed holds its own. It will be seen from the table we have given, that outside of cotton the fiber crops of the United States do not aggregate a large sum. It seems quite safe to say that for many yet to come that the two staple fibers, of the United States will be cotton in the South and wool in the North. If machinery can be devised for cheaply converting other fiber crops into merchantable fibers of high quality, then, flax in the North, hemp in the Middle States, and ramie and jute in the South will take important rank, and other tropical and subtropical plants will also be brought into active importance.

THALAMUS. In anatomy, the part of the brain from which the optic nerves have part of their origin. In botany, the part on which the ovary is seated. The succulent red center of a strawberry, the core in the fruit of a raspberry, are the thalami of these plants. Some botanists call it receptacle of the fruit.

THALLUS. The leaf-like expansion of lichens, sea-weeds, etc. Hence these plants are sometimes called *Thallogens*, or *Thallophytes*.

THATCH. Straw, or any other dry vegetable substance, laid on the top of a building, rick, etc., to keep out the wet. There are many different materials that may be made use of as thatch, but the straw of wheat and rye, when well laid, forms the neatest and most secure covering for general purposes. The reed is a highly valuable article for the purpose of thatch, where a lasting roof is required; but is much too expensive at first, although it is cheapest in the end. Reed is also thought to be too stubborn for common purposes. In relation to the economy of thatching it is unfortunately true that, farmers often lose money for want of some waterproof covering to stacks and ricks. Very few stackers are able so carefully to lay a stack that it will not take more or less rain, especially when accompanied by driving winds. Yet if the crown of the stack is carefully topped, and thatch of some material carried well down to the shoulders of the stack, but little difficulty will be experienced. Cornstalks, leaves and all, laid with the butts up, commencing at the lower end of the slope, and so lapped that only about one-third of the stalks are uncovered, make a good thatch. Where lumber is cheap we have seen wide boards used, lapped as in siding, with good effect. The mode of thatching in a rough way will readily suggest itself to the intelligent farmer.

THECA. A case, usually the urn of mosses, in which their spores are situated.

THECOSTOMES. The class of insects which have their suckers surrounded by a sheath or case.

THEINE. The active principle in tea, *Thea viridis,* giving it its invigorating or stimulant quality. It is the same in coffee, *Coffea Arabica.* In coffee it is called caffein, the leaves containing more than the berries. The fruit of *Paullinia sorbilis,* a plant found in the valley of the Amazon, belonging to the family *Sapindaceæ,* contains a remarkable quantity of *Theine,* the alkaloid, being known as *Guaranine.* The kola nut, *Cola acuminata,* and Paraguay tea, also contain notable quantities of *Theine.* Good black tea contains of *Theine* 2.13 per cent.; various samples of coffee beans, 0.8 to 1 per cent.; dried coffee leaves, 1.26; *Guarana,* 5.07; kola, 2.13. Paraguay tea contains 1.25 per cent. of *Theine.* Thus it will be seen that one of the substances named is more than twice as rich as tea and another equal to it. (See article Tea.)

THEODOLITE. A surveying instrument for measuring both vertical and horizontal angles, necessary in accurate surveys.

THEORY. The expression of a general law based all on numerous ascertained facts. An hypothesis is merely a guess, without any basis on fact.

THERAPEUTICS. The science which treats of the action of medicines.

THERMOMETER. An instrument for measuring variations of heat or temperature. Fahrenheit's thermometer is the one generally used, the freezing point of which is 32° and the boiling point 212 at the sea level. In the arts and sciences, and especially in chemistry, Reaumer's and the Centigrade are often used. The following table will show the correspondence between the thermometers of Reaumer, Centigrade and Fahrenheit:

Reaum.	Cent.	Fahr.	Reaum.	Cent.	Fahr.
80	100.	212.	29	36.25	97.25
79	98.75	209.75	28	35.	95.
78	97.5	207.5	27	33.75	92.75
77	96.25	205.25	26	32.5	90.5
76	95.	203.	25	31.25	88.25
75	93.75	200.75	24	30.	86.
74	92.5	198.5	23	28.75	83.75
73	91.25	196.25	22	27.5	81.5
72	90.	194.	21	26.25	79.25
71	88.75	191.75	20	25.	77.
70	87.5	189.5	19	23.75	74.75
69	86.25	187.25	18	22.5	72.5
68	85.	185.	17	21.25	70.25
67	83.75	182.75	16	20.	68.
66	82.5	180.5	15	18.75	65 75
65	81.25	178.25	14	17.5	63.5
64	80.	176.	13	16.25	61.25
63	78.75	173.75	12	15.	59.
62	77.5	171.5	11	13.75	56.75
61	76.25	169.25	10	12.5	54.5
60	75.	167.	9	11.25	52.25
59	73.75	164.75	8	10.	50.
58	72.5	162.5	7	8.75	47.75
57	71.25	160.25	6	7.5	45.5
56	70.	158.	5	6.25	43.25
55	68.75	155.75	4	5.	41
54	67.5	153.5	3	3.75	38.75
53	66.25	151.25	2	2.5	36.5
52	65.	149.	1	1.25	34.25
51	63.75	146.85	0	0.	32.
50	62.5	144.5	1	1.25	29.75
49	61.25	142.25	2	2.5	27.5
48	60	140.	3	3.75	25.25
47	58.75	137.75	4	5.	23.
46	57.5	135.5	5	6.25	20.75
45	56.25	133.25	6	7 5	18.5
44	55.	131.	7	8.75	16.25
43	53.75	128.75	8	10.	14.
42	52 5	126.5	9	11.25	11.75
41	51.25	124.25	10	12.5	9.5
40	50.	122.	11	13.75	7.25
39	48.75	119.75	12	15.	5.
38	47.5	117.5	13	16.25	2.75
37	46.25	115.25	14	17.5	0.5
36	45.	113.	15	18.75	1.75
35	43.75	110.75	16	20.	4.
34	42.5	108.5	17	21.25	6.25
33	41.25	106.25	18	22 5	8.5
32	40.	104.	19	23.75	10.75
31	38.75	101.75	20	25.	13.
30	37.5	99.	....	....	....

THERMOSCOPE. A general term, including any instrument for measuring heat.

THIBITIAN GOAT. (See Goat.)

THICK LEG. (See Shot of Grease.)

THINNING OUT. Removing some plants, branches of a tree, or fruit to give the rest a better opportunity of growing large. It is an important operation in the orchard, as a tree over-burdened with fruit will not produce such fine specimens as one that has fewer to perfect.

THISTLE. *Circium.* There are numerous species, ten principal ones being enumerated in the North. They are all more annoying than noxious, except the dreaded Canada thistle. All are marked by the stalks, leaves and flower-heads being more or less prickly, by the heads being many-flowered, of a reddish purple or cream color, by the leaves on the stalks being sessile, alternate, often pinnatifid, and prickly, and by the seed being armed with *pappus,* or hairs, uniting in a ring, by which they are carried by the wind. Of the principal species, the common thistle, *C. lanciolatum* is naturalized from

Europe, *C. muticum* is the swamp thistle, *C. pumilum* is the pasture thistle, *C. horridulum* is the yellow thistle, and *C. arvense* is the Canada thistle.

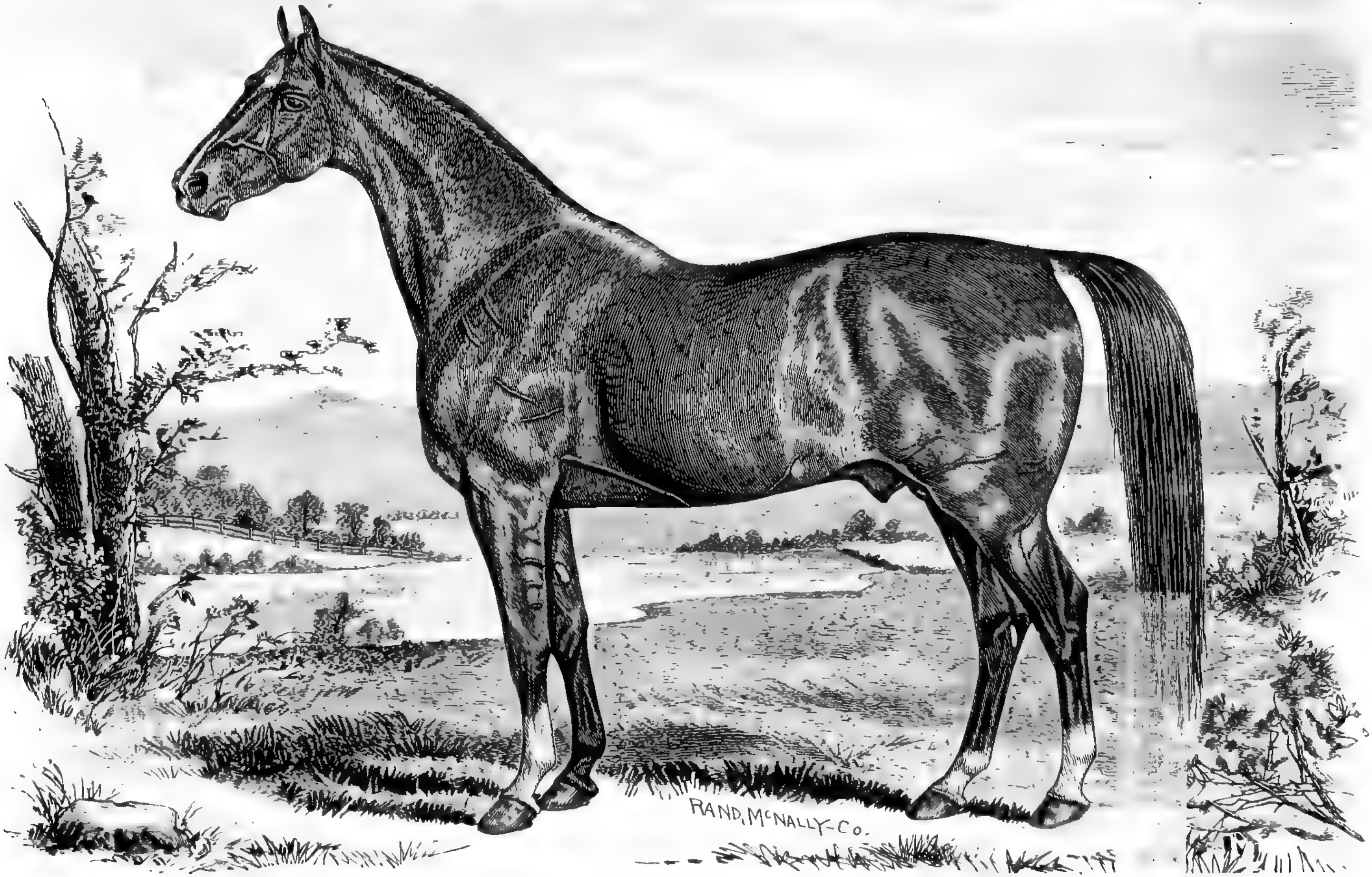
THORAX. The chest. The cavity of the chest is termed the thoracic cavity, and contains the heart and lungs. In entomology, the second segment of the frame.

THORACIC. Relating to the chest. The thoracic duct is a vessel which receives the contents of the lacteals and absorbents, and conveys it to the blood by the subclavian vein.

THORN. A name given to the hawthorn, and also generally applied to all spined, and even imperfectly spined plants, used for hedging.

THORN APPLE. Jamestown weed, Jimson weed, stink weed, *Datura stramonium.* A dangerous, unsightly and noxious weed, naturalized all over the United States, a member of the nightshade family, and known by its bad odor, large, funnel-shaped flower with plaited border, and by the spined, dark green seed pods. Children eating the seeds are poisoned, often fatally. The plant is valuable in medicine, but should be exterminated when found. It is a native of Asia and tropical America, but being an annual, readily propagates itself by seed. Some greenhouse species are very handsome.

THOROUGHBRED. The word Thoroughbred does not mean, as many suppose, an animal of pure blood, that is unmixed. If so, any wild animal would be a thoroughbred. The word thoroughbred is used to designate animals bred from the best blood, but originally derived from a mixture of races, as the short-horn cattle, and racing horses. In the articles Blood Horse, American and English, and in the article Horse, and in the article Short-horns, will be found matters of general interest relative to thoroughbred horses and cattle. In this article it will only be necessary to notice the essentials in thoroughbreds as applied to the horse. Mr. J. H. Walsh, (Stonehenge) a well known and competent English authority, in relation to the object for encouraging this breed of horses writes graphically and logically upon the thoroughbred. It will be of interest. The great object of encouraging the breed of racehorses, our authority states, is lost sight of, if suitable crosses for hunting, cavalry, and hack-mares can not be obtained from their ranks. In these three kinds, soundness of the feet and legs is all important, together with a capacity to bear a continuation of severe work. These qualities are highly developed in the Arab, and until lately were met with in his descendants on the English turf. Even now a horse with a stain in his pedigree will not bear the amount of training which a thoroughbred will sustain, his health and spirits soon giving way if forced to go through the work which the race horse requires to make him fit. But the legs and feet of the latter are the drawbacks to his use, and the trainer of the present day will generally be sadly taxed to make them last through a dry summer. Our modern roads are also much harder since the introduction of macadamization, and thus, in proportion to our greater demands, is the absence of the material to meet them. A hack that is not pretty well bred is now neglected, except for high weights, because his paces are not soft and pleasant, and he does not satisfy the eye. But how many of the fashionable sort will bear constant use on the road without becoming lame? And how many sound horses are there to be met with out of a hundred, taken at random from the ranks of any kind, tolerably well bred? Every horse proprietor will tell you, scarcely five per cent.; and some will even go so far as to say, that a sound horse is utterly unknown. Even though the thoroughbred horse is well fitted to compete with others in all cases where speed is the chief point of trial—as in flat-racing, steeple-chasing, hunting, etc.,—and yet he is not so well qualified for some kinds of harness work, or for road work of any kind, as the horse expressly bred for these purposes. There is no doubt that thoroughbred horses might be selected and bred expressly for this kind of work, and would excel all others, because originally their limbs and constitutions were at least as sound as, or perhaps even sounder than, any other class of horses; but while they are selected and bred solely for speed, without much reference to these other qualities, it is useless to expect much improvement; but, on the contrary, they may be expected to become yearly more and more soft and yielding. For many purposes the Eastern horse is wholly unfit — as, for instance, for heavy and dead pulls; here his high courage, light weight, and hasty temper are adverse to the performance of the task, and he is far excelled by the old English, or modern improved cart-horse. No thoroughbred horse would try again and again at a dead pull like many of our best breeds of cart-horses; and therefore he is little calculated for work which requires this slow struggling kind of exertion. The pull of the Eastern horse, or his descendant, is a snatch; and though it may to a certain extent be modified by use, yet it can never be brought up to the standard of the English cart-horse, even if the weight of carcase and size and strength of limb of the former could be sufficiently increased. Such then are the general qualities of the thoroughbred horse and the purposes to which he can be beneficially applied. It remains now to consider the formation and specific characteristics best adapted to the turf, which is his chief arena; and also to the hunting-field, which now absorbs a very large number of his breed. Finally, it will be necessary to consider him as a means of improving other breeds, such as the cavalry-charger, hack and harness horse, and for the stable. In the first place purity of blood must be considered as a *sine quâ non,* for without it a horse can not be considered thoroughbred, and therefore we have only to ascertain the exact meaning of the term blood. It is not to be supposed that there is any real difference between the blood of the thoroughbred horse and that of the half-bred animal; no one could discriminate between the two by any known means; the term blood is here synonymous with breed, and by purity of blood is meant purity in the breeding of the individual animal under consideration; that is to say, that the horse which is entirely bred from one source is pure from any mixture with any other, and may be a pure Suffolk Punch, or a pure Clydesdale, or a pure thoroughbred horse. But all these terms are comparative, since there is no such animal as a perfectly purely bred horse of any breed, whether cart-horse, hack, or racehorse; all have been produced from an admixture with other kinds, and though now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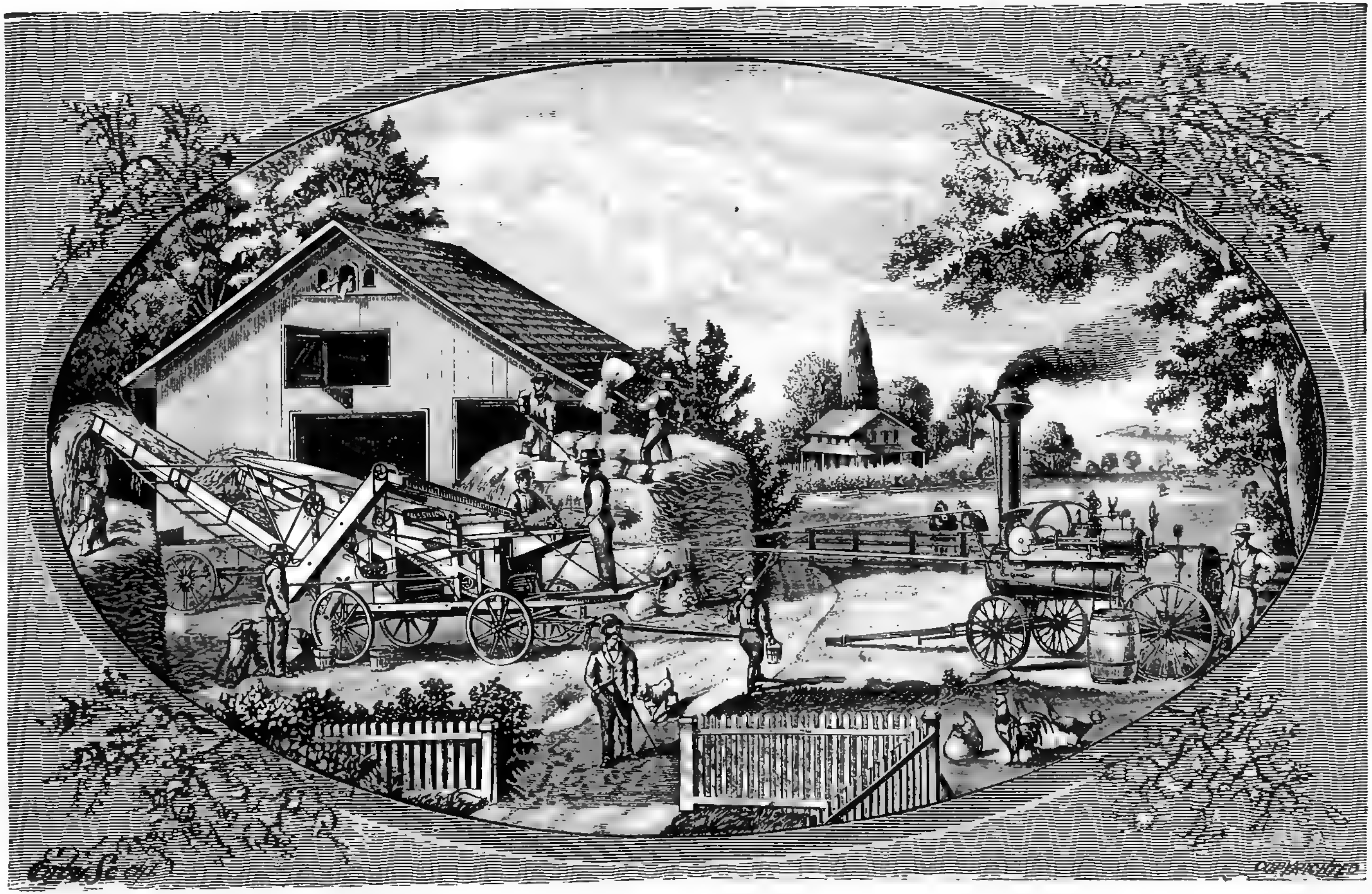
THOROUGHBRED STALLION VOLTIGEUR.



THRESHING BY STEAM,

kept as pure as possible, yet they were originally compounded from varying elements; and thus the racehorse of 1700, was obtained from a mixture of Turks, Arabs, and Barbs. Even the best and purest thoroughbreds are stained with some slight cross with the old English or Spanish horse, as has been heretofore shown; therefore it is only by comparison that the word pure is applicable to them or any others. But since the thoroughbred horse, as he is called, has long been bred for the race course, and selections have been made with that view alone, it is reasonable to suppose that this breed is the best for that purpose, and that a stain of any other is a deviation from the clearest stream into one more muddy, and therefore impure; the consequence is, that the animal bred from the impure source fails in some of the essential characteristics of the pure breed, and is in so far useless for this particular object. Now, in practice this is found to be the case, for in every instance it has resulted that the horse bred with the slightest deviation from the sources indicated by the stud-book, is unable to compete in lasting power with those which are entirely of pure blood. Hence it is established as a rule, that for racing purposes every horse must be a thoroughbred; that is, descended from a sire and dam whose names are met with in the stud-book. On page 943 we give a life-like illustration of the well-known racer, Voltigeur, which will show the admirable make-up of this wonderful subfamily of horses.

THOROUGH PIN. Thorough pin is a dropsical effusion, or enlargement of the sheath of the tendon which passes along the upper and posterior side of the hock joint, a synovial effusion in the bursa of the flexor muscle, and is similar to bog spavin and wind galls; both may exist, or be found separately without occasioning lameness. The best means of relief is by pressure, and cold applications alternately. The best means, unless a veterinarian is employed, is as given, the horse to wear a high shoe to relieve pressure, and a spring truss with rest. The difficulty with all this class is that the swelling is apt to return when the pressure is removed.

THRESHING. The old-time plan of threshing with the flail, is now only resorted to in those cases where it is necessary to save the straw of full length, and practically unbroken. This being the object, hand threshing by the flail has not been practically superseded by the use of machines. So again the most ancient practice of threshing by tramping with animals, is not now practiced except to a limited extent, and then generally only in the case of oats, when the straw is required for feeding cattle, it being well known that stock will eat straw better from under the feet of horses than if thrashed in any other way. The steam threshing machine of today is probably the perfection of swift, clean, and cheap threshing, many of the larger class of steam driven machines working up to 1,000 bushels, and even more in good wheat, per day; the practical limit of horse machines being less than half this amount, the grain being winnowed in the most perfect manner, and the straw at the same operation being delivered, by means of an automatic carrier, directly on the straw stack. Various devices have been patented for threshing by means of power machines, among them beaters and rotating flails. The spiked cylinder is, however, in most general use, being faster than any other known device. The chief improvements of late years in threshing have been in perfecting the winnowing apparatus, especially in regulating the blast from the fan, which is sometimes so strong as to blow the grain off the riddle. These devices have in view an automatic arrangement of the entrance passage for air, whereby, when the machinery moves rapidly, the size of the passage is decreased and the quantity of air admitted thus diminished, the operation being analogous to that of a governor of a steam engine, although the appliances nowhere resemble it. The theory of operation observed in several of these is this: The blast from the fan is directed against a flap, which communicates, by means of a lever, with a valve on the air opening. When the blast is moderate the valve, which is weighted, remains open; but when the blast becomes violent, owing to the rapid motion of the fan, the flap is moved, and the lever connection closes the valve wholly or in part. As the machinery moves more slowly the force on the flap is withdrawn, and the valve opens automatically by reason of the weight. Most farmers in the West are practically acquainted with steam threshing. Not so all in older settled countries where small farms are the rule. To illustrate threshing by steam, we give on page 944 a cut of steam engine, thresher, and gearing, with elevator for carrying the straw to the stack. Every bushel of grain, of whatever kind, sent forward from the farm in anything but the most merchantable condition, costs the farmer a loss precisely in accordance with the freight on, and the handling of the trash contained; the cost of recleaning, and the added depreciation in value from reduction in the weight of the standard bushel; added to this the lower price obtained, from the general inferior appearance of the grain from all these causes combined. Added together, the whole amounts to three or four times the cost of careful recleaning at home. Threshers, who, in fair to good grain, always work by the bushel, of course wish to make as much measure as possible, by rushing the grain through, often imperfectly threshed, and of course full of dust, dirt, straw, and light grain. The first four causes constitute a dead loss to the farmer, whether he recleans or not. The light grain, if sold with the good, always causes depreciation in quality more than enough to counterbalance its weight. Thus the farmer really has no one to blame if he allows it to be so. A little intelligent supervision will obviate all but the latter evil of light grain. This may be made right by recleaning; for, if the grain be conscientiously threshed and cleaned, still a dead loss must ensue to the farmer if he allows the grain to go from him without recleaning, since all the light grain and trash, inseparable from the best machine work, counts as nothing to the miller who makes the flour. Retained at home, this is all available as feed in some shape, and will pay the cost of recleaning with a heavy percentage added. It will indeed pay alone in the freightage of the trash, since this never realizes the transportation charges; these charges are no inconsiderable item, when thousands of miles are estimated. Thus he retains the light grain at home, and saves freights, for light grain counts for nothing in the markets of the world. So he saves in the enhanced value of clean grain—the most important of all. Last, but by no means least, he has the satisfaction of knowing that he is reaping enhanced profits honestly earned, by sending his products to market in the best possible condition. Then again, the straw in many sections of the Northwest is coming to be of value, both as winter bedding for stock and as partial winter feeding. As taken from the carrier of the machine, it should be carefully stacked, tramping the middle of the stack as much as possible, keeping the center well up meanwhile, with the longer straw as much as possible at the outside, and carrying the ricks as high as feasible, without expending too much labor. These, if built pretty broad, and in L shape, or, as three sides of a hollow square, will afford excellent shelter for stock in winter, and at the same time make excellent winter feed for cattle, horses and mules, with the addition of a little corn or other grain. There is one other thing in this connection, not generally well understood by farmers; grain once in the stack, and well protected, should not be threshed sooner than six weeks after. It takes about this time to get through the sweat that always ensues after stacking, however dry the grain may be. The same may be said of hay. It should never be fed to stock while it is undergoing this sweat. If grain is to be threshed at once, it should be done directly from the shock. If the grain, after being in a heap over night, or longer, shows any disposition to heat, it should be thoroughly aired by being thrown from one side of the barn floor to the other, or by being run through the fanning mill; this process to be continued from time to time, until it is thoroughly dry. A little attention to the details we have mentioned, will save many dollars yearly to individual farmers, now entirely lost.

THRIPS. These are minute orange-colored insects found in growing wheat heads, and said to subsist by sucking the juices of the unripe grains, causing them to shrivel. A usual remedy is to thoroughly dust the field with air-slaked, but dry lime. A species of leaf hopper, *Erythroneura*, is popularly but erroneously called the grape vine thrip, it sometimes severely injures the foliage of the vine by sucking the juices, causing them to assume a withered and spotted appearance, and sometimes to shed their leaves. The Entomologist of the Department of Agriculture, Washington, in one of the late reports says: The *Thripidæ* were placed by Westwood in a separate order called *Thysanoptera*, or fringed-winged insects, from their wings being ciliated or fringed. Packard places them in the *Hemiptera*. These insects possess two setiform, horny mandibles, which, by their juncture at the tip, form a two-valved syphon. They are of very small size, with bodies long, linear, and depressed; the four narrow wings are fringed with hair, and, when at rest, are laid horizontally along the back. By some naturalists they are said to injure wheat, etc. Dr. Packard says they are very injurious to grain and flowers, eating holes in the leaves or corollas, and sucking the sap from the flowers of wheat, in the bottom of which they hide. With a lens we have seen the sap oozing out of small punctures made by these insects on grape-leaves. Harris says, they live on leaves and flowers, in buds, or in the crevices of the bark of plants. Their punctures poison plants and often produce deformities in the leaves and blossoms. Curtis in his work on farm-insects states that the European species, *Thrips* (*Limothripps*) *cerealis*, once destroyed one-third of the wheat-crop in Piedmont, and that the shriveled grains of wheat are caused by the thrips extracting the milky secretion. Westwood says that, the thrips infest wheat to a mischievous extent, causing the grain to shrink. These are only a few extracts from reliable authorities, to show that by some it is considered an injurious insect, and yet on the other hand Mr. Walsh once said he did not believe the true thrips to be a vegetable-feeder, but that on the contrary they are cannibal insects preying upon injurious larvæ; and again he says, these insects have hitherto been considered to be vegetable-feeders, but are generally, if not universally, insectivorous, and feed upon the eggs of the wheat-midge (*Diplosis tritici*) and on gall-making larvæ. A small yellow thrips is mentioned in Mr. Riley's second report as destroying the eggs of the curculio or plum-weevil. From the above statements it appears that in certain cases the true thrips (not the insect generally known by the name of the grape-thrips, and which is a leaf-hopper), is in some degree beneficial by destroying other insects; but it appears to be very questionable if advantage from the few insects destroyed by them is at all commensurate with the injuries they inflict on our grain-crops, grape vines, fruit trees, and vegetation in general. The remedies suggested for the destruction of these insects, in gardens and greenhouses, are the same as those suggested for plant-lice (*Aphides*), such as dusting with slaked lime, syringing with whale oil, soap and water; or strong soap suds, tobacco water, or a decoction of aloes or quassia and water and soapsuds, taking care not to wet the fruit, when on grape-leaves. It must, however, here be again remarked that the insect, generally known as the grape-vine thrips, is a homopterous insect or leaf-hopper, which, when disturbed, leaps with great activity from the leaves, and is not of the same long, linear form as the true thrips, which generally remains stationary upon the leaf, or, at most, crawls slowly over it, and never flies in such swarms as the *Erythroneura*, or grape-vine leaf-hopper, whenever the vines are disturbed.

THROAT. Faux, the commencement of the tube of a personate or labiate flower.

THROWING FOR OPERATIONS. When any painful operation is to be performed on an animal, it must be securely fastened. This is done by hobbling and casting the animal, and then securely tying. For operations not requiring a long time, a pen may be made, three feet wide six feet long, with strong posts where the limbs will stand. To these the limbs may be securely bound, and the animal may be supported, if necessary, with slings. Secure the head, and he can neither bite nor kick. The manner of throwing is described in the Horse Owners' Cyclopædia as follows: Hobbles consist of four broad padded leather straps, provided with strong buckles, and long enough to encircle the pasterns. To each of these an iron ring is stitched, and to one of them a strong, soft rope, six yards in length, is securely attached. Provided with four, or, if possible, five assistants, the operator buckles the hobble with the rope attached to the near foreleg, and the remaining three to the other legs. Then passing the rope through their rings, and through the first also, it is held by three assistants, the nearest of whom stands about a yard from the horse, so as to pull upwards as well as away from him; a fourth assistant holds him by the head to keep him quiet, and to be ready to fall on it as soon as he is down, and the fifth stands at his quarters, ready to push him over on his off side. This place is sometimes occupied by the operator himself when short of hands. Casting should never be attempted on any hard surface, a thick bed of straw being necessary to prevent injury from the heavy fall which takes place. The hind legs should be brought as far forward as possible before begining to pull the rope, and when the men do this they should do it with a will, but without jerking, so as to take the horse off his guard, when he will resist much less stoutly than if he is allowed more time. As soon as the legs are drawn up together, the man at the quarters is quite safe from injury, and he may lean forcibly against that part, and force the horse over to the off side, upon which he falls: the assistant at the head keeping that part down, no further struggling takes place, and he is secured by passing the end of the rope under the hobble rings between the fore and hind legs, and securing it with a hitch. Something more, however, is necessary to be done before any of the usual operations can be performed, as all of the legs are at liberty to a certain extent and the scrotum can not be reached in safety. The following further precautions must therefore be taken, varying according to the part to be operated on. For castration the horse should be cast on his near side, with a web halter in the usual place of a collar. The rope of the halter is then passed through the ring of the hobble on the off hind leg, and using it as a pulley the foot is drawn forcibly forward beyond the arm and firmly secured to the webbing around the neck, and bringing it back again it may be passed around the thigh above the hock (which should be guarded from friction by a soft cloth or leather), and again secured to the webbing. By these precautions the scrotum is completely exposed, and the hind legs can not be stirred beyond the slight spasmodic twitch which extends to the whole body. To perform any operation on the fore leg it must be taken out of its hobble, and drawn forward upon the straw by a webbing attached to its pastern, where it must be held by an assistant, the horse having little or no power over it in this position. The hind leg is secured in the same way as for castration, unless the fetlock is to be fired, when webbing must be applied to the thigh above the hock only. With most horses, however, firing can be performed without casting, by buckling up the fore leg, or by having it held by a competent assistant. When the horse is to be released, the hobbles are quietly unbuckled in succession, beginning with the undermost hind leg. Several improved hobbles have been invented, but they are suited rather for the veterinary surgeon than for the ordinary horsemaster, who will only require them for castration and minor operations. The side line is sometimes used for securing one hind leg thus: the long rope and single hobble only are required, the latter being buckled to the hind pastern, which is to be secured. The rope is then passed over the withers and brought back around the bosom and the shoulder of the same side as the leg to which it is secured, and then passed inside the first part of the rope. By pulling at the end of this cord the hind leg is drawn up to the shoulder, and secured there with a hitch, but the plan is not nearly so safe as casting.

THRUSH. This is a diseased condition of the frog, commencing at the cleft, and extending over the whole frog, attended by a fœtid discharge. It is brought about by foul stables, and neglect of the feet. Clean and excise the diseased growths, and a leather shoe should be worn, to support the layer of tar with which the diseased frog may be covered.

THYME. Two species of thyme are cultivated, the common garden thyme, *Thymus vulgaris*, and the Lemon or Evergreen Thyme, *T. citriodorus*; are perennial plants of low growth, called hardy, but not wintering well in the west without winter protection. It is one of the few sweet herbs, in common cultivation, the others being Sage, Summer Savory, (*Saturjea viminea*), and Sweet Marjoram, (*Origanum majorana*). The cultivation for all the species named is alike, gardeners generally raising them as a secondary crop by transplanting, strong seedlings, or by division of the roots. (See article Sage for cultivation.

THYROID GLAND. A gland situated in front of the throat.

THYRSUS. An inflorescence similar to that of the common lilac.

TIBIA. The largest of the two bones of the fore leg. In entomology, the fourth joint of the leg.

TICKS. Among vegetable productions what is known as Beggar ticks are the ripe seeds of *Bidens chrysanthemoides*, and also the seeds of Spanish Needle, *B. bipinnatus*, is sometimes so called. Sheep ticks, *Hippobosca* (*Melophagus*) *ovina*, is a small louse fly, without wings, often exceedingly troublesome, especially to lambs, the insect leaving the mother sheep for the lambs, while sucking. All sheep should be examined occasionally for ticks. When not numerous they may be removed by picking. They may be destroyed by dipping the sheep (with the exception of the face and head) in a mixture of arsenic, soft soap, potash, and water, or other arsenical preparations; but they, being highly poisonous, are very unsafe remedies, and can not be recommended for general use. Decoctions of tobacco, applications of brimstone, lard, paraffine oil, etc., about the neck, are common remedies. Snuff or sulphur in powder, rubbed thoroughly into the wool, is sometimes used with good results, and a bath made by steeping tobacco in water, about two pounds to ten gallons of water, in which the lambs are immersed, (except the face,) is said to be effective, but in some cases has proved injurious to the health of the lambs. In the case of lambs, therefore, it would be proper to reduce the strength. It should, however, be observed that the weakness produced by the tobacco most usually passes off in a short time. Of Cattle ticks, one of those most usually found is the common *Ixodes*, and which at one time was popularly supposed to be the cause of the Spanish fever in cattle. They are not common in the north except when distributed by Texan cattle, which often are covered with them, when driven from the south. The remedy is by picking. The late lamented Dr. Walsh, in referring to these insects, gave the probable facts in the case as follows: There is a prevailing opinion amongst certain classes, that the ticks which are found on the cattle which die of Texas fever are actually the cause of the disease. In view of this fact, specimens of these ticks have been sent us for examination, from different localities in Illinois, and they are identical with those we have ourselves examined upon diseased cattle in St. Louis, and are but the common cattle tick. It is exceedingly improbable that they have anything to do with the disease, although it is barely possible that they may communicate the infection from the Texas cattle to our native herds.

TIE. In building, a timber or metal used to bind together two parts which are liable to separate.

TILE. (See Drainage.)

TILLAGE. (See Cultivation and Plowing.)

TILLER. Branching off stems from the root.

TILTH. Firmness and preparation of the soil.

TIMBER. In the article Forestry and in the description of the more important species of useful trees, we have noticed those species generally cultivated for profit or ornament. Upon the importance of the timber resources of the country and the yearly increasing scarcity, and the need of planting for continued supply, we append a statement from an address, in 1871, by the editor, before the Illinois State Horticultural Society, and which is of as great force now as then in view of the continually diminishing supply, and also from the facts gathered in relation to forestry: It was remarked by Humboldt that, in felling trees which cover the crowns and slopes of mountains, man in all climates seems to be bringing on future generations too calamities at once—a want of fuel and a scarcity of water. The destruction of timber and the dense mass of natural grasses with which the prairies were originally covered, has added another most serious one—meteorological disturbances which are constantly modifying the climate, and if persisted in without compensation, must ultimately result in depopulating the country by rendering it unfit for human habitation. It was asserted twenty years ago [now thirty—Editor] that, before the United States reached a population of 50,000,000 that, through the waste of valuable timber, the folly and short-sightedness of the age would meet with a degree of censure and reproach not pleasant to contemplate. This point was reached before the census marked 40,000,000; and it is due principally to the causes just mentioned; which may be illustrated by the following deductions based upon facts: Heated air saturated with water in the form of vapor, gives up a portion of it if cooled, or absorbs more if its heat is increased. This power is doubled with each increase of temperature of twenty-seven degrees of Fahrenheit; therefore, if a warm current meets a colder one, both saturated, a portion is condensed and forms clouds and rain. If in falling this rain passes into a dry current of air, it may be absorbed partially or wholly before reaching the earth; or falling through a saturated atmosphere, from high elevations or cold strata, its intensity may be increased by aggregation. All open countries are subject to violent atmospheric alternations; but if clothed with vegetation, especially timber, the changes are less violent, and the temperature is equalized. The solar rays have more power to heat plowed soils, than those unplowed; and just in proportion to their powers of absorption, will be their power to give up this heat again. In the cool recesses of the forest, evaporation goes on more slowly than in the open plain, for the reason that the rays of the sun seldom reach the earth, and hence their power of holding moisture and giving it out slowly by percolation to feed the springs that always abound in such regions. This cooler atmosphere, condensing moisture from the currents of heated and saturated air flowing in from the more open country, often causes the gentle rains incident to such localities. Evaporation causes latent heat, precipitation sets it free again or renders it sensible; and thus nature by increasing the capacity of air to both hold and give up heat and moisture prevents those deluges that would otherwise occur, stores up heat and moisture to be given out regularly and slowly, unless influenced by violent meteorological convulsions. These are of infrequent occurrence in timbered districts, but are frequent, and often devastating, in open countries. While timbered regions have equal and gentle rainfalls, the open country beyond is visited with rain at unequal intervals, and torn by terrible winds accompanied by violent electrical phenomena. Forests modify all this, and although they may have no marked effect upon the amount of annual rainfall, they do cause it to be more equally and gently distributed, than is the case in countries where there is but little timber. Wide regions entirely destitute of timber have little or no rain, and become deserts often, not from their want of fertilizing inorganic and organic elements, but for want of that great fertilizer, water. I am well aware that Professor Henry is reported as saying that the records of the Smithsonian Institute do not indicate an annual diminution of rainfall, during the last twenty years. Annual granted, but its irregularity and also its infrequency is becoming more and more noticeable each year, and is apparent to the most ordinary observer; and it is this irregularity that is constantly harassing the farmer and horticulturist, more and more with each successive year. The meteorological changes incident to the destruction of forests seem to be well known to the ancients, and hence the many mythological tales that have come down to us through the old Hindoo, Chinese, and other writings. Alluding thereto, the poet Bryant says:

> The groves were God's first Temples.

Abraham and his children planted groves in which to worship. Upon the re-occupation of the soil by the Hebrews, they cut them down because pagans worshipped there. The denudation constantly going on, the once fertile Canaan, land of groves and meadows, flowing with milk a d honey, became an arid waste. The vast deserts of the earth, from the fossil woods occasionally found therein, were probably once fertile regions. The valley of the Nile, once famous for its forests, at length became useful for cultivation only by means of irrigation; later, through the planting of some millions of forests trees by the Pachas of Egypt, this country has again been visited by rain. The modern civilized man will leave deserts in his path much sooner than did the ancients, because his wants are more multifarious, and because he has the means of much quicker and more sure destruction of the forests. What he leaves, is more surely destroyed by desolating fires driven by tornadoes occasioned by meteorological changes which certainly follow this destruction. These changes are already beginning to show themselves in California in one direction, just as surely in Utah in another direction; in California by increasing drought through denudation, and in Utah, as in Egypt, by an increasing rainfall through replanting. The vast treeless plains of the far West were once clothed with timber, at least portions of them, else why the dry beds of rivers which have again become living streams by settlement and the protection of timber; an illustration of which may be found at Denver, Colorado. Look at modern Persia, prostrate with gaunt famine and without possibility of help, since the regions adjacent are desert and uninhabited, except by marauding barbarians; these tracts must be traversed by primitive pack-mule or camel trains, consuming their loads ere they could reach these famishing and dying wretches. What has lately befallen Persia, may be the fate of regions now abounding in agricultural and horticultural wealth, in succeeding generations, if the progress of destruction in our forests, and the denudation of our natural grasses is allowed to go on without replacement. Let us look for a moment at the destruction going on in a single section of our country, the lumber region of Michigan and Wisconsin, bounding upon lakes Michigan and Superior; for in the limit of this paper I can but touch upon facts. To write up the subject fairly would require a large volume. The records are many of them already written, and the curious in such matters have but to read to find them. According to the report of the Commissioner of Agriculture for 1870, there are 10,000,000 acres of land in Wisconsin and the upper peninsula of Michigan, north of the forty-fourth degree of north latitude, which, previous to the settlement of that portion of these states, were covered with forest growths, valuable for timber and fuel. Since that time at least one-half of this growth has been cut off, and the timber brought into market and sold; and 1,000,000 acres of hard wood timber has been felled and burned upon the land by the settlers, while clearing up their farms. About 4,000,000 acres remain undisturbed. From the mills in that territory, there have been annually shipped 750,000,000 feet of lumber. To the ports of Lake Michigan, in 1869, there was brought the enormous quantity of 1,250,000,000 feet of lumber, and with that shipped east through the Straits of Mackinaw, the grand total of lumber annually sent from the forests of northern Wisconsin, and the upper peninsula of Michigan, is 1,750,000,000 feet. Does any one apprehend the immensity of these figures? We may arrive at it by synthesis. Suppose a machine, capable of making and counting one hundred strokes per minute, were to run night and day without stopping, it would count 52,596,000 in one year; consequently to count this number it must work uninterruptedly for nearly thirty four years or, more exactly, thirty-three years, three months, twenty days, twenty-one minutes, and nearly five seconds. The average yield of pine timber in this region is usually estimated by practical lumbermen, at 300,000 feet per forty acres. Some place it higher. Reckoning 330,000 feet, it will be seen to require a little more than 200,000 acres for the annual timber supply. Add to this quantity 100,000 acres for railroad ties, telegraph posts, hewn timber, and shingles, determined by actual amount received in the Chicago market, and 30,000 acres for the amount cut and burned in clearing the land, and we have 330,000 acres denuded annually. At this rate of consumption, all the valuable timber remaining on these tracts, (at the time this estimate was made, 1869,) would be consumed in twelve years. The destruction of these forests by a great conflagration has been estimated to be equal to a ten year's supply of timber, all of which will be a total loss, except in so far as the lumbermen may be able to immediately work up the charred remains. This ten years' supply would amount to 10,750,000,000 feet, worth, at twenty dollars per thousand, $215,000,000. Add to this the destruction of personal property, and the sum will approximate $250,000,000; and thus we have destroyed, in one short month, including the losses in Chicago, over $500,000,000 as one of the items of loss, aggravated by climatic changes incident to the artificial denudation of our forests and our natural grasses. The remedial means that are being used to increase our timber are principally in the prairie regions. It is estimated that there have been annually sent out from the districts just ranged by fire, 100,000,000 trees; also 50,000,000 of nursery-grown forest trees are annually shipped—one firm alone, in Illinois, furnishing 10,000,000 to 15,000,000 a year, the balance being made up by the other nurserymen throughout the West. Besides this there is some stock annually imported from Europe, but in the aggregate this is not appreciable, and owing to the losses sustained thereon, these importations are growing less each year. Therefore, we have in round numbers, 150,000,000 of trees planted each year, which at 1,000 trees per acre, would give 150,000 acres per year, not half enough planted in all the prairie States, to replenish the waste in two small districts. In a money point of view, it will therefore be seen that there is no more profitable occupation that can be followed, for the next fifty years at least, than the raising of timber for sale. If we ever arrive at a practical solution of this question, it must be because it will enrich the pocket. Looked at from an æsthetic standpoint, it meets our most pleasant approbation. As a sanitary measure, it is of great value. That it ameliorates and modifies climates, there is no longer a question; and the money value of timber plantations to the planter is also so well assured by experiments, both in this country and in Europe, that there need be no longer hesitation on this score. The only questions remaining are how to work so as to secure the greatest area of plantations, where to plant, and how to plant. The first can only be accomplished by concert of action among the agricultural classes. The second question, where to plant, may be answered—upon knolls, on the steepest hill sides, above rocky bluffs, along the margins of regular and irregular streams, the dry beds of former streams, sloughs, and other low places, occupying each site with timber appropriate to its situation. Plant in rows if practicable—and there are comparatively but few places in the West where it is not so—upon thoroughly prepared land, so thickly as to soon shade the soil, and give good cultivation from three to six years, according to the variety of timber planted. One more question occurs here, and that is as to how much to plant. It is estimated in Europe that at least one-fifth of the area of a country should be covered with trees, to insure the best results in general tillage. This would give forty acres for each farm of two hundred acres. A large area for many farmers to look at, but let them remember there is money in it, and with modern appliances for cultivation after the planting is once done, it simply means so many acres less of corn. If this area were planted it would not be twenty years before each farm would have its system of springs and rivulets, and from having one of the worst watered, we should have one of the fairest climates, the best watered, and most beautiful country that the sun ever shone upon. Nature has bestowed here a region lacking only trees to make it a paradise. It is filling up with the human energy, and intelligence, and skilled labor of the nations of the earth. Absolute freedom, both civil and religious, is the prerogative of all, under the law. We have only to heed the lessons that nature and events are constantly teaching us, to become not only one of the most prosperous and happy, but also the greatest and most far-sighted people upon the face of the earth. The prosperity of nations rests upon their agricultural resources, and one of the pillars of that agriculture is wealth of timber. And no nation can continue permanently great without it. It devolves upon this generation to lay the foundation of the prosperity of succeeding ones. Nature clothed the earth with timber and grasses, and in the fact that it takes generations to produce the monarchs of the forest, is the lesson that man may not with impunity destroy these without replacement. They have been destroyed heretofore, the destruction is still going on, but at what a terrible price! and how fearful the lesson to the destroyers in every era! Let those who are curious read its history in every land. If we expect assistance from the general government I fear we are bound to be disappointed. Unlike some European ones, which we are sometimes pleased to term despotic, ours being subject to periodical change, the politicians have no time to look at the future; present perquisites absorb the thoughts of too many; it is only a far-seeing few who take heed to the hereafter. The State governments of Illinois, Missouri, Kansas, and Iowa, have done something; they should do more by assisting individuals and corporations, (by every means in their power) upon whom must devolve the task of clothing these vast plains with forest growths. Parents desire to leave their children prosperous and happy, and what better heritage can a father leave his child, next to a good name, than a well kept farm, sheltered by pleasant groves, within whose cool recesses are born living springs that issuing forth gratefully slake the thirst of flocks and herds, and trickling to the valley form the rivulet, which, swollen along its way by other brooks from other homestead groves, turns in its laughing course hundreds of mills busy with their wealth of productive industry. This is no improbable picture, but is simply a view of the certain results of conformity to Nature's laws of cause and effect; and we know from history as well, that such tree-planting as I have here reccomended will surely produce the blessings enumerated. The opposite of this picture we are already beginning to see in the drying up of streams once used for turning mills, in the accumulative force of, and constantly increasing destruction from tornadoes, in the extreme heat and drought of our already tropical summers, followed by the cold winds of arctic winters, alternated with torrents of rain or fearful storms of snow. The children of those barbarous nations which followed the civilization that destroyed the ancient forests, retained the traditions relating thereto. As succeeding civilization advanced, these traditions were woven into fables, incorporated into their religions, and gods and goddesses made the avengers of the sacrilege. Shall the destruction of the great forests of the western continent again depopulate nations? We think not. The printing press has given wings to science, and science has already shown the means of recuperation but not until that recuperation may also afford the means of wealth. We have spoken of the attention which some of the European governments are paying to the protection of timber. With them the industries are of paramount importance. England the greatest manufacturing nation on the face of the earth, is beginning to be alarmed at the exhaustion of her coal-fields, which is expected to take place any time between the years 2300 and 3000, as her facilities for deep mining may be more or less increased. The total denudation of our great forests may be fixed at a much nearer date by estimating the constantly increasing demand upon our timber, far exceeding both the natural and artificial growths, and yet we are not giving the heed to the subject that its importance demands I do not hesitate to say that if this denudation is allowed to go on without adequate replanting, this generation will see the almost total destruction of our more valuable hard and soft-wood trees. Believing our forest wealth practically inexhaustible we have gone on perfecting wonderful machinery, marvelous in its perfection for the working of wood. For this industry is one of the paramount ones, and actually pays more than one half of our internal revenue. But if as we go on perfecting our machinery we do not also increase our supply of the raw material, this very perfection will eventually bring disaster upon the whole industry. In Prussia, France and Bavaria it is estimated that there are about 10,000,000 acres of state forests. One-half of these belong to Prussia. In this country, as well as in other European ones, there are schools of forestry. At the head ot the schools, as in other schools of technology, are placed men eminent for their practical attainments in these several branches of human knowledge, and as an item, in one direction, resulting from the schools of forestry we may note, as an important fact, that the annual revenue derived by France from her state forests before the war, was over three dollars per acre, or $8,700,000 per year from 2,700,000 acres. The subject of tree planting may now be considered as one of paramount importance. As affecting us physically, in the present and future it is so, and it is fast becoming so in a money point of view. We have shown from statistics what the average acre of timber will produce in lumber under the destructive means employed in all new countries for its manufacture. If multiplied by the present prices, and the other economies connected with forestry are estimated, even aside from any and all social considerations except money value, it may readily be perceived that the planting of the waste tracts that may always be found upon every farm will pay better in the future than any other crop that can be grown. The Hon. J. M. Edmonds, another writer, in relation to this subject of forest waste says: Maine, Michigan, Wisconsin, Minnesota, and Florida are the only States east of the Mississippi which now export any appreciable quantity of timber more than they import, and the reserve in these States is being rapidly cut away. The mountain and plateau region, occupying the interior of the continent, has only a moderate supply. No supplies can be drawn from this region for the older States, or even for the great plains; without exhausting a reserve which is already below the immediate prospective demand. In the Pacific States and Territories there is still an adequate supply, but not beyond the early prospective wants of their own people. The States bordering the Mississippi on the west have no surplus, and most of them are at this moment importing to meet the demands of even their sparse population. Arizona, New Mexico, Colorado, Wyoming, Montana, Idaho, and Dakota have but a meager supply, not sufficient for a population as dense as now occupies Ohio, Indiana, or Illinois. Only the newly acquired Territory of Alaska remains to be considered. Very little is known of its timber resources, but, in much the largest portion, it is known that its rigorous climate precludes the growth of valuable forests, but it is not too much to presume that the timber in that Territory will be sufficient to meet the demands of the trade now opening with the great populations of China and Japan. Considering, then, the present and the prospective forest products in this country in the light of their necessity for domestic purposes, and for the protection of men, animals, fruits, and grain, and of their value in inducing moisture, protecting the soil, and tempering the climate, it is, indeed, important that every section of the country should retain, if it has them, and if does not have them, should immediately engage in their production, at least to the extent of supplying local use and protection. In upper Egypt, the rains, which eighty years ago were abundant, have ceased since the Arabs cut down the trees along the valley of the Nile towards Libia and Arabia. A contrary effect has been produced in lower Egypt, from the extensive planting of trees by the Pacha. In Alexandria and Cairo, where rain was formerly a rarity, it has, since that period, become more frequent. Prof. R C. Kedzie, of the Michigan State Agricultural College, in an address—The Influence of Forest Trees on Agriculture—delivered not long since before an agricultural society in that State, gave a very earnest warning against the wasteful destruction of forests, citing, at the same time, the well known facts of current history. It is noticeable as a hopeful fact, that prominent agricultural societies, in various sections of the country, have recently been emphatically directing public attention to this matter. In 1864 the British government founded an improved general system of forest administration for the whole Indian empire, having in view the preservation and development of state forests. All superior government forests are reserved, and made inalienable, their boundaries marked, and forest rules and penalties defined. Surveys have been made, and are still in progress, towards establishing data as to the nature and extent of the timber resources. Several thousand mahogany trees have been raised in the Terai. Large tracts have been planted to wood for the purpose of supplying the railways, which consume immense quantities for fuel. Puget Sound, Washington Territory, is well known as a principal source of the lumber export of the North Pacific coast. Besides amounts consumed within our own territories, many cargoes of lumber are annually shipped from thence to ports in China, the Sandwich Islands, Australia, and South America. The following statement in regard to the resources of Puget Sound is on the authority of Mr. Joseph Cushman, receiver of public moneys at Olympia, situate at the head of the sound: The time is not far distant when nearly all the ship building on the Pacific coast will be done on the shores of Puget Sound. From the Cascade range to the Pacific, comprising about one-half of Washington Territory, the surface is densely covered with the finest forest growth in the world. Some of the trees, straight as an arrow, are four hundred feet in height, and fourteen feet in diameter near the ground. Varieties of the fir predominate, interspersed with spruce, hemlock, tamarack, white cedar, maple, ash, white oak, and, on some of the mountain slopes, white pine. The yellow fir (*Abies Douglasii*) is a tree peculiar to the North Pacific coast from the forty-second parallel to Alaska, and is found only east of the Cascade range, north of the boundary of forty-nine degrees. This is the timber principally used at the saw mills on the Sound, and is both strong and durable; in fact it is the strongest timber on the coast, both in perpendicular pressure and horizontal strain.

TIMBER TREES, RANGE OF. The statistical atlas of Gen. Walker contains a careful analysis of our forest wealth, prepared by Prof. Brewer, of Yale College. It will be found valuable, in connection with the articles Forestry and Timber. Considered botanically, the flora of the United States is very rich in woody plants. The actual number of species is not known, but 800 is perhaps not too high an estimate. There is no dividing line in nature between trees and shrubs; the arbitrary rule adopted by most botanists is to call trees only such species as grow to thirty or more feet high; less than that are shrubs. Sometimes, however, the habit of the plant will place among the trees a plant which, from size alone, would be called a shrub. An examination of various authorities shows that upwards of 300 indigenous species of trees are known to botanists growing within the limits of the United States, which attain the height of thirty feet. About 250 of these are, somewhere in the United States, tolerably abundant, or, at least, not rare. If for our purpose we exclude all the smaller trees that never attain a height of fifty feet, also those tropical species, however large, which occur with us only in extreme Southern Florida, also a few Mexican trees found only along our extreme southern border, also such rare species as may occur only in Alaska, also all those very rare species nowhere common, and consider only the larger trees which are somewhere in our territory tolerably abundant, we have still about 120 species, of which about twenty species attain a height of 100 feet, twelve a height of 200 feet, while perhaps five or six may attain a height of 300 feet and over. Of the 120 species indicated, about fifty belong to the *Coniferæ.* How many of these species are of special importance in commerce, or in the home industries (of other use than for fuel), it is impossible to say, but it is a very large proportion of the whole number. Many of the smaller species, however, and of the larger shrubs, give special character to large areas of woodlands, and can not be ignored in any discussion of American trees, whether considered botanically or economically. A glance at the map shows large regions either treeless or very sparsely wooded. It is possible to cross the continent, from the Pacific to the Gulf of Mexico, without passing through a forest five miles in extent, or large enough to be indicated on the map. Then, again, the woodlands of the East are separated from those of the West by a broad, treeless plain from six to fifteen degrees wide. The forests and woodlands on the two sides of this gap are entirely unlike in their aspect and in their botanic characters. On the eastern side, broad-leaved, hard wood species predominate, both in abundance of individuals and in number of species, the forests of large areas consisting entirely of such kinds. On the west, the forests are entirely of *Coniferæ;* other species occur, some of great value, but they nowhere (or at most in only rare cases in the extreme west) form a conspicuous or even noticeable element in the forests of both sides; the nearest approach to it is the aspen, (*Populus tremuloides*), which is a common tree in the North from the Atlantic to the Pacific. Two species of cottonwood are also abundant in some localities, and form an important element in the fringe of wood bordering streams, but are never otherwise a conspicuous element in the forests of the West. These three species of poplar are the only broad-leaved trees that figure as trees on both sides of the central treeless plains; but others stray across as mere shrubs on one side. Among the *Coniferæ,* one cedar is found on both sides as an abundant wood in places, but it is a low, crabbed growth west, a large shrub oftener than a tree. Neither beech, nor elm, nor hickory, nor mulberry, nor basswood, nor tulip-tree, nor magnolia, nor sassafras forms an element in the forests of the Rocky mountains and westward. For convenience in discussing the kinds of wood, we may divide our domain into ten geographical divisions, viz.: 1. New England; 2. The Middle States; 3. The Southeastern region; 4. The Northwestern region; 5. the Southwestern; 6. The Plains; 7. The Rocky Mountain region; 8. Arizona, New Mexico, and the Great Basin; 9. The Pacific region, and 10. Alaska. Only native species are considered in the following discussion of the kinds of wood. So much confusion exists in the popular and commercial names of many of our trees that the botanical name is given where necessary for precision. One example is sufficient to illustrate this confusion of names. The most widely spread and valuable of western timbers, *Abies Douglasii,* which grows from British Columbia to New Mexico, is known in its different localities under the various names of Douglas fir, red fir, black fir, Douglas spruce, red spruce, black spruce, hemlock, Oregon pine, western pitch, Bear River pine, swamp pine, and perhaps others; moreover, nearly all of these names are also applied to other species. Similar confusion exists in the popular names of not a few species. New England was originally entirely wooded, and has about eighty or eighty-five species of trees, of which about sixty may reach fifty feet in height. Maine is a great source of pine-spruce lumber, but, as a whole, hard wood species predominate, particularly south of the forty-fourth parallel. Many of these hard woods are noted for their durability and texture, and form the raw material for a great variety of manufactures, particularly of carriages and various tools and implements where tough wood is an essential part. The extent and variety of manufactures in wood is relatively greater in this region than elsewhere, and ship building is an important industry. The large timber used in house and ship building is unquestionably rapidly diminishing, but the area of woodlands is not decreasing in the same ratio. In many places the large trees suitable for sawing, are cut without clearing the land of the smaller growth, leaving it still woodland; and as such it is shown on the map, in article Forestry, page 369. As a whole, the area of woodlands in this region is but slowly, if indeed at all, diminishing, and in large districts it increases from year to year. This is particularly the case in portions of the western part, where hilly regions, formerly largely in tillage and pasturage, are now growing up with trees, mostly of hard wood kinds. Some of the timber thus grown is considered peculiarly valuable in manufactures, where strength and durability are needed. This extension of woodland areas is by natural process. Few, if any, forests have been planted, except on the sandy regions along the southern part and on the islands, where pines have been planted to some extent. The extensive planting of trees for shade and ornament, however, increases largely the actual amount of wood in this region. To appreciate how much it is only necessary to see many of the New England villages and cities from some height in the summer, where the abundance of trees gives the appearance of a forest to the scene. Some of the cities have more actual wood growing in their streets and parks than is sufficient to be termed a heavy forest of timber in the sparsely wooded regions of the West. In New England, the elm, and perhaps the sugar maple, attain their finest development and greatest abundance. The Middle States have about 100 to 105 species of trees, sixty-five to sixty-seven of which sometimes reach fifty feet in height. The region was originally entirely wooded. Over much of it the forests were very heavy, and there are still immense quantities of timber available. The forests of this region are usually made up of quite a number of species; in some places the broad leaved species predominating, in others the *Coniferæ;* but both kinds commonly grow together, the *Coniferæ* usually less abundant in the southern and western portions. The deciduous oaks, chestnut, beech, two species of ash, and perhaps the white pine, attain in this district their greatest size. The original forests are noted for their grandeur, and, with some of the secondary forests, for the diversity of their timber products. On the ridges of the Appalachians, which cross Pennsylvania and New York, while the hard woods may not attain their greatest size, some of them, particularly white oak, white ash, and some of the hickories are believed to attain their greatest perfection as regards strength and durability, or at least they are only equaled by the timber of the same species extended on the line of these ridges beyond this district in both directions. This is a matter of great importance in ship and boat building, and in the manufacture of railroad cars and of agricultural implements, all of which industries are here prominent. In portions of New York and Pennsylvania there are still large forests of excellent timber yet almost untouched by the axe; but, as a whole, the woodlands and forests are rapidly diminishing, both in area and in aggregate value, and there is as yet no corresponding compensation. Probably the price of timber must advance considerably before adequate means will be taken to produce a future supply by growth. How much this may be aided by wise legislation is still a problem. The southeastern region, extending from Virginia to Florida, is the richest in species, is of peculiar interest to the botanist, and of first class importance in commerce. (We can not say that any one wooded region is more important than others, inasmuch as wood is a prime necessity in every civilized community.) This region, originally entirely wooded, has upward of 130 species of trees, (a much larger number, indeed, if we include the larger shrubs and the tropical species of extreme Southern Florida,) seventy-five of which attain a height of fifty or more feet, and perhaps a dozen species attain a height of 100 feet. A belt of pine timber extends nearly the whole length of this district, of varying width, occupying a part of the region between the mountains and the sea. This is the great source of hard pine timber, (known in commerce as hard pine, yellow pine, heavy pine, pitch-pine, southern pine, and Georgia pine.) State statistics show that the annual export from Georgia alone now amounts to from 200,000,000 to 300,000,000 of feet per annum. The trade is yearly growing, and the adjacent States are contributing largely to the supply. But this is not the only commercial lumber of this district. The live-oak of Florida has a reputation throughout the world as ship-timber. The hard woods of the mountain-ridges have been less utilized than the growth of the regions already spoken of; but this is not owing to any inferiority of the wood itself. It is believed that the white oak attains its greatest development of strength in certain parts of Virginia and West Virginia, hardly equaling in size, however, its greatest development in the States immediately north. While pine is abundant along the belt mentioned, and is at present of greater commercial importance, the broad leaved species are the most abundant element in the forests. Here we find the magnolias and many flowering trees and shrubs in their greatest development and beauty. The area of woodlands, as a whole, has not probably much diminished of late years; but the trees suitable for hewing and sawing are decreasing under the heavy drafts made by commerce. In very many cases the land is despoiled of only its best timber trees; the others are left, so that it is yet woodland, and in due time a new crop of timber will result. The data for the preparation of the report of this region are more imperfect than for either of the regions before enumerated. The northwestern region extends from Ohio to Iowa and Minnesota, inclusive. In its original state it had every variety of forest feature represented, from the heavy forests of broad leaved species of the Ohio bottoms and the dense *Coniferæ* forests of Michigan, through every gradation of lighter forests, openings and belts, along the streams, to the grassy prairie and the treeless plains which everywhere terminate this district on the west. It is represented by about 105 to 110 species, about sixty-eight or seventy of which may reach a height of fifty feet. In southern Ohio and Indiana, the forests are of broad leaved species; oaks and various hard woods grow to magnificent size and of good texture, while black walnut, bass wood, white wood (or tulip tree), attain here their greatest development. The pine region may be said to begin in northwestern Ohio and extend across Michigan and Wisconsin to northern Minnesota. The northern parts of the three States last mentioned now furnish a larger quantity of sawed lumber than any other part of the country. The census of 1870 gave the total production of sawed lumber in the United States at 12,750,000,000 feet, and of this Michigan furnished over 2,250,000, and Wisconsin over 1,000,000, the two States producing upward of one-fourth of the whole yield of the country. The Chicago Lumberman's Exchange gives as the receipts of lumber at that city over 1,000,000,000 feet for each of the three years following that census. This is sawed lumber, exclusive of laths, shingles, and all forms of hewed timber. A prominent journal devoted to the lumber trade, gives the production of logs for a single river during the winter of 1873-'74 as 433,000,000 feet, and deplored the dull trade, as shown by such a short crop. To illustrate the capacity for sawing lumber, it may be stated that a single mill in Michigan, on June 3, 1874, as a test of capacity, sawed 179,718 feet of lumber in three working hours, the actual running time being two hours and forty minutes. (This was given on the authority of a local journal.) Many mills boast a capacity of 50,000 to 150,000 feet per day. But these examples of production tell a story of destruction also; and great as is the supply of pine in this region, it is so rapidly diminishing under the demands of the growing cities of the West, that serious apprehensions are awakened of a scarcity within a comparatively few years. The data for northeastern Minnesota are very meagre. Between the pine forests and the treeless plains, the prevailing trees are of broad leaved species, sometimes forming forests of considerable density and size. Sometimes the limits of prairie and woodlands are well defined; at others there is a regular gradation, through glades and openings, from the actual forest to the prairie. It must be remembered that the uncolored portions of the map are by no means always treeless. A region with less than forty acres woodland per square mile, if sparsely settled, may have sufficient timber and wood for the ordinary wants of such a population. Again, there are other regions without actual trees, but with low shrubs, sufficient for fuel and many other uses. The prairies of this region are the typical prairies of the country. Respecting their origin and the conditions which have rendered them treeless there have been many theories, which it is not necessary here to discuss. Periods of excessive drought, fires, the physical texture of the soil, are the leading theories, some advocating one, and some another. Where the prairies are uncultivated or have at most but a sparse population, the patches of wood (where they occur) are doubtless diminishing in number and area through man's agency. Where, however, a prairie region is largely occupied by settlers and a considerable part is under cultivation, the amount of wood is doubtless rapidly increasing. This is brought about in part by checking the fires which would otherwise kill the trees while young, in part by fostering in various ways any spontaneous growth of wood that may occur, and in part by actual planting. In some places the aspect of the country has been entirely changed in this character by the settlement of the country; and in the more fertile regions there seems no good reason why a future supply of wood and timber may not be produced on lands originally treeless, whenever the price is sufficiently enhanced to make a successful growth profitable. The southwestern region extends from Kentucky and Missouri to Alabama and thence westward to the western edge of the timber in Texas. Originally the eastern and southeastern portions were heavily wooded, prairies, however, occurring far eastward in the district, increasing in number and area westward, until the dry and treeless plains are reached which skirt the whole western border. It has about 112 to 118 species, sixty to sixty-five of which attain a height of fifty feet. The belt of pine of the southeastern States extends into this region near the gulf of Alabama, thence running west and leaving the coast, extending into the Indian Territory and Texas. This belt is not continuous, however, west of Mobile bay, and there are other detached areas of considerable extent with valuable pinelands. In this district are swamps having an immense growth of cypress. Although so much of *Coniferæ* may be found, broad leaved species constitute by far the most abundant element of the forests, embracing both hard and soft woods, and some species, which are shrubs or small trees elsewhere, attain in this district large dimensions. Sassafras, which is but an insignificant tree in New England, in Missouri becomes a tree sometimes three or more feet in diameter, equaling camphor-wood for the manufacture of chests for household use. Black walnut is also abundant in places and grows to great size, and various species of timber trees are abundant over large parts of this district. This region has not furnished so much wood or timber to commerce as either of the districts before considered. This is not due to any deficiency in quantity or quality of its woods but entirely to other causes. In this district, as in the northwestern, the woods diminish westward, and finally fade out in the oak openings and crosstimbers of Texas and the fringes of wood that follow the streams far beyond the other trees into the plains west. Over most of this district, particularly the better wooded portions, the area of woodlands is not seriously diminishing, but, as elsewhere in places most available for commerce, the better timber trees are disappearing. In the western borders, where the supply is at best sparse, it grows yearly less by the destruction or use of the scanty supply, and no efforts are made to replace it. West of the districts described, the treeless belt already spoken of, separates entirely the wooded portions of the two sides of the continent, a belt extending from Mexico to the Arctic ocean. It is fully 350 miles wide in its narrowest part, between latitude 36° and 37°, widening to our northern boundary where it is eight hundred miles wide, or wider if we include a few outlying patches of timber on some of the northern ridges and mountains. Different parts of this belt, the plains in common language, vary greatly in their aspect. Sometimes they are absolutely treeless, as far as the vision extends; in others a fringe of timber from a few rods to several miles wide skirts the streams, while the spaces between are treeless; and again others, particularly northward, some of the intervening hills are dotted with scattered cedars, usually shrubby and crabbed, but in places attaining the size and dignity of trees. The Black Hills have heavy forests of pine and spruce, and appear like a forest-island three hundred miles long rising out of this sea of plain far from the forests of either side. A few other similar though smaller detached forests occur in this treeless waste. The causes which have left this great area so bare are, without doubt, mostly climatic. Although in places the character of the soil is unfavorable, the great cause is doubtless the scanty or capricious rainfall of the region. What can be done toward clothing this with trees by artificial means is an entirely unsolved problem. The Rocky Mountain region lies near the chain so-called and north of latitude 36°. From the Columbia river northward to Alaska, forests clothe the whole mountain belt, except where too high or on limited parks and prairies. On our northern boundary the treeless plains suddenly cease at the eastern base of the chain, (about longitude 113° 40′ west,) and heavy forests are almost continuous thence westward to the Pacific south of the Columbia river (about latitude 38° north) the forests of this chain are everywhere separated from those near the Pacific by dry and treeless plains and valleys of greater or less width. The forests of the northern part of the chain are continuous from Alaska southward to about latitude 42° 40′ north, where a nearly treeless belt about a hundred miles wide cuts entirely through them from the bare plains east to the more barren basin in the interior. South of this belt, forests begin again and extend southward from southern Wyoming across Colorado and into northern New Mexico, more than four hundred miles, with a width of two hundred to two hundred and fifty miles. This forest is of varying degrees of density and interspersed in it, are many treeless, or nearly treeless valleys called parks. This forest is surrounded on every side by treeless areas, the limits usually sharply defined except along the southern and southwestern edge, where they shade off more gradually in density. The northwestern part of this forest is continuous with the forests of the north slope of the Uintahs, and these again with the forests of the Wasatch of Utah. Southwesterly in New Mexico and Arizona, are detached forests of similar character, clothing in each case mountain chains. These forests are everywhere of *Coniferæ*. The whole tree vegetation consists of twenty-eight or thirty species, about one-third of which are broad leaved kinds and two-thirds conifers, the latter constituting the forests. Of the former, box-elder (*Negundo aceroides*) occurs most abundantly along the eastern base of the mountains; two kinds of cottonwood, along the streams of the plains or in the parks; alders along streams but higher in the mountains; the aspen as a small tree (locally known as *Asp*) in the mountains and on the margin of the parks. No oaks occur as trees, but a scrubby form, (*Quercus alba*, var. *Gunnisonii*,) rarely more than ten to twenty feet high sometimes occurs on the foothills of the south. These and a few other species known to the botanist but not abundant as wood, and usually here as stragglers from some other region, make up the ten or eleven broad leaved species. The great Colorado forest spoken of consists essentially of five species of conifers, viz., *Pinus ponderosa*, (called here yellow pine,) *P. contorta*, (called tamarack, and red pine,) *Abies Engelmanni*, (really a spruce, but called white pine, as it is a soft white wood,) *A. Mengiesii*, (called here balsam,) and *A. Douglasii*, (called by a variety of names). These five species are by far the most abundant, large areas often being covered almost exclusively by but one or two of them. Other species not here named, are frequently met with; not rare, as the botanist would say, but of vastly less economic interest than the species enumerated. On the outlying spurs and ridges which extend into the woodless region on every side, scrubby cedars are found, and in the drier valleys the nut pine or pinon (*P. edulis*) is abundant, particularly southward—a low, scrubby tree, usually less than twenty and rarely more than thirty-five feet high. These, with a few others, make up the eighteen or twenty species of *Coniferæ*. The timber of this region is diminishing much faster than a legitimate use demands. Where one tree is cut for use, ten perhaps are killed by fires, which destroy great forests nearly every year, kindled by the carelessness of the whites, or perhaps as often by the Indians, who sometimes fire the forests to drive out game, sometimes to annoy an enemy, and sometimes no one knows why. Whatever may be the cause, blackened trunks disfigure many hundreds of square miles. For that portion of the Rocky mountain region lying between the forty-third and forty-ninth parallels accurate information is, as a whole, rather meager. For Idaho and the Yellowstone region, they are more complete and reliable, but for the region north and east of the Wind River mountains they are scant and unsatisfactory. The species of the northern Rocky mountain region are perhaps the same as those south, but varying in relative abundance. The two magnificent firs *Abies grandis*, (called white spruce, but in Oregon yellow fir,) and *A. amabalis*, become more abundant. In the northern part, particularly in the Kooskooskie region, heavy pine forests are reported. West of the Rocky mountains is another treeless or sparsely wooded region, which extends from the Columbia river to Mexico. Its northern portion narrows northward, but forms an important part of the valley of the Columbia and its tributaries; it embraces the whole of the great basin except insignificant edges of the rim; it throws out an eastern branch entirely through the Rocky mountains, and southward it is continuous with the treeless or sparsely wooded region which extends across the continent along our southern frontier. In this area occur the driest and the most inhospitable deserts of our country. It is of too varied character to admit here of details. Some portions are grassy prairies, some are plains of lava, others are deserts of drifting sand, others are half naked rock cut by canons, others are alkali plains and short valleys, others are great areas covered with sage brush and grease-wood, others pass into chapparal, in fact, there is every gradation, from naked barrenness to great forests. Some of the mountain chains found in this area are as bare of trees as are the valleys themselves; others have large shrubs of scrubby pines or cedars, while others are clothed with forests. The extreme northern part consists largely of lava plains. South of this the Blue mountains of Eastern Oregon have heavy forests of pine, fir, and spruce of the same species found in the northern Rocky mountains. Still south of this are the sage plains and deserts. In Nevada the valleys are treeless, (with very rare exceptions,) the ridges sometimes bare, sometimes dotted with shrubs and scrubby pines, the actual amount of wood being small, yet of inestimable value to a country so rich in minerals and so poor in wood. Over parts there is a crabbed, shrubby growth, becoming in places, chapparal, but oftener of scattered shrubs, attaining in favorable places the size of small trees. One of these, called mountain mahogany, (*Cercocarpus ledifolius*,) is often over thirty feet high, with a base two feet in diameter, the wood very hard, close-grained, dark-colored, and taking a beautiful finish when wrought. The shrubby vegetation of the region, including as it does the sage bushes, grease-woods, creosote bush, etc., is of great interest to the botanist, but can hardly claim further notice here. South of latitude 35° are a few species of small trees of much greater value. Of these, first in importance is the mesquite, (*Prosopis* (*Algaroba*) *glandulosa*,) thriving in hot, dry places in the valleys and on the mesas, but is rare on the steeper slopes. The tree has a spreading habit, rarely more than thirty feet high and twelve inches in diameter. The very hard and durable wood is used for a great variety of purposes. Posts in use for fifty years are still sound, and its value for railroad ties must ultimately be great. The fruit, of eight to twelve beans, in a long, sweet, pulpy pod, like that of the carob (or St. John's bread) of the Old World, is a valuable food for animals, and even for man, while in Western Texas a considerable trade has sprung up in mesquite-gum, which is similar to gum-arabic. This species extends from California to Texas, and in the future will doubtless be extensively planted and cultivated. The tornillo or screw-pod mesquite (*Prosopis pubescens*) is smaller and of more restricted range, but of similar use. Another small tree, called arbol de hierro, or iron wood (*Olneya tesota*) is of much local value, and may become a commercial wood. Other broad leaved trees occur; cottonwoods and sycamores are common along the streams. In parts of this region are several *Cacti* and one *Yucca*, attaining a tree-size, more picturesque in the landscape than useful to man. The higher mountains of Arizona are well timbered with conifers. The prevailing species are red spruce (*Abies Douglasii*) and yellow pine, (*P. brachyptera*). The most notable of these forests (the limits of which have lately been demonstrated by the explorations of Lieut. Wheeler) extends nearly 400 miles. Other isolated forests, occupying mountains, are indicated on the map. On many of the lower ridges, the pinon (*Pinus edulis*) abounds, furnishing food to the Indians and fuel to the whites It is a crabbed shrub, rather than a tree, usually less than twenty or twenty-five feet high. Other trees occur of more limited range or abundance, the actual number known to botanists in the whole of this vast region amounting to about thirty-five species. The Sierra Nevada and Cascade mountains lie nearly parallel with the coast of the Pacific, with their eastern base 100 to 200 miles distant from it. This chain is nearly continuous from the northern frontier southward to latitude 35°, a distance of about 1,000 miles, everywhere a broad and high chain, its summits far above the line of tree vegetation, often in the perpetual snow, culminating in the loftiest peaks in the United States. Its broad western slope is everywhere heavily timbered. Along the coast for the same distance are the Coast Ranges, a system of mountain chains more or less connected together, but broken by gaps and separated by valleys, and usually rather steep on the ocean side. They form a belt twenty-five to fifty miles wide, and are mostly between 2,000 and 4,000 feet high, but with numerous points rising to twice that height. The Coast Ranges are generally wooded. Between these two mountain systems a series of valleys extend their whole length, from Puget Sound to Southern California, cut across by a few ridges, so that it is not a single continuous depression, but rather a succession of valleys. North of the Columbia this valley is heavily wooded. The forests are open, but the trees are large, and little prairies are interspersed. Passing southward, the valley of the Willamette is largely prairie, but there is an abundance of wood for all uses. Between the Upper Willamette and the Upper Sacramento, several ridges cross from the Coast Ranges to the Cascades, and forests and prairies alternate. The former are heavily timbered. The great central valley of California is by far the largest of the series, and is treeless, or but sparsely wooded, for an area 420 miles long by thirty to sixty miles wide. The northern half of this has more wood than the southern, where large areas are absolutely treeless, except a very narrow fringe along the few streams. This region of mountain and valley, as a whole, and in all its relations, economic, scenic, and botanic, has, perhaps, the most interesting tree vegetation known. The whole number of species known to botanists amounts to eighty-eight or ninety, but a vastly smaller number are found in any one botanical or commercial district. Many of the more noted species are very restricted in their range, and not more than three or four important timber trees extend the whole length of the region. It is therefore necessary to treat its parts more in detail than in the case of the other districts. In this district are, perhaps, the grandest forests on the globe. In Washington Territory, they are made up of but few species, of which *Abies Douglasii,* (called here red fir,) is the most important. Commonly 150 or more feet high, and four or more feet in diameter, but sometimes fifteen feet (in extreme cases even over twenty feet) in diameter and over 300 feet high, straight growth, the wood firm, elastic, holding spikes with great tenacity, it produces the most noted timber of the Territory. Oregon cedar, (*Thuja gigantea,*) yellow or punkin pine, (*P. ponderosa,*) yellow fir, (*Abies grandis,*) black spruce, (*A Menziesii,*) are the next most abundant species, all attaining a great size. The popular names are much confused, the generic terms of cedar, pine, spruce, and fir are all very loosely and capriciously applied. The finest of the forests are about Puget Sound, and on the western flanks of the Cascades. On the Coast Ranges, the forests are denser, and with tangled undergrowth, but the trees not of such large average size. Regarding the wonderful quantity of wood produced, one authority, (for many years Surveyor-general of the Territory) states that the whole region west of the summit of the Cascades to the Pacific, and north of the Columbia, will yield an average of 32,000 feet per acre of merchantable lumber. He states that about one-thirty-second part of this area is prairie. The following extracts from the annual reports of the Commissioner of the General Land-Office of the United States relate to this Territory: The land will produce from 25,000 to 300,000 feet per acre, and there are vast tracts that would cover the entire surface with cord-wood ten feet in height; there are localities that would afford double. Again, the reports speak of the forests of pine, fir, and cedar which grow thickly, from one to fifteen feet in diameter and 200 to 300 feet high; and again, of the forests of red and yellow pine of gigantic growth, often, attaining a height of 300 feet and from nine to twelve feet in diameter. Similar testimony could be greatly extended. In the extreme northeastern part, and east of the Cascades, are forests of pine; these forests are in character more like those of the Rocky mountains, with which they are continuous. Passing south of the Columbia river, the same species occur; but the forests are not so heavy, although individual trees may be as large. Prairies become more numerous and larger, and oaks and other broad leaved trees become more common in the valleys. In places, larch (*Larix occidentalis*) is abundant, and the yew (*Taxus brevifolia*) attains in Oregon and Northern California a height of fifty or seventy-five feet, a greater size than is attained by any yew elsewhere in America. As a whole, Oregon is very heavily timbered. Passing southward to California, the tree vegetation changes still more, and becomes the richest in species of any region west of the great plains, embracing a total of over eighty species. Some fifty species of *Coniferæ* have been enumerated by botanists, embracing several species, and even genera, found elsewhere. All the conifers of Washington and Oregon are found here, but not in the same relative abundance or size. The yellow pine (*P. ponderosa*) attains its greatest development, and is often over 200 or 250 feet in height, and four to eight (sometimes twelve) feet in diameter. The sugar-pine (*P. Lambertiana*) is perhaps the most valuable pine of the State; is abundant, of excellent quality, and great size. There are four firs (*Abies* of the section *Picea,*) three large spruces, and about twelve species of pine, more or less abundant. (More than twice that number of supposed species have been described by botanists.) The big trees (*Sequoia gigantea*) occur on the western slope of the Sierra Nevada, and are too well known to need notice here beyond the remark that the ease with which they are propagated, and their valuable timber and rapid growth, will doubtless give them great value for cultivation in the future. Of more present value is the red-wood, (*Sequoia sempervirens,*) which only grows very near the sea, between latitude 36° and 43°, and on portions of this coast forms forests rivaling, if indeed not exceeding, any found elsewhere on the earth. The trees are often ten, and sometimes exceed more than twenty feet in diameter, very straight, 200 to 300 feet high; and the wood, which is light, is straight-grained, very durable, and adapted to many uses. It is extensively cut, and the lumber shipped to South America, the Pacific islands, China, and even to New Zealand. It is rapidly diminishing in quantity, and the only slight compensation is that when cut a new growth sprouts from the stump, which is not true of any other timber tree belonging to the *Coniferæ.* California cedar (*Libocedrus decurrens*) occurs in the mountains of large size. Several species of cypress, (*Cupressus,*) the California nutmeg, (*Torreya*) and cedars of smaller size abound. Among the broad leaved trees there are many of great beauty, but there is a great lack of hard woods. The laurel, (*Tetranthera Californica,*) has been sparingly used in ship building; an ash, one maple, (neither abundant,) and some of the oaks do service where smaller hard woods are needed, but the supply is deficient. But among these trees are some of marvelous beauty, particularly among the oaks. Two cottonwoods, two sycamores, the Madrona, (*Arbutus Menziesii,*) and other trees are not rare. The data for Alaska are insufficient to construct a map of distribution and density of timber with reasonable accuracy; so the attempt is not made. Some portions of that extensive territory are heavily wooded, other portions are treeless, and there is every gradation, but the relative areas of each, and their boundaries, are unknown. Official reports speak of the forests as being really magnificent, covering the lower hills and uplands with dense masses of pine, spruce, fir, hemlock, cedar, and other valuable timber, principally evergreens. Again, that the forests extend almost to the water's edge along the southern shores, but north and east of the Alaskan peninsula they exist only in the interior, except at the heads of bays and sounds, while the inland forests are abundant, extending to within a short distance of the Arctic Ocean. In establishing the United States military post of Fort Tongas, in clearing the timber for this post, a magnificent growth of yellow cedar trees, eight feet in diameter and 150 feet in height was found. Nearly the whole of the Yukon district is well supplied with timber; and much more appears to the same effect. Of the species on the Yukon, Mr. Dall states that the white spruce, (*Abies alba,*) is the largest and most valuable tree found in the Yukon district. The next in importance is the birch (*Betula glandulosa*). Various other species are mentioned.

TIMOTHY GRASS. *Phleum pratense* Meadow cat's-tail grass. In rainy weather it too readily imbibes moisture. It gives very sweet and early herbage for sheep in spring, and mixed with other grasses, is found very useful in laying down land to pasture for a few years. The soil which suits timothy grass best is a good, moist, and rather stiff loam. On gravel it soon dies off. It is scarcely to be recommended without a mixture of other grasses, although very heavy crops of it have been grown; and from its strong stem when full grown, it should always be fed off when young, or cut for soiling horses and cattle before the stem has acquired its full growth. In rich land which is tired of clover it may form a very good substitute, to cut up green and depasture afterward. The seed is usually sown on wheat in the spring, or it may be sown with oats. Two pecks are commonly used, but it is better to use three pecks, or even a bushel when other grasses are not used. Clover and timothy do well together; eight pounds of clover and eight quarts of timothy seed may be used. (See Grasses.)

TISSUE. A membrane, or expansion of a cellular structure in animals or plants.

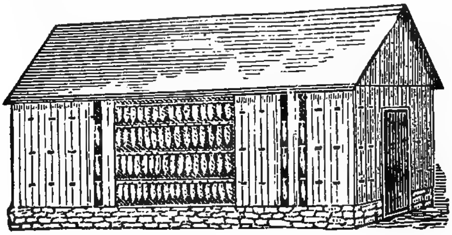
TITMOUSE. *Parus.* The small black cap titmouse or chickadee and the tufted titmouse are the two common species Their principal food is the eggs of insects, found in the crevices of the bark of trees, and small insects. They are beneficial birds and should be scrupulously preserved. The tufted titmouse has a series of pretty notes.

TOAD. *Bufo.* The common toad of the North, West and South is perfectly harmless so far as containing venom inimical to the human family is concerned. The warty excresences contain an acrid fluid, which exudes when crushed. It is unfounded, the vulgar idea that this fluid will produce warts upon the hands. The food of the toad is insects even including the hated potato beetle; they are naturally retiring and inoffensive, seeking damp, dark places where insects abound. They will become quite tame if not injured and soon clear a garden of insects if protected. Gardeners are beginning to learn this fact and act accordingly.

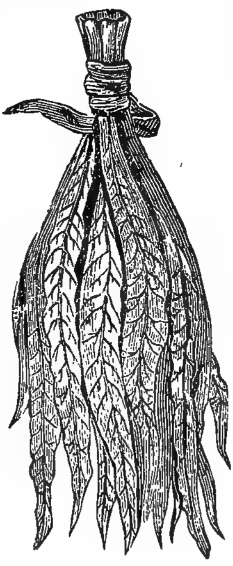
TOADFLAX. Weeds of the genus *Antirrhinum* and *Linaria:* they are usually perennial, and should be extirpated.

TOBACCO. *Nicotiana.* There are many species of tobacco, fourteen being enumerated by Loudon. The two principal under cultivation with their varieties are *N. Rustica,* grown in the colder portions of Europe, and *N. Tabacum,* cultivated in the United States, of this latter, the Cuba, and the Connecticut seed leaf are the varieties principally cultivated in the United States for cigars These varieties are not so rich in oil are lighter, and more bulky than varieties used for manufacturing into plug and other chewing, and pipe smoking tobaccos. Of the manufacturing tobaccos, there are innumerable varieties. The principal States for the production are Virginia, Kentucky, Tennessee, Missouri and Ohio. Of the sections named, Kentucky produces by far the largest quantity. The cotton States produce but little tobacco, but, at the centennial exposition twenty-one States were represented, which besides the hung leaf exhibited ninety specimens of pressed leaf, the best sample being from Virginia and valued at four dollars per pound. In cigar tobaccos, Connecticut produces the best, and Wisconsin the next best tobacco, if we may except Florida which produces comparatively but a small quantity, but of a high grade for wrappers and fillers to cigars. It is now thought that there are soils in Arizona that when opened to culture will produce very superior tobacco, as there is in California. Indeed, no crop is so much influenced by soil and climate as tobacco. When greater care in the selection of soils, manures, cultivation and especially in curing come to be more carefully attended to, there is no reason why tobacco from particular valley districts in the South, in the granitic formation, should not produce tobacco fully equal to the famous Yara of Cuba Inattention to these plants and ignorance on the part of many cultivators, who have undertaken the cultivation of tobacco, has caused a glut of common tobacco which of late years have operated strongly against the profits of the crop. This will be evident by United States statistics which show the fact that, in 1869 the crop of the United States amounted to but about 324,000,000 pounds against, in round numbers, 412,000,000 in 1870; 410,000,000 in 1871; 505,000,000 in 1872: 502,000,000 in 1873; 358,000,000 in 1874; 520,000,000 in 1875; also 482,000,000 in 1876; and 581,500,000 in 1877; the conclusion is that, year by year, with slight variation, the planters have gone on increasing the crop until they have glutted the markets of the world. In relation to the product per acre 2,500 pounds have been produced, yet for the decade ending with 1878, 700 pounds was the average. The average price being five to six cents per pound. This average will cause continued loss to the planter. A good cultivator should get 1,500 pounds. At 700 pounds the acre brings but $38.50, a losing business, at 1,500 pounds, the acre brings $82.50. This leaves little margin for profit; but, if the 1,500 pounds be of superior quality the price will be raised to eight, ten, and even thirty cents per pound, and the profits are amply secured. The planter will thus see the necessity of never undertaking this crop until by experiment he is assured first that his soil, climate and situation—including protection from sweeping winds—is right, and also that he thoroughly understands the cultivation, curing and packing in the best possible manner and also that he has the necessary capital for carrying the whole forward. The following synopsis of the necessities in tobacco raising in the tobacco belt, say between 36° and 40°, we take from a statement by one of the most intelligent tobacco planters of the South. These general rules will apply wherever tobacco may be grown: Select good land for the crop; plow and subsoil it in Autumn to get the multiplied benefits of winter's freezes. This can not be too strongly urged. Have early and vigorous plants and plenty of them. It were better to have 100,000 too many than 10,000 too few. To make sure of them give personal attention to the selection and preparation of the plant bed and to the care of the young plants in the means necessary to hasten their growth, and to protect them from the dreadful fly. Collect manure in season and out of season, and from every available source—from the fence-corners, the ditch-bank, the urinal, the ash pile. Distribute it with a liberal hand; nothing short of princely liberality will answer. Plow it under (both the home-made and the commercial) in February, that it may become thoroughly incorporated in the soil and be ready to answer to the first and every call of the growing plant. Often (we believe generally) the greatest part of manure applied to tobacco—and this is true of the bought fertilizer as well as that made on the farm—is lost to that crop from being applied too late. Don't wait to apply your dearly-purchased guano in the hill or the drill from fear that, if applied sooner, it will vanish into thin air before the plant needs it. This is an exploded fallacy. Experience, our best teacher, has demonstrated beyond cavil that stable and commercial manure are most efficacious when used in conjunction. In no other way can they be so intimately intermixed as by plowing them under—the one broadcasted on the other—at an early period of the preparation of the tobacco lot. This second plowing should not be so deep as the first; an average of three to four inches is about the right depth. Early in May (in the main tobacco belt to which this article chiefly refers, that is to say, between the thirty-fifth and fortieth parallels of north latitude), re-plow the land to about the depth of the February plowing, and drag and cross-drag, and, if need be, drag it again, until the soil is brought to the finest possible tilth. Thus you augment many-fold the probabilities of a stand on the first planting, and lessen materially the subsequent labor of cultivation. Plant on lists (narrow beds made by throwing four furrows together with the mold-board plow) rather than in hills, if for no other reason than that having now, if never before, to pay wages in some shape to labor, whenever and wherever possible horse-power should be substituted for man-power—the plow for the hoe. Plant as early as possible after a continuance of pleasant spring weather is assured. Seek to have a forward crop, as the benefits claimed for a late one from the fall dews do not compensate for the many advantages resulting from early maturity. Make it an inflexible rule to plant no tobacco after the 10th of July—we mean, of course, in the tobacco belt we have named. Where one good crop is made from later planting ninety-nine prove utter failures. Far better rub out and start afresh the next year. Take pains in transplanting, that little or no re-planting may be necessary. The cut-worm being a prime cause of most of the trouble in securing a stand, hunt it assiduously and particularly in the early morning when it can most readily be found. Keep the grass and weeds down, and the soil loose and mellow by frequent stirring, avoiding as much as possible cutting and tearing the roots of the plant in all stages of its growth, and more especially after topping. When at all practicable—and, with the great improvement in cultivators, sweeps, and other farm implements, it is oftener practicable than generally supposed—substitute for hand-work in cultivation that of the horse. The difference in cost will tell in the balance sheet at the close of the operation. Attend closely to worming for on it hinges in no little degree the quality and quantity of tobacco you will have for sale. A worm eaten crop brings no money. So important is this operation that it may properly claim more than a passing notice. Not only is it the most tedious, the most unremitting, and the most expensive operation connected with the production of tobacco, but the necessity for it determines more than all other causes the limit of the crop which in general it has been found possible for a single hand to manage. Therefore bring to your aid every possible adjunct in diminishing the number of worms. Use poison for killing the moth in the manner so frequently described in treatises on tobacco, to wit, by injecting a solution of cobalt or other deadly drug into the flower of the

Jamestown or jimson weed (*Datura stramonium*), if necessary planting seeds of the weed for the purpose. Employ at night the flames of lamps, of torches, or of huge bonfires, in which the moth may find a quick and certain death. In worming, spare those worms found covered with a white film or net-like substance, this being the cocoon producing the ichneumon fly, an enemy to the worm likely to prove a valuable ally to the planter in his war of extermination. Turn your flock of turkeys into the tobacco field, that they, too, may prey upon the pest, and themselves grow fat in so doing. If these remedies should fail, sprinkle diluted spirits of turpentine over the plant through the rose of a watering pot, a herculean task truly in a large crop, but mere child's play to the hand-picking process, for the one sprinkling suffices to keep off the worms for all time, whereas the hand-picking is a continual round of expensive labor from the appearance of the first worm until the last plant has been carried to the barn. We have no idea that such sprinkling will at all affect the odor or flavor of the tobacco when cured. If, as stated by a writer in a California paper, the well known yellow-jacket be useful in destroying tobacco worms, by all means win it as an ally. As proving its usefulness, the writer asserts that one of his neighbors, Mr. Culp, during fifteen years growing tobacco, has never expended a dollar for labor to destroy the worm, trusting all to this little workman, who, he says, carefully searches the plants for the worms, and never allows one to escape its vigilance. We can not speak from our own experience as to many of these suggested means for overcoming the horn-worm, but we have no hesitation in saying to the farmer, try any, try all of them rather than have your crop eaten to shreds, and the labor of more than half the year brought to naught in a few days, it may be, by a single glut of worms. Prime high and top low. While open to objection in particular cases, even with the character of tobacco chiefly under consideration, and altogether inadmissible, it may be, in the management of other varieties of tobacco, this is a safe rule, we think, to follow in general practice. We favor priming by all means; for when no priming is practiced the lower leaves (made worthless by constant whipping on the ground) serve only as a harbor for worms, which are the more difficult to find because of the increased burden of stooping. Moreover, if the bottom leaves be saved on the cut stalk, as most likely they will be, there is always the temptation to put them on the market. Yet another advantage to be gained by the removal of these bottom leaves, which is what the planter terms priming, is the increased circulation of air and distribution of light thereby afforded, both essential factors, the merest tyro knows, to the full development of plant life. Topping (the pinching off with the finger-nail the bud at the top of the plant) is an operation requiring considerable skill and judgment. Let it be performed only by hands having these prerequisites. That as many plants as possible may ripen at the same time (a desideratum not to be undervalued in aiming, as all should, at a uniform crop) wait until a large number of plants begin to button before commencing to top. Going about through the crop, topping a plant here and there because it may chance to have buttoned before its fellows, is a damaging process not to be tolerated. No inflexible rule can be given for the number of leaves that should be left on a plant. All depends upon the variety of tobacco, the strength of the soil, the promise of the particular plant, the probable seasons and time left for ripening, etc. One of the most successful growers of heavy dark tobacco we have ever known once stated to us his conviction, after years of observation and practice, that one year with another, taking the seasons as they come, eight leaves would give a better result than any other number. Our own experience has tended to confirm this judgment. See to it that the suckers are promptly removed. It is work quickly done, and with worming may constitute a single operation. We come now to consider the last operation in the field, cutting the crop. In this, as in topping, a man of judgment, experience, and fidelity is needed. An inexperienced hand, one without judgment, and particularly one who is indifferent to the interests of his employer, will slash away, right and left, not knowing or caring whether the tobacco he cuts be ripe or green, doing more damage in a few hours than his whole year's wages would compensate for, even could they be garnisheed. Therefore, be on hand to see for yourself, and do not delegate the duty to any less interested party, that a crop managed well, it may be, so far, from the initial plant-bed, shall not be spoiled in the closing work by an incompetent or unfaithful cutter. Be there, too, to see, in this supreme hour, that injury from sunburn is warded off by the timely removal, to the shade, of the plants that have been cut, or by a proper covering, where they lie, against the scorching rays of the sun. The neglect of this precaution has played havoc with many a crop when brought under the auctioneer's hammer. We should have no space to describe the different methods of curing tobacco, as for instance, sun-curing, air-curing, flue-curing, open-fire-curing, etc., even though the whole subject had not been gone over again and again in previous reports of this department. We can only say of this operation, as of all others connected with the production of tobacco, that much depends on its proper doing and that, as much as possible, it should have the personal superintendence of the owner. But the crop may have been brought along successfully even to the completion of this operation and lack one thing yet, if it be not now properly manipulated. Therefore, go yourself, trust no other into your barns, see with your own eyes, and not through the medium of others; handle with your own hands, and know of a surety that the tobacco hanging on the tier-poles is in proper order for striking and bulking, and act accordingly. When, later on, it is being stripped, sorted, and tied into bundles, or hands, as they are often called, be there again, *propriâ personâ*, to see that it is properly classed, both as to color and to length, the lugs going with lugs, the short with short, the long with long, etc. Instruct those sorting that when in doubt as to where a particular leaf should be put to put it at least one grade lower than they had thought of doing. Thus any error will be on the safe side. Prize in hogsheads to weigh what is usually called for in the market in which you sell, and, above all, let the tobacco in each hogshead be as near alike as possible, uniform throughout, so that the sample, from whatever point it may be taken, can be relied on as representing the whole hogshead, and that there be left no shadow of suspicion that nesting has been attempted, or any dishonest practice even so much as attempted. Again, manuring is important. If guano, poultry droppings, or other special manures are used, they must be followed by a liberal application of stable manure and the plowing under of green crops. For manufacturing tobacco, chewing, snuff, etc., twelve loads of sheep manure, twenty loads of horse, thirty loads of cattle, or thirty loads of hog manure would be indicated; those first mentioned being preferable. For cigar or other smoking tobacco: sheep manure, eight loads; horse manure, fifteen loads; cattle manure, twenty loads. If the soil is sandy the cow manure being indicated, guano may be applied also, 200 pounds, or poultry droppings 400 pounds per acre. Land in good heart, say capable of producing fifty or sixty bushels of corn per acre, being understood to start with. The tobacco house must be of ample size to properly cure the tobacco without crowding. The building having fifteen feet posts, a space twenty-four by thirty feet is not too much for each acre of heavy tobacco. Barns and outbuildings may be utilized to some extent, but tobacco can not be properly cured in them, since the crop sometimes requires firing—that is, drying by fire heat. Tobacco in the South is usually packed in hogsheads; in the North in cases. For cultivating and curing cigar tobacco, as practiced in the North, the following synopsis will give an intelligent idea: Ground can not be too rich. Barn yard manure is, beyond dispute, the most preferable, if not the only reliable fertilizer. Gypsum, wood ashes, etc., are good auxiliaries. Sandy loam, preferable to a stiffer soil, and thorough cultivation are the great requisites. Without this, a paying crop can not be expected. Fall plowing, or early spring desirable. When ground is thus prepared, say about May twentieth, it should be ridged in rows, three and a half feet apart, or four feet, if the ground is very rich. After ridging cut out indentations to receive the plant, say three and a half inches deep on the row, and from twenty-two to thirty inches apart, as experience may dictate, a medium between the two being, perhaps, as good as any, depending, of course, on soil, season, etc. The plants should be set below the general level of the row, as by future hoeing the higher portions will be cut down to a level. All other cultivation should be the same as that for corn or other hoed crops, thorough and frequent. No weeds dare be allowed at any time. In an average season the plant will mature sufficiently by the early part of August to dispense with further cultivation of ground, as the plant shading it will check the growth of weeds. Whenever the plant develops from fourteen to sixteen leaves, break off the top, don't cut it off. This arrests the further production of leaves, but will promote the growth of suckers, which will have to be removed, after attaining a length of three to four inches, as often as they appear. It may be well to refer here to two formidable enemies of the plant, viz: the black cut-worm and the green tobacco worm. The former will attack the root of the plant as soon as it is put into the ground. The depredations of this worm sometimes necessitate frequent re-planting. They must be hunted and destroyed until they disappear, which they will do as the season advances. The last named generally appears about July first, and feeds on the leaf until the crop is secured in the sheds. In fact, they frequently, if not picked off clean, cling to the leaves after the stalk is hung up. About these there is but one advice to give, pick them off and destroy them, going over the field for this purpose daily, as the ravages of the green worm do more to injure the quality, perhaps, than any one thing. Ususally, from three to four weeks from the time of topping, the plant will mature and be ready to cut. Uniform size of leaves, and a stiffness of the leaf, making it liable to break by bending and handling, are the surest signs of maturity. Cut after the dew is off, but not during the middle of the day, when the sun is bright, as you must guard against burning while it is undergoing the wilting process, preparatory to spearing and handling in the removal to the shed. When sufficiently wilted, the plan most in practice is spearing or stringing upon laths four feet long, five or six plants to each lath, and then removing same into shed and hang up for curing. Distance between lath, general arrangement of shed and management thereof, as to ventilation, admission of light, etc., must be attended to. Air and light having a great influence on the curing and fixing of color, must be used to the best advantage in catering to the tastes of the trade, which, by the way, are subject to frequent changes; sometimes light tobacco is in demand and again dark only will meet a ready sale. Strange, but true, frequently when we have it dark the buyers want it light, and vice versa. In removing plants to the shed after cutting various devices are used. Sleds, wagons in various styles, any way in which you succeed without breaking or bruising the leaf, is a good, and the quickest way, with these ends accomplished, is the best. By the middle of December, and after, whenever the plant is sufficiently pliable by moisture to strip or handle it without



TOBACCO HOUSE.



HAND OF TOBACCO.

injury, you can strip it; assorting leaves is one of the prominent features in the stripping process. All solid leaves should be kept separate as wrappers, and these sorted into hands of ten or twelve leaves, each hand tied at the butt by a single leaf. All leaves in the same hand should be of uniform length. The hands should then be assorted with reference to length into two or three sizes. All defective leaves should be treated alike and put up separately, the respective qualities being bulked up separately ready for market. The packing or casing is generally done by parties buying it from the grower.

TOLU. A balsam from *Myrospermum* (*myroxylon*) *toluiferum* of South America.

TOMATO. *Lycopersicum esculentum.* Like the lycopersicum family generally, the tomato is a native of America, the southern half of the continent being its home. It was introduced into England in 1596, and from there found its way to India. Until within, comparatively, a few years, it was considered poisonous, or at least unfit for food. Now it is cultivated in every garden, and has become an indispensable adjunct to the table, whether in its fresh state or canned. It is easily susceptible to frost, but of the easiest cultivation. The plan most successful on ordinary loam or clay, being to throw up rather high ridges five feet apart. Set the plants three and a half feet on these ridges, keep clean, and allow the vines to droop along the sharp sides of the ridges. Thus the sun and air is admitted, rot is prevented, the trouble and cost of trellising is avoided, and as large crops, (sometimes 500 bushels per acre) may be raised as in any other way. The seed should be sown in a hot bed as early as the first of March, and the plants pricked out six inches apart, as soon as large enough, transplanting to the open ground as soon as the days and nights become permanently warm. When the first frosts kill the vines in the fall, if the tomatoes are gathered and spread under glass, they will continue to ripen for a month. Select some of the large, smooth, red varieties for table use and canning, and the yellow plum variety for preserving.

TOMATO WINE. (See Gallizing.)

TOMENTOSE. Covered with down hair.

TON. A weight formerly of twenty cwt., or 2,240 pounds; now 2,000 pounds.

TONGUE. The soft, fleshy organ of taste. It is covered by nerves and blood-vessels.

TONICS. Those medicines which improve the general health and appetite. They are commonly called bitters.

TONKA BEAN. The fruit of the *Dipterix odorata,* used to flavor snuff.

TONSILS. Small glands situated in the throat.

TOOL HOUSE. An indispensable building, (either separate or attached to some other) dry and well ventilated, where tools, implements, machinery, etc., may be stored, when not in use. Such tools as are required for use every day, or at short intervals, should occupy such a position as to be easily accessible. The work shop may naturally occupy a portion of this building, and be provided with a carpenter's bench, saw horses, saddler's seat, and the tools, such as axes, planes, chisels, bits, augurs, needles, awls, thread, etc., for repairing.

TOP DRESSING. Top dressing is that form of manuring where the fertilizing material is applied to the surface of the earth, instead of being plowed under, as for instance, in the case of meadows, pastures, young wheat, and other cereal grains, young grass, orchards, etc. It may be intended to act simply as a fertilizer, or to effect the two-fold purpose of a mulch to protect a crop during the winter, and at the same time produce fertilization. In the latter case green manure may be applied in the autumn, and the long straw be raked together, and carted away in the spring, unless the crop is of such a nature that it will readily grow through. If a meadow or pasture, it should be raked off. If grain, it may be applied more thinly, and the grain will grow through. As a rule, however, a top dressing should consist of well rotted manure or compost. Of mineral substances, ashes, lime, gypsum, and salt are used; of commercial fertilizers, superphosphate, guano, poudrette, and other manures of like nature, should be lightly harrowed in, to save waste. Liquid manure is always used as a top dressing. It is one of the most valuable in the whole category of manures, and prompt in its action. Of these, the diluted urine of animals, leakage from compost heaps, and sewage waste are most generally used. In relation to the philosophy of top dressing, Prof. Johnson says: Fresh stable manure contains some seventy per cent. of water, twenty-five per cent. of vegetable and animal matters, and five per cent. of salts and mineral substance. If we put it on a cloth strainer, and slowly wash it with the rain of a watering pot, we shall dissolve out a portion of the organic matter, (some two per cent.,) and a portion of the salts, (some four or five per cent.) and we shall, besides, drive through the cloth some of the fine particles of the manure that do not actually dissolve; but the coarse parts will remain on the strainer. The same happens on the ground. The most active fertilizing elements are carried into the soil in solution, the undissolved matters which exist in a state of fine division are mechanically carried into the soil to an extent depending upon its porosity, while the coarse matters—the straw of the litter—remain on the surface. Now, what happens to dissolved matters, consisting of humic acid, which gives the brown color to dung liquor, and of carbonates, phosphates and sulphates, of ammonia, potash, lime, magnesia and soda? Are they liable to run to waste? No more, it would appear, than if the manure was buried in the soil. Not so much, in fact, as in the latter case, because they have more soil to pass through before they can escape into the springs. If the soil is fine in texture, has enough fine earth, or rather that retentive power over the soluble matters of manure which reside in the fine earth, and which enables good soil to filter out and hold in its pores these soluble matters, so that you can put dung heap liquor into a leach tub half full of such earth, and pure drinkable water will run out below, then you need fear no waste. But if the soil is coarse in texture, and water runs through it very rapidly, and dung heap liquor is not much clarified and sweetened by passing it, then the manure may suffer decided loss. Yet again, in case of the coarse, open soil, if it be full of grass roots or grain roots, which are ready to absorb the dissolved matters as soon and as fast as the spring rains descend, you may lose, indeed, some manure; but you may also do well to lose a part of it, in order to put another greater part where the growing crops will be certain to pay back for all the expenditure and give a margin of profit besides. On light, unretentive land, bare of vegetation, do not apply manure to the surface during the winter. A principal benefit of stable manure to such soil consists in mixing with the bulky, insoluble matters of the dung and litter which are of the most porous and moisture holding character, and which operate to counteract the leachy and droughty qualities of the soil. On such land hold the manure in reserve, carefully protected by cover if practicable, and bury it in the soil where the pushing roots of the new sown crops will find it, and where it will be food to the plant not only, but drink also, in virtue of its hygroscopic nature, all the summer through. The presence of abundance of stable manure in such a soil enables it to hold a much greater proportion of the rain that falls upon it; less rain runs off into the streams; there is less leaching, therefore, of plant food; at the same time there is increase of plant drink. This point can only be appreciated when we know that the evaporation of water through the foliage of crops amounts to 5,000,000 pounds per acre every season, and must go on whether there is rain to supply it or not. After having, by any proper system of management, so altered the texture of leachy soil that it will hold almost all the water that falls upon it; after having incorporated with it vegetable matter in considerable quantities, and mixed with coal ashes—leached ashes, perhaps—so that the soil has a great many fine pores, and so that the rain penetrates it slowly, and but little runs away altogether, then we have practically a different condition of things, and need not fear loss by drainage. The more the soil approaches that state which is implied by the term loamy, the more we can risk our manure upon the surface when the crop is not there. One effect of surface manuring upon soils which are in grass or occupied with crops or upon soils not thus occupied, if they are retentive of the element of fertility, has been mentioned by Dr. Hatch, that is, a decided effect on the texture of the soil. The German farmers have a special word for it; they call it fermentation, and have written books upon it. There is a kind of texture which is proper to land in good condition, something like that which you find in a well-cultivated garden. It is a thing which it is rather difficult to describe; but, when you once understand what it is, you can easily identify it. It is a sort of mellowness of the soil. If you take up a board which has been laying in a walk, you will see a difference between the soil underneath that board and the soil close at hand. There is a friability, a fineness, or something about that soil which is apparently very agreeable to the roots of plants. Dr. Hatch remarked that sod upon which manure had been laying during the winter broke up more easily and was a different sort of thing from sod where this had not happened. This quality depends chiefly upon the protection which the cover, be it board, stone or, manure, affords against the dashing of the rain, which compacts and puddles the surface, and against the drying effects of sun and wind, which tend to form a crust. The shelter keeps the earth uniformly moist, and as friable at the surface as it is below, or as its nature admits. It also favors the burrowing of earth-worms, grubs and other insects at the surface, which otherwise must go deeper to enjoy the moisture they require. This shelter, then, of surface-strewn litter is a cheap tillage, or takes the place of tillage to some extent, and on soils of certain texture is very favorable, or at least is thought to be by many intelligent, practical men. Speaking of the value of night-soil as a fertilizer, Mr. Clift said: I have been in the habit for five and twenty years of utilizing night-soil—taking the contents of the privy as prepared, and spreading them in the garden, upon my mowing-fields, and using them in the cultivation of almost all kinds of crops, especially garden crops, and I have eaten, and my family have eaten very freely of the various kinds of vegetables and fruits which have grown on this soil, which is pretty thoroughly saturated with night-soil. I have never discovered that it has done me or them any harm. The celery that is grown with this kind of fertilizer I know to be of very fine flavor, and I prefer to use it rather than any other in the cultivation of celery in trenches, where the application has been not only of the solid contents of the privy, but the liquid manure, of course very greatly diluted, applied to the growing crop. It makes very good celery, it makes good potatoes, it makes good sweet corn, good cabbages, good turnips, and good everything that I want to grow in the garden; and if it has ever done my family any harm, I have never found it out. Dr. Riggs spoke as follows of the earth-closet system and the value of night-soil when prepared in this way: The earth-closet system is true in theory, and it is true in every way; but, unhappily, it has never been applied until lately, and now not perfectly. The vaults of our privies should be so arranged that they should be regular manure factories, and so that a man can go into them in the winter time and manipulate the manure by mixing dry earth with it. This earth—no matter if it is nothing but light, loamy soil, what we call yellow dirt is just as good—should be dry. When it is dry, it mixes with the night-soil and deodorizes it completely, so much so, that you could carry it in a snuff box and present it to your neighbor, and he could not tell of what it was composed. Now, other manures should be deodorized in the same way, but night-soil especially should have that treatment. The cellar for composting of that material should be so arranged that it can be easily removed; we should have it under control. Coal ashes have considerable alkali, but it is in the form of carbonate of lime. The composition of coal ashes is carbonate of lime, alumina, and oxide of iron—valuable as far as it goes, and very valuable on light, sandy soil. Like the application of other carbonates, it makes light land heavier and more adhesive, and it has the contrary effect on clays; but it should not be composted with any manure any more than should lime. A point in which I think they are lacking in the stables we have visited, although the management is excellent, is this; the manure lacks packing. It is the carbonate of lime that causes that evaporation or the development of gases, and if it was thoroughly packed by those pigs, (that is their true field of action) they would find their manure much richer and much stronger when they undertook to get it out than they will under the present arrangement. That has been my experience. I have tried lime in compost heaps where there was nothing but vegetable matter, and it is very valuable, but in night-soil it is perfectly destructive to the fertilizing qualities; that is, in the main. I think it causes loss, so that it is not as good, or certainly no better, than road scrapings, or the soil that we get by the side of our fences. I think that we ought to have a proper reservoir made, not merely large enough for the excrement, both liquid and solid, to be kept during the year, but to give room for its manipulation, by throwing on this dry earth to deodorize it. Copperas, sulphate of iron, is very good, better than anything else, to deodorize a vault. You may take the strongest manure, and put in a few quarts of pulverized copperas, either in the form of a solution or a fine powder, and it will deodorize it so completely without any earth at all that you will hardly know what you are shoveling. It is better than plaster in a cellar like the one of which I am speaking. It costs more, but you can buy it by the quantity at about a cent and three-quarters or two cents a pound. You will find that copperas water or copperas sprinkled over it, will deodorize it so completely that your men will not object to working in it. Mr. Weld, of New York, gave his method of securing and preserving the contents of the privy as follows: I think a vault is a nuisance. There is a box which slides under the privy, which I originally had on runners, but I found it more convenient to knock the runners off, slip the box on a stone-boat and carry it off. The box is four and one-half or five feet long, two feet wide, and fourteen inches deep. There is a constant supply of dry earth kept in the privy, and when any member of my family uses the closet a dipper of earth is thrown in. It is not a very disagreeable thing to do, nor is there any thing disagreeable about keeping the box clean. The stone-boat is brought down, the box is raised with a crow-bar, for it is rather heavy to lift, the stone-boat shoved under, and the box is carried off, and the contents put on the top of the ground, or worked right into the garden. The manure does not deteriorate if left on the surface. The box is emptied a good many times a year, although I have but a small family, And the more dirt goes in it the better it is. It works easily. I frequently go in, and to the disgust of the man whose business it is to keep the earth box full, throw on half the contents of the box so as to be sure to have dirt enough. It is always crumbling, so that there is no trouble about applying it. The foregoing will apply to the saving of all offensive manures in their natural state. All such manures are also most valuable for top dressing, but are better if slightly covered under.

TORMENTIL. *Potentilla officinalis.* An exotic with an astringent root.

TORREFACTION. Roasting mineral bodies, usually under a red heat.

TORTRICES. A tribe of nocturnal lepidoptera, the larvæ of most of which conceal themselves by rolling up leaves and living in the interior.

TORUS. The end of the flower branch on which the carpels are situated.

TOURMALINE. A gem, valued from its property of polarizing light.

TOURNIQUET. A bandage which may be tightened to any extent by means of a screw, so as to exert pressure upon a cushion, and compress the arterial trunks to which it is applied It is chiefly used to prevent hemorrhage in the operations of amputation.

TRACHEA. The windpipe.

TRACHEÆ. The spiral vessels of leaves and insects.

TRACHELIDANS. A family of coleoptera, in many of which the head is supported on a kind of neck.

TRACHEOTOMY. The operation of tracheotomy is described by the late Dr. Dadd as follows: The operation consists in making an opening into the windpipe to admit air to the lungs, when the natural passage is obstructed by foreign bodies, or when its calibre is lessened by tumefaction occasioned by disease. In severe cases of laryngitis, strangles, and their kindred diseases, when the patient seems almost suffocated, tracheotomy should be immediately performed. In performing the operation, we select a spot about six inches below the throat, in front of the neck, and over the region of the windpipe; an incision is to be made with a common penknife, (in lieu of a better instrument,) to the extent of two or three inches, in a downward direction, so as to lay bare the trachea; having exposed space sufficient, a circular piece between two rings, corresponding to the size of the tube, is to be cut out, and a short tube inserted, which can be confined in position by means of tape passed around the neck. When the obstruction is removed, or the fauces restored to their natural state, remove the tube, bring the edges of the integuments together, and sew them up.

TRACHYTE. An ancient lava.

TRAGACANTH. A gum, which swells, but is not soluble in cold water.

TRAM ROAD. A road set with stone flags, wood, or iron ways, at such distances that the wheels of wagons, etc., may continually roll on them.

TRANSITION ROCKS. The extensive series of stratified and ancient rocks lying between the granitic series and the coal. It consists of slates, gneiss, and crystalline limestones.

TRANSPLANTING. Transplanting is the art of so removing plants that they shall receive the slightest possible check in the removal. The objects in transplanting is, first, to increase the season of growth of exotic plants by previous forcing in hot beds and greenhouses, that we may get easier and longer continued flowering and fruitage; second, the economical and better care certain classes of plants may receive, by growing them while young in confined spaces, as cabbage, cauliflower, celery and other plants, which indeed mature perfectly in the North; third, in the case of trees that may be more easily grown in masses or narrow rows while young; fourth, to increase the root fibers by successive transplantings, thus inducing a more stocky growth of plants, and earlier fruitage. This latter may be also accomplished by root pruning. The whole art of transplanting during the season of growth is simply to keep sufficient moisture at the roots to compensate the exhalation from the roots until new feeding roots can be thrown out. Some plants have been known to transpire twice their own weight in a day Hence plants not naturally supplied with fibrous roots, tap rooted plants, and those having soft and succulent leaves are, as a rule, difficult of transplantation. As a rule, plants will in favorable weather throw out new roots in twenty-four hours after being moved. Thus, to facilitate this action, they are usually moved during cloudy weather or just before night, after the sun has lost its power. It may, therefore, be taken as an axiom that to secure success in transplanting of plants with their foliage that it will depend upon the preservation of as many fibrous roots as possible and the prevention of excessive evaporation. In the case of trees and shrubs which drop their leaves periodically, there is little difficulty experienced during their season of rest. The same may be said of evergreens. Keep the roots moist and success is pretty certain. As a rule, transplanting is not as difficult as is generally imagined. The great and yearly losses sustained in the transplantation of the various plants usually purchased of the gardener, florist and nurseryman, make it very important that a few plain directions be given relating thereto. When sent out by respectable propagators and growers, plants are usually in good condition. It is to the interest of the grower that they shall be so. One of the most fatal mistakes, made by novices in the art is, that transplanting must be done when the earth is wet. If you can so time your work, that you transplant just before a shower, you will have hit the mark exactly, but if not, wait until the land is again in good working order. Never set out plants in the mud. Just at night or in cloudy weather, is the best time. If the plants are small keep the roots in water, until they are planted. If larger protect from the sun and air. We have known evergreens especially killed by contact with the sun and wind for five minutes. For ourselves we never wait for rain for transplanting, but have water near, hauled in barrels if necessary, for extensive planting. One hand plants, or rather fastens the plant, by drawing earth enough around it, for the purpose, another pours sufficient water about it to thoroughly wet it about the roots. When it has disappeared the planting may be finished by drawing over and around it dry or moist earth. Be sure and press the earth firmly about the roots when planted, but leave the surface light and mellow. Some of the more delicate plants, or those not easily transplanted, may need shading for a day or two, if you are very particular for perfect success, but under ordinary circumstances, it will not be needed. The same rules here indicated will apply to all larger plants, shrubs and trees. Keep the roots as much as possible from the sun and air. Give water at the roots when transplanted, draw over all dry, or only moist earth, mulch thoroughly, and nature will do the rest. In this connection, cast away the old fogyish notion that the top must be cut away to correspond to the rest. It is a relic of superstitious ignorance. The roots of a tree are its feeding mouths. The leaves are its lungs and stomach. Mutilate either unduly, and it is fatal to the prospect for health, and just in proportion to the top, in just such proportion will be formation of root surface. Never buy trees and plants at any price that have been unduly mutilated at the root, and the roots being fairly supplied, never cut away more of the top than just sufficient to bring the tree into as symmetrical shape as possible, for again we say, just in proportion to the leaf surface, so will be the power of the plant or tree, in forming new roots, or rather spongioles for feeding. We are thus particular because there is really no reason for the great annual loss which is sustained in the transplantation of trees and plants.

TRAPA NATANS. The water chestnut.

TRAP ROCKS. Ancient rocks of fusion occurring in mountains and large seams. They consist of various mixtures of hornblende and feldspar, and when containing much iron are very destructible, but usually resist the action of weather for an immense time.

TRAUMATIC. Relating to or arising from a wound.

TRAVELER'S JOY. *Clematis vitalba.* A climbing shrub with white flowers.

TREFOIL. *Trifolium.* A name applied to clover and also to lucerne, melilot clover, and formerly to all plants of the pulse family having three leaves like the common clover. The word is now scarcely used, the proper name of the individual species being applied. See articles Clover, Lucerne, Vetch, Melilotus, etc. The tick trefoil, desmodium, has many varieties, all noxious weeds, bearing bean-like pods, covered with hooked hairs, which fasten persistently to animals and the clothing of men.

TREES IN CITIES AND VILLAGES. We constantly hear complaints from citizens that the trees they have spent so much money in having planted and cared for, give but little satisfaction. A large majority die in the course of a few years, or at least become dingy and unhealthy from the effects of the smoke of the bituminous coal used so universally in the West. Evergreens are especially sensitive to disability from this cause. Among deciduous trees, the elm soonest shows blackening and stoppage of the pores, although all lose vigor to a greater or less degree from this cause, and notably all those having rough or hairy leaves, and this, undoubtedly, from the fact that these rough surfaces are not so easily washed by rains and showering as are the smooth and glossy leaved varieties. It is unfortunate, for in no place is the sanitary need of oxygen-giving plants more necessary than in our densely populated cities. Among the trees that longest resist the effects of city air, the cottonwoods bear the palm. The most serious objection to this tree is, the habit of discharging cotton, as the downy covering of the seeds is called. This, however, may be obviated, by selecting cuttings from the male tree, which does not throw off this substance. It has the added advantage of being healthy in a great variety of soils. The Plane (button wood) is also a most eligible tree for street planting in soils congenial to it. Its habit of throwing off its old bark annually, thus leaving its trunk smooth, gives this tree a peculiarly clean and fresh appearance, possessed by none outside this family. It also exposes a large leaf surface to the atmosphere, and exhales oxygen correspondingly. Ash leaved maple, *Acer negundo*, so far as our observation goes, also does well as a street tree. In fact all the maples do so measurably. The fact that the Ash leaved maple never grows to a great size we do not consider a special disability. It grows quickly, and that is what is wanted. If it were generally understood, great size is not what is wanted in street trees. These may be well for parks, and also waste places, but our streets and yards should be planted with smaller, quick-growing varieties, that will stand the smoke and dust of our crowded thoroughfares. In villages and country places, the inhabitants may have a wider selection. Here elms and hard maples, beech, sycamore and linden, the oaks, walnuts and hickory, may have full scope to grow and spread, giving shade and adding grandeur to the scenery. It is one of the pleasantest features of farm life that the prairie home may be shaded with varieties that in time will become giants, and yet which will, while growing, shade the lawn about the homestead, and furnish a grateful resting place from the noonday heat, or a pleasant place where the family may gather after the labors of the day to enjoy the summer twilight while engaged in pleasant chat, or listening to the evening song of the birds which are drawn thither. No less pleasant is the merry music of these feathered messengers at early dawn, when their joyous warblings fill the fragrant morning air with melody.

TREES OF THE UNITED STATES. In the articles Forestry, Timber, Timber Trees, range of, etc., will be found much valuable information which has not been commonly known to the general reader, and indeed which has not come under the reading of many who take a special interest in forestry and tree planting. At the centennial exhibition, at Philadelphia in 1876, special pains was taken by the United States Government, to collect specimens of the trees of the country; showing sections of the wood, together with such information as could be had as to their distribution, characteristics and peculiarities as could be obtained. Data relating to these was subsequently collated and digested and made public in a report of the Department of Agriculture, and we here reproduce the substance, for reference, in the interest of that large class whom it specially interests. The arrangement is by Dr. George Vasey, the accomplished botanist of the Department of Agriculture, Washington. As collector for the Southern States, Mr. A. H. Curtiss, of Liberty, Va., a well-known botanist, was engaged. A large number of the trees of the Middle States were obtained in the vicinity of Washington. Of these, thirty species were procured from a part of the General Washington estate at Mount Vernon, now owned by Dr. E. P. Howland. The trees peculiar to the New England States were procured by Mr. C. G. Pringle, of Charlotte, Vt. As collector for the Western States, Mr. John Wolf, of Canton, Ill,, was employed. In making the collection in Colorado, he was assisted by Mr. C. W. Derry, of Granite, Lake county, Col. Again, the semi-tropical trees of Southern Florida were obtained by Dr. A. W. Chapman, of Apalachicola, during a two months' cruise by schooner on the west coast, among the various keys and inlets, and far into the interior by the Caloosahatchee river. A portion of the trees of Texas were obtained by Dr. S. B. Buckley, of Austin, whose labors in developing the botany of that section are well known; and a portion were collected by Dr. F. G. Lindheimer, a veteran botanist, whose collections of Texas plants, made many years ago, enrich the principal herbaria of the country. In Utah, Mr. L. F. Ward, botanist of the survey of the Colorado river by Messrs. Powell and Thompson, made the collection of the trees of that region. The trees of the high sierras of California and Nevada were procured by Mr. J. G. Lemmon, of Sierra county, Cal. The magnificent coniferous trees of that region are represented by large wedge-shaped sections of trees from four to seven feet in diameter, the preparation of which cost a great amount of toil and expense. The immense trees had to be felled, and the desired sections removed by sawing and splitting with wedges until the portions were reduced to proper size. The trees of the Pacific slope, in California, were collected by Mr. G. R. Vasey, with valuable aid and assistance from Dr. Kellogg, of San Francisco, Dr. J. G. Cooper, and others. Dr. Edward Palmer made the collection for the southern portion of California, Arizona, and Southern Utah. Mr. A. J. Dufur, Centennial Commissioner for Oregon, collected the peculiar trees of that State. After the woods were received at Washington, they were taken to a mill and reduced to the uniform length of two feet; then each section was divided by sawing longitudinally into two pieces, which were planed on the sawed surface, one arranged to show the outer or bark surface and the other to show the grain of the wood, its color, density, etc. The corresponding botanical specimens for each species are displayed in frames arranged in the immediate vicinity of the trees to which they belong. By this means, an intelligent view of the appearance and properties of every species of the trees of the country may be obtained. Great difficulty, says the compiler, was experienced in deciding upon the limitations of height and size which should characterize a tree. It is well known that certain plants which are only shrubs in some places become large trees in other places; sometimes the difference depending on climate and sometimes on other circumstances. Thus, *Magnolia glauca*, or White Bay, grows and matures its flowers and fruit in some portions of Massachusetts, where it attains only the size of a large shrub. It, however, steadily increases in size in situations farther south, until in Georgia and Florida it attains the size of a large tree. In some places, the same plant appears as a shrub or a tree, under different circumstances, in closely contiguous localities. Dr. Chapman, who made the collection of trees of South Florida, says: I was much disappointed in the size of most of the forest growth in that region. A peculiarity of these tropical trees is, that for miles they occur to you as mere shrubs, when at some other locality you find them lofty trees. As a general rule, there has not been admitted into the collection any tree which does not, under favorable circumstances, attain a height of twenty feet and a diameter of four inches. Yet, in a few cases, to more fully illustrate a family, a tree has been admitted which would fall below that standard. The list given below enumerates about 400 species, the greater portion of which are represented by specimens in the collection. Some portions of the country have been so incompletely explored that our knowledge of their vegetation is imperfect; yet it is probable that this catalogue presents, with great accuracy, our present knowledge of the trees of the United States. In two or three instances only, foreign species have been admitted, because of their extensive naturalization, in some sections. The two largest genera of trees are the oaks and the pines, of which we have about thirty species of each. Of coniferous trees, including the pines, firs, cedars, larches, cypress, sequoias, etc., we have about sixty species. The rose family, including the plums, cherries, thorns, etc., is represented by over thirty species. Of the order *Leguminosæ*, or trees of the pod-bearing family, we have over twenty, embracing the locusts, acacias, redbuds, mesquits, etc. Of ericaceous trees we have eight species, including the Californian manzanita and madrone trees, the sorrel tree of the Southern States, and others. Of maples we have eight; of magnolias, seven; of ash, eleven; of elms, six; of walnuts and hickorys, thirteen; of poplars, eight; and of birch, six species. The usual difficulty has been encountered in deciding as to the standing of certain forms which some botanists regard as species and others as only varieties. In most well marked cases, these are entered in the catalogue under distinct numbers, either as species or as varieties, as the evidences in the case seemed most convincing. The range, or botanical region of each species, is indicated in a general manner, thus: Those trees which occur more or less extensively over the whole or the larger portion of the country east or the base of the Rocky mountains or east of the Mississippi river are marked eastern United States. This region is sub-divided, by a line running eastward from the mouth of the Ohio river to the Atlantic, into two portions, one of which is called Northeastern United States, and the other Southeastern United States. Other localities are indicated as Southern States, New England States, Western States, Alleghany mountains, etc. The western portion of the United States and Territories is marked in detached regions, as follows: Rocky Mountains of Colorado, or Rocky Mountains of Colorado and Utah; Sierra Nevada Mountains of California, Oregon, and Washingington Territory; California; Southern California; Arizona. The portion of the country adjoining the Mexican border is indicated by the locality Western Texas and Westward. Certain portions of our country have not yet been sufficiently explored to determine accurately all the species of trees thereto belonging. This is the case with respect to the southern portion of Florida. Some species which at one time were thought to be indigenous in that region have not been confirmed by any late investigations, and will probably have to be erased from the list. The same difficulty occurs with respect to some of the trees of the Rocky mountains and the western coast, particularly the conifers and the willows. In a short time allotted to making this collection, it did not seem possible to obtain wood specimens of every species given in the catalogue. The number wanting, however, is but a small percentage of the whole. Among the good results growing out of this work, we may mention, first, that much information has been gained respecting species hitherto imperfectly known: and, secondly, that four or five new species, or species before unknown to our flora, have been obtained. These are mainly in South Florida, and include two exogens, viz, an anona or custard apple, and a chrysophyllum or star apple; and one endogen, a palm of the genus *Thrinax*. The arrangement is as follows:

MAGNOLIACEÆ.

Magnolia grandiflora. Evergreen Magnolia. Southern States. A large and beautiful tree, with thick, glossy evergreen leaves, and large white flowers, which are exceedingly fragrant.

M. glauca. Sweet Bay. White Bay. Massachusetts southward. Northward, this is only a small tree or shrub, but in the South it attains a large size, and the leaves become evergreen.

M. Umbrella. Umbrella Tree. Southern States, Alleghany mountains.

M. acuminata. Cucumber Tree. New York, South and West. This species has a greater range to the north and west, where it sometimes attains a large size.

M. cordata Yellow Cucumber Tree. Southern States.

M. Fraseri. Long-leaved Cucumber Tree. Southern States.

M. macrophylla. Large-leaved Umbrella Tree. Southern States.

Liriodendron tulipifera. Tulip Tree, Yellow Poplar. Eastern United States. One of the largest and most beautiful of North American trees. In the Western States, it attains an immense size. It is found principally in the rich bottom lands of the large rivers, where its wood is extensively employed for building purposes and for the manufacture of furniture. As an ornamental tree, it is hardly surpassed by any other; its form being regular, its foliage peculiar and pleasing, and its abundant flowers, though not highly colored, are yet very beautiful.

ANONACEÆ.

Anona. Custard Apple. Southern Florida. Discovered by Dr. Chapman, in South Florida. It grows fifteen to twenty feet high. The fruit is small and eatable when full ripe. The species is undetermined.

Asimina triloba. Papaw. From Pennsylvania South and West. A small tree, very common in the Southern States, less frequent at the North. It produces an oblong pulpy fruit about four inches long, which, when ripe, has a rich luscious taste.

CAPPARIDACEÆ.

Capparis Jamaicensis. Caper Tree. South Florida. A shrub or small tree of South Florida, also growing in the West Indies. The true capers of commerce are the fruit of the Old World species.

CANELLACEÆ.

Canella alba. White Wood; Wild Cinnamon. South Florida. A small tree in South Florida. In the West Indies, it is abundant, and called Wild Cinnamon and White Wood. The bark is aromatic and tonic, and is much employed in medicine.

TAMARISCINEÆ.

Fouquiera splendens. Western Texas and Arizona. Grows in Western Texas, and thence westward to Southern California. In our borders, it is usually only a shrub; but in Mexico it grows twenty to thirty feet high, and on account of its spiny branches is used for hedges and fences.

GUTTIFERÆ.

Clusia flava. South Florida. A West Indian tree, said to have been found in Florida, but not recently observed.

TERNSTROMIACEÆ.

Gordonia lasianthus. Loblolly Bay. Southern States. A tree thirty to fifty feet high, growing in swamps near the seacoast from North Carolina to Florida and Louisiana. The leaves are evergreen; the flowers showy white, and sweet-scented. The bark is much employed in tanning, as a substitute for oak-bark.

G. pubescens. Mountain Bay. Southern States. A small tree rarely over thirty feet high, found in Georgia and Florida, and quite rare. It has been introduced into cultivation, and is hardy as far north as Philadelphia. When in bloom, it is beautiful, and it flowers continuously for two or three months.

TILIACEÆ.

The Tilias in Europe are called Lime trees, or Linn. Our species are commonly called Basswood. They are large trees, and have a wide range, being found probably in every State east of the Rocky mountains. It is, however, not abundant, except in some localities. The wood is white and soft, and is employed to some extent in the manufacture of furniture, etc.

T. Americana. Basswood; Linden. Eastern United States.

T. heterophylla. White Basswood. Eastern United States.

T. pubescens. White Basswood. Eastern United States.

ZYGOPHYLLACEÆ.

Guaiacum sanctum. Lignum Vitæ. South Florida. A small tree, quite rare in South Florida, but common in the West Indies. It is very similar to, and has the same properties as the *G. officinale* of the West Indies, which furnishes the gum resin called guaiacum, which is a common stimulative aromatic medicine. The wood is much heavier than water.

ZANTHOXYLACEÆ.

Zanthoxylum Americanum. Prickly Ash; Toothache Tree. Northeastern United States. A shrub or small tree. The bark is very hot and aromatic, and is somewhat used medicinally.

Z. Carolinianum. Southern Prickly Ash. Southern States. A small tree found from South Carolina to Florida and westward. The bark is aromatic and tonic. The young stems are spiny, and the old ones more or less covered with tubercles, which have developed from the spines.

Z. Floridanum. Satin Wood. South Florida.

Z. Pterota. False Iron Wood; Yellow Wood. The Gulf States. A small shrubby tree occurring from Florida to Texas. The wood is yellow and close-grained.

Ptelea trifoliata. Hop-tree. Eastern United States. This is seldom more than a tall shrub. The fruit, a wafer-like seed, grows in clusters, is a bitter tonic, and has been used as a substitute for hops.

P. angustifolia. Narrower-leaved than the preceding. Rocky Mountains; Texas to California.

SIMARUBIACEÆ.

Simaruba glauca. Quassia; Bitter-wood. South Florida. Found in South Florida by Dr. Blodgett. It occurs in the West Indies with another species, the *Simaruba amara*, the bark of which is medicinal, and possesses the same properties as quassia.

BURSERACEÆ.

Bursera gummifera. West India Birch; Gummo Limbo. South Florida. The largest of the South Florida trees, abounding in gum.

Amyris Floridana. Torch Wood. South Florida. Mostly a shrub, but becoming a small evergreen and elegant tree.

OLACINEÆ.

Ximenia Americana. Hog Plum. South Florida. Mostly shrubby but sometimes twenty feet high. It bears a drupe the size of a plum, which is yellow and pleasant-tasted.

MELIACEÆ.

Melia Azederach. Pride of India; Bread Tree. Naturalized in Southern States. A native of Persia, but quite freely naturalized in some parts of the South. It is there one of the commonest ornamental trees. The wood is of a reddish color, solid, durable, and taking a beautiful finish.

ILICINEÆ.

Ilex opaca. Evergreen Holly. Southern States. In favorable localities this tree attains a pretty large size, frequently forty feet high, and twelve to fifteen inches diameter. The wood is very heavy, compact, and fine-grained. It is employed in some parts of cabinet work. It very closely resembles the European Holly.

I. Dahoon. Dahoon Holly. Southern States.

I. decidua. Deciduous Holly. Southern States.

I. monticola. Holly. Southern States.

CELASTRINEÆ.

Schæfferea frutescens. Crab-wood; False Box. South Florida. A small tree of South Florida; the wood is close and fine grained, and is said to be exported from the West Indies as a kind of box wood.

Euonymus occidentalis. California Spindle Tree. California.

E. atropurpureus. Waahoo. Southern and Western States.

RHAMNACEÆ.

Frangula Caroliniana. Alder Buckthorn. Virginia and southward.

F. Purshiana. Oregon Buckthorn. Western coast.

F. Californica. California Coffee-tree. Western coast. This much resembles the *F. Caroliniana*. In California, the berries of this species have been employed to some extent as a substitute for coffee. Some persons recommend it; others have been made sick by its use.

Ceanothus thyrsiflorus. California Lilac. Western coast. One of the most showy shrubs or small trees of California.

C. divaricatus. California.

Zizyphus obtusifolia Texas Jujube-tree. Texas and westward.

Scutia ferrea. South Florida.

SAPINDACEÆ.

Æsculus glabra. Ohio Buckeye. Tennessee and Western States. This tree attains, in favorable situations, twenty to thirty feet height, and is much in use as an ornamental tree. It is not found wild east of the Alleghany mountains; its favorable locality being the banks of the Western rivers, in Ohio, Illinois and Kentucky. The wood is light, soft and useless. The nuts are said to be poisonous to cattle eating them.

Æ. flava. Sweet Buckeye. Southern States. This tree prevails more to the southward than the Ohio Buckeye. It is abundant in the mountainous districts of North and South Carolina and Georgia. In favorable situations, it frequently attains a height of fifty to sixty feet, and the trunk a diameter of two to three feet. The flowers are of a light agreeable yellow and quite ornamental. The wood is soft and perishable.

Æ. pavia. Red Buckeye. Southern States. This species has nearly the same range as the preceding, but is usually only a shrub of eight or ten feet height; sometimes, however, becoming a small tree.

Æ. Californica. California Buckeye. California. This is the only buckeye of the Pacific coast. It forms a low, spreading, bushy tree from fifteen to twenty feet high.

Ungnadia speciosa. Spanish Buckeye. Texas and Westward. This is a large shrub or small tree, a native of Texas and New Mexico. The chestnut-like fruits have an agreeable, sweet taste, but are strongly emetic. The foliage resembles that of the hickory, (*Carya*).

Sapindus marginatus. Soap Berry. Southern States. This tree varies from twenty to forty feet in height. It occurs along the coast in Georgia and Florida, also in Arkansas and Texas. The berries are smaller than those of the next species, but, like that, the black hard nuts of the berries are sometimes strung for beads and crosses.

Saponaria. White Wood. South Florida. This species was found by Dr. Chapman in south Florida. In the West Indies, the berries and the roots are used as a substitute for soap. The berries are used to intoxicate fish.

Hypelate paniculata. Madeira Wood. South Florida. A small tree found in South Florida. The wood is very like mahogany, and is highly valued.

Acer saccharinum. Sugar Maple; Hard Maple. Eastern United States. The well known Sugar Maple, from the sap of which in the Northern States and in Canada large quantities of sugar and syrup are made annually. It is one of the noblest of American trees, both for the value of its wood and the beauty of its form and foliage. It is much employed as an ornamental tree.

A. saccharinum, var. *nigrum.* Black Sugar Maple. Eastern United States. This variety differs little from the common form except in a darker wood.

A. dascycarpum. Silver-leaf Maple. Eastern United States. One of the most beautiful of maples; much used as a shade-tree on account of its rapid growth and beautiful foliage.

A. rubrum. Red Maple. Eastern United States. More compact in form and less rapid in growth than the preceding, but, like it, a favorite for street planting and ornament.

A. Pennsylvanicum. Striped-bark Maple. Northeastern United States. A small tree, the young bark with longitudinal stripes of green and black. Rare and little known outside of the Northeastern States.

A. macrophyllum. Oregon Maple California and Oregon. This occurs in the mountainous districts of California and Oregon. In Oregon, it attains a large size, and the wood abounds in that peculiarity of grain which is called Bird's-eye and Curled Maple. For cabinet purposes it is thought to be equal to mahogany.

A. circinnatum. Vine Maple. Oregon and Washington Territory. This species has a low and frequently reclining or prostrate trunk, which sends forth branches, at first upright, then bending down to the ground, and forming almost impenetrable thickets.

A. grandidentatum. Great-toothed Maple. California and Oregon. A small tree or shrub of the Rocky mountains.

Negundo aceroides. Box Elder. Eastern United States. This is a fine ornamental tree, of rapid growth, not commonly growing more than twenty to thirty feet high. It is rare east of the Alleghanies, but found along all the rivers of the West, reaching into Kansas, Missouri and Nebraska, and even northward to Minnesota and the British possessions. The sap contains a large amount of sugar. The wood is fine and close-grained, and has been used in cabinet work.

N. Californica California Box Elder. California. This species is confined to the Pacific coast. It does not seem to differ greatly from the preceding species.

Staphylea trifoliata. Bladder Tree Eastern United States. A large shrub or small tree ten to fifteen feet high, with trifoliate leaves, peculiar three-lobed bladdery pods.

ANACARDIACEÆ.

Rhus typhina. Staghorn Sumach. Eastern United States. The Sumachs are large shrubs or small trees mostly with pinnate leaves. The leaves and young twigs, are employed in tanning and are thought to be equal in strength to those of the Sicilian Sumach.

R. glabra. Smooth Sumach. Eastern United States.

R. microphylla. Small leaved Sumach. Texas and Southwest.

R. copallina. Dwarf Sumach. Eastern United States.

R. Metopium. Coral Sumach. South Florida. This grows in South Florida, where it attains a height of twenty to thirty feet. It is very poisonous. In the West Indies, it is called Mountain Manchineel and Burnwood.

R. venenata. Poison Sumach. Eastern United States.

R. integrifolia. One-leaved Sumach. South Carolina. This species and the succeeding do not have pinnate leaves. They are found in Southern California. The red berries of this species are used by the Indians to make a cooling acid drink.

R. Laurina. Laurel Sumach. South California. A low spreading tree, much branched and very leafy, and exhaling to a considerable distance an aromatic odor. The flowers are somewhat showy, and the plant would be fine in cultivation.

Pistacia Mexicana. Mexican Pistacia-tree. Texas.

Schinus molle. Pepper Tree. Southwestern United States. Cultivated as an ornamental tree in California and in Mexico. It is probably introduced. The berries have the taste of black pepper.

VITACEÆ.

Vitis æstivalis. Summer Grape. Eastern United States.

V. cordifolia. Winter or Frost Grape. Eastern United States.

LEGUMINOSÆ.

Robinia Pseudacacia. Common Locust. Pennsylvania and southward. Hardly found north of the fortieth degree of latitude except in cultivation. It is chiefly found in the Alleghanies and the mountainous parts of Kentucky and Tennessee. It is a beautiful tree, attaining a height of fifty feet and upward. The wood is hard, compact, and very durable, much used in ship building.

R. viscosa. Clammy Locust. Virginia and southward. A smaller tree than the preceding, and much more rare, being confined to the mountains of Georgia and North Carolina.

R. Neo-Mexicana. New Mexican Locust. New Mexico and Arizona. A small tree, rarely exceeding twenty feet. Very thorny. Grows in stony ravines at the foot of mountains in New Mexico and Arizona.

Olneya tesota. Palo de Hierro. New Mexico and Arizona.

Piscidia Erythrina. Jamaica Dogwood. South Florida. A tolerably large tree of South Florida; also grows in the West Indies. Its blossoms resemble those of the Locust. The wood is heavy, coarse-grained and durable.

Cladrastris tinctoria. Yellow wood. Tennessee and Kentucky. This is one of the handsomest flowering-trees of the Locust kind. It grows chiefly in the mountainous regions of Kentucky and Tennessee. The wood is yellow, and has been used in domestic dyeing. The tree rarely exceeds forty feet in height and one foot in diameter. It is well worthy of cultivation.

Sophora affinis. Texas and Southwest.

S. Speciosa. Texas and Southwest. Our two Sophoras are small trees of Texas and New Mexico, seldom over six inches in diameter. They produce an abundance of showy flowers very early in the season. The *Sophora speciosa* has evergreen leaves, and beautiful red beans, which are said to be poisonous.

Gymnocladus Canadensis. Kentucky Coffee-tree. Eastern United States. A tall, large and handsome tree, rare in Western New York, Pennsylvania, and the States north of the Ohio river; more common in Kentucky and southwestward. The wood is very compact and close-grained, and valuable for cabinet work. The large beans of the pods have been used for coffee.

Gleditschia triacanthos. Honey Locust. Eastern United States. This is a large and handsome tree; the trunk and branches generally beset with long and formidable spines, on which account it has been employed as a hedge-plant. The long pods contain a sweetish pulp, and have been used in fermenting a kind of beer, but are of no practical value. The wood is heavy, and affords excellent fuel, but is not considered durable as a timber. The tree is rare in the Atlantic States, but rather common west of the Alleghanies, in Tennessee, Kentucky, and the tributaries of the Ohio and Mississippi.

G. monosperma. Water Locust. Illinois and southward. This is a smaller tree than the preceding, growing in swamps in the Southern States and in the vicinity of the Ohio river. The pods are short, roundish, and only one-seeded. The tree is thorny, like the Honey Locust.

Cercidium floridum. Green-bark. Western Texas and Arizona. This is the Palo Verdi of the Mexicans and the Green-barked Acacia of American travelers. The bark is smooth and green on the young trees. It is a small, wide-spreading tree, with many branches, rarely seen a foot through, and twenty to thirty feet high.

Parkinsonia aculeata. Jerusalem Thorn. Western Texas and Arizona. Mostly a shrub; quite ornamental, and frequent in cultivation in the region bordering on Mexico.

P. microphylla. Western Texas and Arizona.

Cercis Canadensis. Redbud or Judas Tree. Eastern United States. The Redbuds are small trees; very ornamental. This species is frequent east of the Mississippi. The next is found principally on the Pacific Coast.

C. occidentalis. Western Redbud. Western United States.

Prosopis glandulosa. Mesquite. Texas to California. A scrubby, small tree, seldom more than twenty-five to thirty feet high; sometimes constituting extensive forests. It produces an abundance of bean-like pods, which contain a sweet pulp. Both beans and pulp are eaten by Indians and often by whites, but they are used chiefly as food for horses, which eat them with avidity. The wood is very hard and durable, dark brown, and resembles mahogany. Fences made of this timber are very durable. The wounded bark in spring exudes a gum of the same quality as gum arabic.

Strombocarpus pubescens. Screw-bean. Texas and westward. This tree is very similar to the preceding, but of smaller size. The pods are two to three inches long, and twisted like a screw. They are eaten by the Colorado Indians, powdered to a coarse meal, and made into a kind of bread. They are also good food for the horses.

Leucæna retusa. Texas and westward.

Acacia Farneseiana. Texas and westward.

Pithecolobium Unguis-Cati Cat's-claw. South Florida. In South Florida, mostly a shrub, rarely a small tree. The bark has medicinal properties.

ROSACEÆ.

Prunus Americana. Wild Yellow or Red Plum. Eastern United States. This is the common wild plum of the country east of the Rocky mountains, from Mississippi to Minnesota. In the valley of the Mississippi, and particularly southwestward, the two next named species also occur.

P. rivularis. Wild Plum. Mississippi Valley and westward.

P. Chicasa. Chickasaw Plum. Southeastern United States.

P. umbellata. Small Wild Plum. South Carolina and southward. A small purple or black plum, sour and bitter, growing from South Carolina to Florida.

P. Pennsylvanica. Wild Red Cherry. Eastern States. A small tree, or often a shrub, with sour, unpleasant fruit.

P. serotina. Wild Black Cherry. Eastern United States. A fine, large tree, of wide range, frequent in the Northern and Western States, and along the Alleghany Mountains in the Southern States. The wood is compact, fine-grained, and highly esteemed for cabinet work. The fruit is small, rather sweet and pleasant when fully ripe.

P. Virginiana. Choke-cherry. Eastern United States.

P. Caroliniana. Mock Orange. North Carolina and southward. A small tree with evergreen leaves, growing from North Carolina to Florida and in the Gulf States. It closely resembles the Cherry Laurel of Europe. It is a beautiful tree for cultivation, but probably would not bear a northern climate.

P. demissa. Rocky Mountain Choke-cherry. Rocky Mountains and California.

P. Andersonii. Desert Plum. California and Nevada.

P. ilicifolia. Holly-leaved Cherry. California.

P. mollis. Oregon. This is the principal wild cherry of Oregon and the northwestern coast. It grows to the height of twenty to thirty feet. The fruit is astringent and unpleasant.

Nuttallia cerasiformis. California.

Adenostoma sparsiflora. Chimisell. California.

Cercocarpus ledifolius. Mountain Mahogany. Rocky Mountains. A low, spreading tree, not usually over ten to fifteen feet high, but sometimes forty feet high, and two and a half feet thick. The leaves are evergreen; the wood is a dark red, like mahogany, extremely compact and heavy. It is frequent on the mountains of Utah, Nevada, and California.

C. parvifolius. Small Mountain Mahogany. California. A much smaller tree or shrub than the preceding; the wood quite similar.

Pyrus coronaria. American Crab Apple. Eastern United States. The common wild crab apple of the United States, growing in grades and frequently forming extensive thickets. The fruit is variable, but seldom palatable or serviceable. It is used, however, in new portions of the country for preserves or for making cider.

P. angustifolia. Narrow-leaved Crab. Pennsylvania southward and westward. Perhaps only a variety of the preceding, with narrower leaves and rather smaller fruit.

P. Americana. American Mountain Ash. Northeastern United States. A small tree growing in swamps and mountain woods, sparingly in the Alleghany Mountains, most common in New England and northward. It is frequently seen in cultivation, and much resembles the European Mountain Ash. The clusters of bright-red berries are very ornamental, and remain on the tree until winter.

P. rivularis. Oregon Crab Apple. Oregon and Rocky Mountains. This is a small tree, ranging from California northward into Alaska. The fruit is of the size of a cherry, of an agreeable flavor, and used, particularly in Alaska, by the natives of the country for food.

C. tomentosa. Black or Pear Thorn. Eastern United States.

Cratægus spathulata. Wild Thorn. Virginia and southward. Of wild thorns, we have numerous species, most of which are small and shrubby. About twelve species and varieties of the country east of the Rocky mountains may be counted as small trees, and two of the Rocky mountains and western coast.

C. apiifolia. Wild Thorn. Virginia and southward.

C. cordata. Washington Thorn. Virginia and southward.

C. arborescens. Wild Thorn. Southern States.

C. coccinea. Scarlet-fruited Thorn. Eastern United States.

C. tomentosa. Black or Pear Thorn. Eastern United States.

C. tomentosa, var. *punctata.* Black Thorn. Eastern United States.

C. tomentosa, var. *mollis* Gr. Wild Thorn. Eastern United States.

C. Crus-galli. Cockspur Thorn. Eastern United States.

C. æstivalis. Wild Hawthorn. Southern States.

C. flava. Summer Haw. Virginia and southward.

C. glandulosa. Wild Hawthorn. Virginia and southward.

C. rivularis. Western Hawthorn. Rocky Mountains.

C. sanguinea. Oregon Thorn. Oregon.

Photinia arbutifolia. Laurel Hawthorn. California. A beautiful evergreen shrub or small tree of the Pacific coast. It sometimes attains the height of twenty or twenty-five feet and a thickness of trunk of twelve or fifteen inches.

Amelanchier Canadensis. Service or June Berry. Eastern United States. Usually a small tree, but sometimes becoming thirty to forty feet high, with a diameter of ten or twelve inches. It is found mostly by the banks of mountain streams. There are several varieties, some of them used as ornamental shrubs.

A. alnifolius. Service Berry. Rocky Mountains. This is usually a shrub; in Oregon and Washington Territory, it is said to be a small tree, yielding abundance of berries, which are largely employed as food by the Indians.

HAMAMELACEÆ.

Liquidambar styraciflua. Sweet Gum or Bilsterd. Eastern United States. A large and beautiful tree, with singular star-like leaves, somewhat resembling the maple. It grows in the Atlantic States in rich, low woods; also in the Mississippi valley, but not far north of the Ohio. The wood is compact and fine-grained, but not durable. It is a fine ornamental tree, and deserving of cultivation.

RHIZOPHORACEÆ.

Rhizophora Mangle. Red Mangrove. South Florida. Commonly a low, spreading tree in South Florida, also in Louisiana and on the coast of Texas. On the Thousand Islands, it attains a height of forty to sixty feet. All the low keys along the coast are covered by this tree. It sends down roots from its germinating fruits, which take root upon reaching the earth, and thus forms an impenetrable thicket like the Banyan tree of India.

COMBRETACEÆ.

Conocarpus erectus. White Button Wood. Florida. A small tree of the West Indies and South Florida. It furnishes almost the only fuel used in South Florida, and extends north as far as Ancelote Keys. (Dr. Chapman.)

Laguncularia racemosa. Black Button Wood. South Florida. Found by Dr. Chapman in South Florida; a small tree everywhere; is a mere shrub, except among the Thousand Islands and north of Cape Sable, where it forms a large tree.

MYRTACEÆ.

Eugenia buxifolia. Iron Wood. South Florida. The Eugenias are in Florida small trees, reaching twenty to twenty-five feet in height. They belong to the Myrtle family, and the flowers of some species are very fragrant. The wood is close-grained, hard, and applicable to cabinet work.

E. monticola. Iron Wood. South Florida.

E. procera. Iron Wood. South Florida.

E. dichotoma. Stopper Wood. South Florida.

Psidium pyriforme. Guava. South Florida. The Guava is a well known fruit in the West Indies, where it is highly esteemed, and eaten either raw or formed into preserves. Dr. Chapman found the tree extensively naturalized at Tampa Bay, Fla.

CACTACEÆ.

Cereus giganteus. Tree Cactus. Western Texas and Arizona. The specimens for this order are from Southern Arizona, where they are striking and characteristic features of the country. The *Cereus giganteus* grows fifty to sixty feet in a straight column, and finally divides into several naked-looking branches. The wood of this and other large Cacti presents a singular net-work of fibers in distinct layers.

C. Thurberi. Thurber's Cactus. Western Texas and Arizona. *Opuntia arborescens.* Tree opuntia. Western Texas and Arizona.

ARALIACEÆ.

Aralia spinosa. Angelica Tree or Hercules' Club. Eastern United States.

CORNACEÆ.

Cornus florida. Flowering Dogwood. Eastern United States. This is usually a small tree, but sometimes acquires a height of forty or fifty feet, and a diameter of trunk of one and one-half feet. It flowers in spring before the full development of the leaves, and then presents a beautiful appearance. It deserves to be more generally cultivated.

C. Nuttallii. White Dogwood. California and Oregon. This species, which is confined to the Pacific coast, has rather larger flowers than the preceding, and is perhaps more showy. The wood of both is hard and valuable. Grows sometimes fifty or sixty feet high.

C. Pubescens. Western Dogwood. California and Oregon. This rarely becomes a small tree, twenty-five to thirty feet high, on the Pacific coast. We have five or six other species of dogwood which do not attain tree size.

Garrya Fremontii. Tassel-tree. Oregon and California. The Garryas are mostly shrubs, though under favorable circumstances the *Garrya elliptica* gains a height of twenty to thirty feet.

G. elliptica. Satin Tassel-tree. California.

Nyssa multiflora. Black or Sour Gum; pepperidge. Eastern United States. A middle-sized tree, growing from Massachusetts to Illinois and Southward. The fibers of the wood are so interwoven that it is almost impossible to split it; hence it is used for wheel hubs, rollers, and cylinders. (Bryant.) It is quite ornamental in cultivation.

N. aquatica. Water Tupelo. Southern States. This species grows in low, wet ground, chiefly in the Southern States, but is found also in New Jersey and Pennsylvania. The wood is very tough, and has been used in the manufacture of wooden bowls, etc.

N. uniflora. Large Tupelo. Virginia and southward. This is the largest tree of the genus. It is confined to the Southern States, growing in swamps. It bears a dark-blue plum-like fruit nearly an inch long. The wood is soft and extremely light. The roots are also extremely light and soft, and have been used as a substitute for cork. The wood is only used to make bowls and trays.

N. capitata. Ogeechee Lime. Southern United States. This species is found in swamps in Georgia and Florida and westward near the coast. It bears an oblong red plum-like fruit, which is agreeably acid, and can be employed as a substitute for the lemon. The tree is small and the wood without value.

CAPRIFOLIACEÆ.

Sambucus glauca. California Elder. California and Rocky Mountains. This species of elder in California forms a low tree, sometimes thirty feet high, with a stem two feet in diameter. Indians and birds eat the berries.

Viburnum prunifolium. Black Haw. Eastern United States. The haws are small trees or large shrubs, with smooth, glossy leaves and handsome flowers. They are worthy of cultivation.

V. Lentago. Sweet Viburnum or Sheepberry. Eastern United States.

V. obovatum. Wild Haw. Virginia and southward.

RUBIACEÆ.

Cephalanthus occidentalis, var. *Californica.* Button-bush. California. This is seldom more than a shrub; but in California it sometimes grows twenty-five to thirty feet high, with a trunk twelve to twenty inches in diameter.

Guettarda Blodgettii. South Florida.

Randia clusiæfolia. Seven-year Apple. South Florida.

Pinckneya pubens Georgia Bark. South Carolina to Florida. A small tree in the lower districts of Georgia and in Florida, rarely exceeding the height of twenty-five feet and a diameter of six inches. The bark is extremely bitter, and has been employed in the treatment of intermittent fevers. It is closely related botanically to the

Cinchona, from which quinine is made, and which furnishes the Peruvian bark of commerce.

ERICACEÆ.

Vaccinium arboreum. Farkleberry. Virginia and southward. A shrub or small tree sometimes twenty feet high, growing from Virginia and Southern Illinois southward.

Oxydendrum arboreum. Sourwood or Sorrel-tree. Pennsylvania and southward. This tree grows chiefly in the mountainous districts of the Alleghanies from Pennsylvania southward. In fertile valleys, at the foot of the mountains, in North Carolina and Tennessee, it attains a height of fifty feet. The common name sour-tree is derived from the acidity of its leaves. The flowers are white, and in spikes five or six inches long. They are very ornamental, and begin to be produced when the tree is five or six feet high.

Kalmia latifolia. Calico-bush or Mountain Laurel. Pennsylvania and southward. A beautiful evergreen shrub, sometimes attaining the size of a small tree. It is very ornamental and deserving of cultivation.

Rhododendron maximum. Rose Bay or Great Laurel. Pennsylvania and southward. Like the preceding, an evergreen shrub of great beauty. It has been much improved by cultivation. Some of the hybrids are most elegant, and a great variety are now sold by nurserymen. It has been hybridized with azalia, and the result of this cross, once supposed to be impossible, has given us many splendid varieties.

R. Californicum. California Rhododendron. Pacific coast.

Arbutus Menziesii. Madrone-tree. California and Oregon.

A. Texana. This species or variety grows in Texas. It is mostly a large shrub; sometimes, however, becoming twenty-five feet high and eight or ten inches in diameter. The leaves are smaller and the flowers less panicled than in the California species. The timber is said to be almost imperishable.

Arctostaphylos glauca. Manzanita. Oregon and California. There are several species of this genus on the western coast, mostly shrubs or small trees, which have been much confused. The specimen under this number is from Southern California, and has a large drupe-like fruit, with a consolidated nut. These berries are pleasant to the taste, and much employed as food by the Indians of that region.

A. tomentosa. Manzanita. California and Rocky Mountains.

A. pungens. Manzanita. California and Rocky Mountains.

STYRACACEÆ.

Halesia diptera. Snowdrop-tree. Georgia and Florida. The Snow drop-trees are found in the Southern States from the Ohio river southward, near the Alleghanies, and on the river-banks in Georgia and Florida. They are usually smallish trees, but sometimes grow forty or fifty feet high, and one and a half to two feet in diameter. They are very desirable for ornamental trees, producing a profusion of white bell-shaped flowers, even when quite small.

H. tetraptera. Silverbell-tree. Virginia and southward.

Symplocos tinctoria. Horse Sugar or Sweet-leaf. Virginia and southward. A small tree with oblong evergreen leaves, and clustered racemes of small white flowers. It grows in low, damp woods and pine barrens in North Carolina, Georgia, and Florida, and attains a height of twelve to twenty feet, with a diameter of eight to ten inches. It is one of the most beautiful trees of the southern forest. (Nuttall.)

CYRILLACEÆ.

Cyrilla racemiflora. Iron-wood. North Carolina and southward.

Cliftonia ligustrina. Buckwheat-tree. Georgia and southward. An elegant small tree, growing from ten to twenty feet high, of about the same range as the preceding. It is evergreen, and exceedingly ornamental when in flower. After flowering, the tree presents a curious appearance, from the abundance of triangular winged capsules, resembling buckwheat, from which the tree receives its popular name.

EBENACEÆ.

Dyospyros Virginiana. Persimmon. Eastern United States. A well known tree, most common in the Southern States, but growing as far north as New York. It grows from thirty to sixty feet high, with a very hard fine-grained wood, which has been used for various purposes. It bears a plum-like fruit an inch or more in length, which when fully ripe is edible and palatable.

D. Texana. Persimmon. Western Texas. This is called Sapote-pieto by the Mexicans and Black Persimmon by the Americans. It is a shrub or middle-sized tree, often with a black, ebony-like core. The fruits are black, and of the size of a cherry and larger, melting, and very sweet. (Dr. Lindheimer.)

SAPOTACEÆ.

Sideroxylon pallidum. Mastic. South Florida. A middle-sized tree of South Florida called Mastic, probably from the production of a gum resembling mastic.

Dipholis salicifolia. South Florida.

Chrysophyllum, microphyllum. Jacq. Golden-leaf. South Florida. A small tree of the West Indies, found lately by Dr. Chapman in South Florida. The leaves have a beautiful, golden, satin-like surface on the under side.

Mimusops Sieberi. Naseberry. South Florida. This is one of trees called Naseberry in the West Indies. It is common in South Florida where it becomes a large tree. Dr. Chapman invariably found the large trunks to be hollow. The fruit is delicious and highly flavored.

Bumelia lycioides. Iron-wood Kentucky and southward. The Bumelias are shrubs or small trees, of no special value.

B. parvifolia. Iron-wood. South Florida.

B. lanuginosa. Iron-wood. Southern States.

B. tenax. Iron-wood. Southern States.

B. reclinata. Iron-wood. Texas and westward.

THEOPHRASTACEÆ.

Jacquinia armillaris. Currant-trees. South Florida. A small tree of South Florida and the West Indies. The wood is curiously grained.

MYRSINACEÆ.

Myrsine Floridana. South Florida. Mostly a shrub, rarely a small tree.

Ardisia Pickeringii. South Florida. Mostly a shrub, but on the keys a small tree. It is an evergreen tree, with laurel-like leaves, and panicles of showy-white, purple-tinged flowers.

BIGNONIACEÆ.

Catalpa bignonioides. Catalpa. Southern States. A tree well known in cultivation, and hardy as far north as latitude 40°. It is native in the Southern and Southwestern States. In Southern Illinois and Indiana the variety *Speciosa* is hardy, also, well up into Wisconsin, and attains a height of fifty or sixty feet, and a diameter of one and a half to two feet. The leaves are large, and the flowers showy, and when in bloom the tree is extremely ornamental. The wood is light, but of a fine texture, and capable of receiving a fine polish. It is very durable, and is growing in favor year by year.

Chilopsis linearis. Texas and Arizona. Usually a shrub, but sometimes attaining a height of twenty-five feet. It has long willow-like leaves, and is very ornamental when in flower.

Tecoma radicans. Trumpet-vine. Southern States. This beautiful woody vine sometimes acquires a woody trunk of a foot in diameter or more.

VERBENACEÆ.

Citharexylum villosum. Fiddle-wood. South Florida. Rarely a small tree, of no economic value.

Avicennia tomentosa. Black Mangrove. South Florida. This and the next species are called Black Mangrove, observed by Dr. Chapman at Cedar Keys and the Thousand Islands. They are low evergreen trees, forming impenetrable thickets on the muddy shores of the sea.

A. oblongifolia. Black Mangrove. South Florida.

ORDER BORRAGINACEÆ.

Cardia bullata. South Florida.

Ehretia Buerreria. South Florida.

E. elliptica. Texas. Mostly shrubby, but sometimes a tree two feet in diameter; fruit an orange-yellow berry, of the size of a pea; much liked by children and birds. The evergreen rough leaves are used to rub and destroy eruptions of the skin. (Dr. Lindheimer.)

OLEACEÆ.

Olea Americana. Devil-wood; American Olive. Southern States. This is a small evergreen tree, with thick, leathery leaves, and small, white, fragrant flowers. It is related to the olive-tree of the eastern world, but its fruit has no value. It is impossible to split, and hence the vulgar name of Devil-wood.

Chionanthus Virginica. Fringe-tree. Middle and Southern States.

Fraxinus Americana. White Ash. Eastern United States. A large and valuable tree ranging over the eastern portion of the United States. The wood is tough and elastic, and much employed in various manufactures. It is a handsome and ornamental tree.

F. pubescens. Red Ash. Eastern United States. A smaller tree than the preceding, perhaps more common. The wood is said to be equally as valuable as that of the White Ash.

F. viridis. Green Ash. Western States. A middle-sized tree, of vigorous and rapid growth, and the wood has the same qualities as the preceding.

F. sambucifolia. Black Ash. Northern and Western States. A large tree, usually growing in moist soil, and hence often called Swamp Ash. The wood is more elastic than that of any other species. It splits easily into thin, narrow strips, which are used for making baskets and hoops for barrels.

F. quadrangulata. Blue Ash. Western States. This species is not found in the Atlantic States. It is found from Ohio to Wisconsin and southward to Kentucky and Tennessee. It is a large tree, growing from sixty to seventy feet high, with a diameter of two feet or more. The wood is quite as valuable as that of the White Ash, and is said to be much more durable when exposed to the weather; hence its value for fence-rails, posts, etc.

F. platycarpa. Carolina Water Ash. Southern States. This species grows in swamps or marshy banks of rivers. It is usually twenty-five or thirty feet high, but sometimes becomes a large tree. The wood is remarkably light and soft, and probably has no economic value.

F. Curtissi. Southern States. Mr. Curtiss found at Eufaula, Ala., a large Ash with remarkably small fruit. This species is provisionally called F. Curtissi. It requires further investigation.

F. Oregona. Oregon Ash. California and Oregon. The common ash of the Pacific coast. It grows sixty to seventy feet high. Is of equal value with the White Ash of the Eastern States.

F. dipetala. California Flowering Ash. California and Oregon.

F. pistaciæfolia. Texas and westward.

F. anomala. Single-leaf Ash. Utah and Arizona. This ash is seldom more than a shrub ten to fifteen feet high, growing in ravines among the foot-hills of southern Utah and Arizona. The leaves are simple, not pinnate, as in the other species.

F. coriacea. Thick-leaved Ash. Utah and Arizona. A smallish tree, with thick, leathery leaves, growing in southern Utah and Arizona.

Forestiera acuminata. Southwestern States. A large shrub or small tree, of no economic value.

F. ligustrina. Southern States.

NYCTAGENIACEÆ.

Poisonia obtusata. South Florida. A small tree of Florida and the West Indies.

POLYGONACEÆ.

Coccoloba uvifera. Seaside Grape. South Florida. This and the following species are low and spreading trees along the coast in Florida and the West Indies. It is remarkable for the grape-like clusters of pear-shaped purple berries, which have an agreeable subacid taste, and which are much employed. The wood is heavy, hard, and valuable for cabinet work.

C. Floridana. Seaside Grape. South Florida.

LAURACEÆ.

Persea Carolinensis. Red Bay. Southern States. This species occurs from Southern Virginia to Florida and the Gulf States. It is found in the vicinity of swamps and swampy river borders. In favorable situations it grows to fifty or sixty feet high and fifteen to twenty inches in diameter. The leaves are large, shining, evergreen. The wood is of a beautiful rose-color, of a fine, compact grain, and finishes almost equal to mahogany.

P. Catesbyana. Catesby's Bay. South Florida.

Sassafras officinale. Sassafras. Eastern United States. This tree is found over a large portion of the United States. It is usually a small tree, but sometimes attains a large size. The wood is not very strong, but is fine-grained and durable. It is valuable for cabinet work. The bark of the root has a spicy, aromatic taste, and has some reputation as a medicine.

Creodaphne Californica. California Myrtle. California and Oregon. The California Laurel is a fine ornamental evergreen tree, growing in open places from fifty to sixty feet high. In thick woods, it has been found shooting up to one hundred or one hundred and twenty feet. The leaves have a very pungent odor, which produces headache in some persons. The wood is very beautiful, and is used for fine cabinet work.

ELEAGNACEÆ.

Shepherdia argentea. Buffalo-berry. Rocky Mountains A large shrub or small tree, growing in thickets on the banks of streams in the Rocky mountain valleys. The scarlet berries have an agreeable taste, and are employed as food by the natives.

EUPHORBIACEÆ.

Hippomane Mancinella. Manchineel. South Florida.

Stillingia sebifera. Tallow-tree. Naturalized in the Southern States. The Tallow-tree is a native of China, but has become extensively naturalized in the East and West Indies, and also in several of the Southern States along the seacoast. In its native country, its seeds and pods are bruised and then boiled, which causes a kind of tallow to rise to the surface. This tallow is much employed in making candles.

Excœcaria lucida. Poison-wood. South Florida.

Drypetes crocea. A small tree of South Florida and the West Indies. The leaves are evergreen, and have much the flavor of tea.

D. Glauca. South Florida.

URTICACEÆ.

Morus rubra. Red Mulberry. Eastern United States. The Red Mulberry is found throughout the greater part of the United States east of the Mississippi, and also some of the States west of that river. (Bryant.) It is commonly a smallish tree, sometimes, however, attaining a large size. The berries are quite palatable, are eaten eagerly by birds, and also have a place in the markets as a second-rate fruit. The wood is strong, compact, and extremely durable.

M. parvifolia. Small-leaved Mulberry. Texas and westward.

Maclura aurantiaca. Osage Orange. Arkansas and Southwest. This tree, which is a native in Arkansas and Texas, has been quite generally introduced over the country, chiefly from its extensive employment as a hedge-plant. The early French settlers called it *Bois d'arc* or Bow-wood, from its use by the Indians for bows. The fruit is of the size and color of a large orange, but is not edible. The wood is very hard, elastic, fine-grained, and durable.

Ficus aurea. Gum-tree; Wild Fig. South Florida. There are many species of wild fig in the West Indies, but this species of South Florida has not been identified with any of them. It is a large tree, full of milky juice, which forms a kind of India rubber, whence it is also called Gum-tree. The fruit is very small and insignificant.

F. pedunculata. Wild Fig. South Florida. This tree is also a native of the West Indies, and, like the Banyan of the West Indies, it sends downward aerial roots, which become fixed in the soil. The fruit is larger than the preceding, being the size of a large cherry.

F. brevifolia. Wild Fig. South Florida.

Ulmus Americana. White Elm. Eastern United States. One of our most common and valuable trees, very popular as a shade tree on account of its graceful form. It is one of the largest of the deciduous trees of the United States, attaining sometimes the height of 100 feet. The wood is employed for various purposes, but it is not considered durable when exposed to the weather.

U. fulva. Slippery Elm. Eastern United States. This is usually a smaller tree than the White Elm. It is not as much esteemed as an ornamental tree. The wood, however, is said to be of better quality and more durable. The inner bark is very mucilaginous, and is extensively used for medical and surgical purposes.

U. racemosa. Corky White Elm. Northern States. This tree is limited to the northern portions of the United States, being found sparingly in New England, New York, and westward to northern Illinois and Wisconsin. It closely resembles the White Elm, but may be distinguished by the corky wings of the smaller branches, which cause them to look grotesque and rough. Dr. S. H. Wright, of Penn Yan, N. Y., says it grows as rapidly as the White Elm, and he thinks will become as large. He has seen some young trees over two feet in diameter. The wood is tougher and finer-grained than the White Elm.

U. alata. Winged Elm. Southern and Western States. This species does not grow in the Northern States except on the line of the Ohio river. It is a smallish tree, and has smaller leaves than the other kind. The branches have a broad and thin corky wing on the opposite sides. The wood is finer-grained and more compact than the White Elm.

U. Floridana. Florida Elm. Florida.

U. crassifolia. Thick-leaved Elm. Texas and Southwest.

Planera aquatica. Planer-tree. Southern States. This tree is found in the Southern States and in Kentucky and Tennessee. It is a tree of medium size, with foliage somewhat like that of the European Elm. It is not a common tree, and the wood is not known to be applied to any useful purpose.

Celtis occidentalis. Sugar or Hackberry. Eastern United States. This tree is rare in the New England

States, but rather common in the Southern and Western ones. There are several varieties, one of which is usually a low and straggling bush. In the Western States, it often becomes a lofty tree. It somewhat resembles the elm in foliage and the ash in bark. It produces a dryish kind of berry about the size of a pea. The wood is white, but is not considered durable.

C Mississippiensis. Mississippi Hackberry. Mississippi valley.

C. reticulata. Net-leaved Hackberry. Texas and Southwest. This is a western species, occurring in Texas and the Rocky mountain region. It is a small tree, often a mere shrub.

C. pallida. Pale-leaved Hackberry. Texas.

PLATANACEÆ.

Platanus occidentalis. Sycamore. Plane tree. Eastern United States. It is probably one of the largest deciduous trees in the United States. It occurs throughout the Eastern, Southern and Western States, and extends beyond the Mississippi river. In the rich bottom-lands of the western rivers, it sometimes attains the enormous circumference of forty to forty-five feet. It much resembles the European Plane tree, and is thought to possess a richer foliage, and to afford a deeper shade. As a timber tree it is of little value, as the wood is liable to warp, and decays early.

P. racemosa. California Sycamore. California. This is the sycamore of the Pacific coast, extending from Central California to Mexico. Although a large tree, it does not attain the size of the eastern species. The wood is said to be more valuable, receiving a good polish and being more durable.

P. Wrightiana. Wright's Sycamore. Arizona.

JUGLANDACEÆ.

Juglans nigra. Black Walnut. Eastern United States. This tree occurs in the Atlantic States, but attains its greatest perfection and abundance in the valleys of the Ohio and Mississippi. It has been so much in request for the timber that it is much less common than formerly. The wood is used for the inside finish of houses, for cabinet work, for gun stocks, and many other purposes. It produces a nut much like the English walnut, but of stronger oily flavor. They are greatly relished by many persons.

J. cinerea. Butternut; White Walnut. Eastern United States. This is more limited in range than the preceding. In Pennsylvania, New York, and New England, it probably attains its greatest perfection. It is a smaller tree than the Black Walnut. It is also found in the Western States. The wood is of a light-brown color, fine-grained, and easily worked. Although less valuable than the Black Walnut, the wood is well adapted to many uses. The nuts are not as highly esteemed as those of the Black Walnut.

J. Californica. California Walnut. California. The California Walnut attains, in favorable situations, a height of fifty to seventy-five feet, and a diameter of two or three feet. It does not seem to be abundant, and we know nothing respecting the value of its wood. It has recently been distinguished as a different species from the walnut of Arizona and New Mexico.

J. rupestris. Small Black Walnut. Texas and Arizona.

Carya olivæformis. Pecan nut. Mississippi valley. This tree grows in the valley of the Mississippi and its tributaries, on the Arkansas, the Illinois, the Wabash, and the Ohio, for some 200 miles above its mouth. The wood is coarse-grained, heavy, and compact. It is a beautiful tree, with a straight and well-shaped trunk. The nut is well known in the markets, and is thought by some to be superior in flavor to any other nut known.

C. alba. Shell bark Hickory. Eastern United States. This species becomes a lofty tree, eighty feet high, with a diameter sometimes of two feet. It is one of the most valuable of the hickories for timber and for fuel. It furnishes most of the hickory nuts of commerce. They are pleasant flavored and highly esteemed. On large trees, the bark shells off in long, narrow plates, whence the common name of the tree. The wood is heavy, elastic, and strong, and for handles of axes and agricultural implements, and many other uses, it is unequaled. There is little difference in the quality and value of many of the different species of hickory.

C. sulcata. Western Shell-bark. Western States.

C. tomentosa. Mocker nut. Eastern United States.

C. amara Bitter nut. Eastern United States. This is a large tree, growing from sixty to seventy feet high. The timber is said to be inferior to the preceding species, and the nuts are thin-shelled, bitter, and worthless.

C. porcina. Pig nut Hickory. Eastern United States. A large tree, with small, pear-shaped fruit, the nuts bitterish and unpalatable. The wood is tough and valuable.

C. microcarpa. Small-fruited Hickory. Eastern United States.

C. myristicæformis. Nutmeg Hickory. Southern States. This species grows in swamps in the Southern States. The fruit resembles a nutmeg, whence the name of Nutmeg Hickory. It is somewhat like that of the Bitter nut tree, but much thicker.

C. aquatica. Swamp Hickory. Southern States. A species growing in swamps in the Southern States, with astringent, bitter fruit, and brittle, worthless timber.

CUPULIFERÆ.

Quercus macrocarpa. Bur Oak; Overcup Oak. Western States. This species is rare in the Eastern States, but common in Michigan, Illinois, Wisconsin, and Minnesota. It is a large tree, and when growing on low ground assumes a rounded and handsome form. It has very large acorns, which are usually deeply immersed in the cup; the border of the cup fringed with loose scales. The wood is open and brittle as it occurs in the prairie country, but valuable for fuel.

Q. alba. White Oak. Eastern United States. This is one of the noblest, largest, and most useful oaks of this country. The wood is strong, compact and durable, and is only second to that of the Live Oak. It is extensively employed in ship building, in manufacturing, and for many purposes.

Q. lyrata. Southern Overcup Oak. Southern States. Much resembles the Bur Oak, but is chiefly confined to the Southern States.

Q. stellata. Post Oak. Eastern United States. This species grows mostly upon poor clay lands. It is a middle-sized tree; the wood is yellowish, strong, fine-grained, and more durable than the White Oak.

Q. bicolor. Swamp White Oak. Eastern United States.

Q. Michauxii. Michaux's Oak. Southeastern United States.

Q. prinus. Chestnut Oak. Eastern United States. A species including several varieties It is usually a large and lofty tree. Its timber is inferior to that of the White Oak in strength, but is still very valuable for many uses.

Q. prinus, var. *monticola.* Rock Chestnut Oak. New England and Middle States.

Q. prinus, var. *acuminata*, Yellow Chestnut Oak. Northern and Western States.

Q. Douglasii. Douglas's Oak. Rocky mountains, California. This and the next two succeeding species are the California White Oaks, extending into Oregon and Columbia. They are probably of equal value with the eastern species.

Q. Garryana. Garry's Oak. California and Oregon.

Q. lobata. California White Oak. California.

Q. undulata. The Rocky Mountain Oak. Rocky mountains. This is the common oak of the Rocky mountains, usually small and scrubby, but sometimes forming a moderate-sized tree. It is very variable in the foliage.

Q. densiflora. California Tan-bark Oak. California. An anomalous species found in California, between an oak and a chestnut. In open ground, it is a beautiful, spreading, pyramidal tree, with a trunk sometimes five to six feet in diameter. Among the forest-trees, it rises to 100 feet or more in height.

Q. agrifolia. California Field Oak. California. This is commonly known in California as Evergreen Oak. It grows usually in open grounds, with a wide, spreading, apple-tree-like top. It is usually a small tree, sometimes a mere shrub, and occasionally becoming forty or fifty feet high.

Q. chrysolepis. Canon Live Oak. California. An evergreen oak, growing in rocky canons and on mountain sides. It is sometimes shrubby; sometimes like the last, becoming forty to fifty feet high. It furnishes the hardest oak-wood of the Pacific coast, and is used in making ox-bows, ax handles, etc.

Q. oblongifolia. Oblong-leaved Oak. Arizona, California.

Q. Emoryi. Emory's Oak. Arizona.

Q. hypoleuca. New Mexican Oak Arizona.

Q. Durandii. Durand's Oak. Texas. This species approaches the Post Oak in general characters. The leaves are variable, being sometimes lobed, and sometimes entire.

Q. phillos. Willow Oak. Southern States. This species is confined to the States bordering the Atlantic and the Gulf; not, however, extending into the New England States. It is remarkable for its narrow, willow-shaped leaves. The wood is strong, but coarse-grained, and not durable.

Q. virens. Live Oak. Southern States. This is the famous Live Oak. It grows from southern Virginia to Florida and westward in the vicinity of the seacoast. The wood is more esteemed for ship building than any other. It is evergreen, and is a large tree with spreading branches.

Q. cinerea. Upland Willow Oak. Southern States. A small tree, growing in sandy pine-barrens from North Carolina to Florida. It is evergreen, with leaves like the Willow Oak, but thicker, and downy on the under surface.

Q. imbricaria. Shingle Oak. Eastern United States. A medium-sized tree, reaching to fifty or sixty feet high, and with a diameter of one and one-half to two feet. It grows principally, in open situations, from New Jersey to Illinois and southward. Its foliage is handsome, resembling that of the Laurel. The wood is coarse-grained and not durable.

Q. aquatica. Water Oak. Southern States. A middle sized tree, of the Southern States, growing on the borders of swamps. The leaves are perennial, of variable form, but always broadest at the upper portion and tapering to a point at the base.

Q. laurifolia. Water Oak. Southern States.

Q. nigra. Black Jack. Eastern United States. A small, scrubby tree, growing usually in poor clay soil. It is found in New Jersey, Maryland, and southward, as also in some of the Western States. The wood furnishes a good fuel, but is too coarse-grained and perishable for any use in the arts.

Q. falcata. Spanish Oak. Eastern United States. A large tree, attaining eighty feet or more in height, and sometimes four feet in diameter. It has about the same range as the Black Jack, not being found in New England nor in the northern part of the Western States. The wood is not valuable except for fuel.

Q. Catesbæi. Turkey Oak. Southern States. A small tree, with foliage much like the preceding. It is found in Florida, Georgia, North and South Carolina. The wood is good fuel, but of no value as timber.

Q. ruba. Red Oak. Eastern United States. This is one of the largest oaks of our country, and is diffused over all the eastern portion of the United States, but more especially to the northward. It is a beautiful tree, with reddish, coarse-grained wood, which is little used in the arts except for barrel staves.

Q. coccinea. Scarlet Oak. Eastern United States. The Scarlet and Quercitron Oaks do not differ much in their characters, and, indeed, are considered but as varieties of one species. They form large and handsome trees, and the bark furnishes a yellow dye which is used in the arts

Q. tinctoria. Quercitron. Eastern United States.

Q. palustris. Pin Oak. Eastern United States. A somewhat smaller tree than the preceding. The leaves are small, smooth, of a pleasant green color, very similar to those of the Scarlet Oak. The wood is stronger and more durable than that species. It is chiefly limited to the Northern States.

Q. Sonomensis. California Oak. California. This species is nearly related to the *Q. rubra* of the Eastern States. It grows in mountainous districts, and forms a pretty large tree.

Q. Wislizenii. California Live Oak. California. A smallish tree of California, with bright green persistent leaves, sometimes called Live Oak.

Q. dumosa. Dwarf Oak. California. This is a common dwarf oak in Southern California.

Q. reticulata. Dwarf Oak. Southern Arizona.

Castanea vesca, var. *Americana*, Gr. American Chestnut. Eastern United States. One of the noblest trees of the American forests. It occurs from Massachusetts to Michigan, and in the mountain districts of Pennsylvania, Virginia and Tennessee, but not in the prairie regions of the Western States. The wood is strong, elastic and durable, and is largely employed in the manufacture of furniture and for the inside finish of railroad cars and steamboats. The nuts are very sweet and palatable, and always command a good price in the markets.

C. pumila. Chincapin. Southern States. This may be called a dwarf chestnut, growing from New Jersey and Pennsylvania to Florida. Northward it is only a large shrub, but in South Carolina and Florida it becomes a tree of thirty to forty feet high, and twelve to fifteen inches diameter. The wood equals that of the chestnut, but the nuts, although generally eaten by children, are not comparable to those of the former.

Castanopsis chrysophylla. California Chestnut. California. A tree of Oregon and California, becoming sixty to one hundred feet high and two to three feet diameter. The bur is scarcely one-third as large as in the common chestnut, with shorter prickles. The shell of the nut is almost as large as the filbert.

C. chrysophylla, var. *pumila.* California Chincapin. California. This is mostly a shrub growing on open mountain sides, and is sometimes called California Chincapin.

Fagus ferruginea. Beech. Eastern United States. The beech is one of our loftiest trees, sometimes reaching the height of 100 feet. It grows from Canada to the Gulf of Mexico. It is wanting in the prairie districts of the West. The wood is hard, fine-grained, and compact. It is largely used for shoe-lasts and handles of tools. It is also employed in the frame-work of buildings. The wood is in great repute as fuel. The nuts have a delicious flavor, but are too small to make them of much economic importance.

Carpinus Americana. Blue Beech. Eastern United States. A small tree fifteen to twenty feet high. The wood is white, compact, and fine-grained.

Ostrya Virginica. Hop Hornbeam; Iron-wood. Eastern United States. The Iron-wood is a small tree, but sometimes grows to a height of forty feet. The wood is heavy and fine-grained, and is used for mallets, wedges, levers, etc. Its growth is very slow.

Corylus rostrata, var. *Californica.* California.

MYRICACEÆ.

Myrica cerifera. L. Bayberry; Wax myrtle. Eastern United States. A shrub or small tree growing near the seacoast. The berries are coated with a waxy secretion, which is sometimes utilized in the domestic manufacture of candies and also in medicinal unguents.

M. inodora. Florida Bayberry. Florida.

M. Californica. California Bayberry or Myrtle. California. This species sometimes attains a height of forty feet, with a trunk two feet in diameter. It grows on the Pacific coast, from Puget Sound to Mexico.

BETULACEÆ.

Betula alba, var. *populifolia.* American White Birch. Northern and Northeastern United States. A small and slender graceful tree, fifteen to twenty-five high, growing from Maine to Pennsylvania, and sparsely on the great lakes.

B. papyracea. Canoe birch, Paper Birch. Northern and northeastern United States. A large and handsome tree, growing to the height of seventy feet, and with a diameter of three feet. It is limited to the northern portions of the country, ranging from Maine to Wisconsin on the northern border, and extending far northward into Canada. It has a brilliant white bark, from which Indians and traders construct canoes. The thin, external sheet of the bark forms the basis of a great variety of Indian fancy work.

B. lutea. Yellow Birch. Northern and northeastern United States. This is a beautiful large tree, growing in moist woods on our northern border. The wood is strong, fine-grained, and makes handsome furniture.

B. lenta. L. Cherry Birch; Black Birch. Northern and northeastern United States. This, like the preceding, is a large tree, chiefly of our northern borders, but extending also along the Alleghany region southward. The bark and twigs are highly aromatic. The wood is of a rosy hue, fine-grained, and valuable for cabinet work and for timber.

B. nigra. L. River Birch; Red Birch. Eastern United States. This becomes a large tree in favorable situations. It is found along the banks of rivers from Eastern Massachusetts southward to Florida, and westward to Kentucky, Illinois, and Iowa. The wood is similar to that of the preceding.

B. occidentalis. Western Birch. Rocky Mountains. This species is a small tree, rarely over twenty-five feet high and six inches in diameter. It is found in the Rocky mountains, along streams; in Colorado, Utah, etc.

Alnus incana. Speckled Alder. Northeastern United States. A shrub, or small tree, growing along streams in New England, New York, and northward. Of no particular value.

A. rhombifolia. California Alder. California.

A. Oregona. Oregon Alder. California and Oregon. On the Pacific coast, in California and Oregon. Often becoming a large tree, sixty to eighty feet high, with a trunk two feet in diameter.

SALICACEÆ.

Salix nigra. Black Willow. Eastern United States. This is almost the only willow of the eastern portion of the continent which attains a tree size. It grows from twenty to thirty feet high, with a thick black bark. On the Pacific coast are several species which become tree willows.

Salix nigra, var. *Purshiana.* Willow. Texas.

S. Longifolia, var. California Long-Leaved Willow. California

S. Wrightiana. Wright's Willow. Texas.

S. lasiolepis. Willow. California.

S. lucida, var. California Shining Willow. California.

Populus tremuloides. American Aspen. Eastern United States and Rocky Mountains. A small tree of the northern border and Canada, also found on the mountain sides through the Rocky mountains.

P. grandidentata. Great Toothed Aspen. Eastern United States. This is a larger tree than the preceding, common in the Northern States, and extending southward along the Alleghany mountains. It much resembles the European Silver Poplar.

P. monilifera. Cottonwood. Eastern United States and Rocky Mountains. This and the next species of cottonwoods have a wide range throughout most parts of the United States. Some botanists consider them to be but forms of one species. They are large, rapidly growing trees, particularly abundant in the prairie regions and Western river banks, extending even to the Pacific Ocean. The wood is light and soft, much employed in some of the Western States for building purposes, and for inside work of houses, under the name of Whitewood and Cottonwood.

P. angulata. Cottonwood. Southern States.

P. heterophylla. Swamp Cottonwood. Eastern United States. This species prevails in the Southern States, but extends northward as far as Delaware and Southern Illinois. It is a large tree, growing chiefly in swampy woods, and little valued.

P. balsamifera. Balsam Poplar. Northern and Western United States. This species grows mostly in northern latitudes, being found in New England and Northern New York, also in the Rocky mountains. It is a large tree; a variety of it is in cultivation.

P. angustifolia, James. Willow leaved Cottonwood. Rocky Mountains. This is now considered to be a variety of the preceding. It is found principally along streams in the Rocky mountains, where it is called Cottonwood, sometimes Willow-leaved Cottonwood.

P. trichocarpa. Cottonwood. California.

CONIFERÆ.

Pinus Banksiana. Banks' Pine; Scrub Pine. Wisconsin to New England. This species is found from the northern parts of the United States nearly to the Arctic ocean, and from Labrador to the Saskatchawan. In Wisconsin it becomes a middle-sized tree, and is used for timber when the trees are found of sufficient size.

P. contorta. Twisted Pine. Rocky Mountains. This tree is found in the Rocky mountains from Colorado to Oregon. It differs widely in regard to size in different localities. Near the Pacific coast it is often low and scrubby, bearing cones at five feet high. In Colorado it is found at an altitude of 7,000 feet, and attains a height of fifty feet.

P. contorta, var. *Bolanderi.* Bolander's Pine. California. This variety in the Sierra Nevada mountains at an altitude of 5,000 to 9,000 feet attains a height of 150 to 200 feet. It is variously called Tamarack, Twisted Pine or Black Pine.

P. inops. Jersey Pine; Scrub Pine. Eastern United States. A straggling tree fifteen to forty feet high, with spreading or drooping branches. It abounds in New Jersey, Maryland, and Virginia, also on the rocky hills bordering the Ohio in Kentucky, Southern Illinois and Indiana. The wood is of little value.

P. mitis. Yellow Pine. Eastern United States, chiefly south. This is a handsome tree, growing from New England to Wisconsin, and sparingly in Missouri, Kentucky, Tennessee, and southward to Florida. The timber is very valuable, commanding a higher price even than the white pine.

P. clausa. Florida. A small tree found by Dr. Chapman at Apalachicola, related to *Pinus inops.*

P. glabra. Spruce Pine, South Carolina and southward. A tree forty to sixty feet high, with smoothish bark and soft white wood, branching from near the ground. Resembles *P. mitis;* grows from South Carolina to Florida

P. resinosa. Red Pine. Massachusetts to Wisconsin. A tree fifty to eighty feet high, with reddish bark, growing from Pennsylvania northward through Canada and Nova Scotia, also in Wisconsin and Michigan. The wood is compact, strong and durable, and for some uses is preferable to the white pine. It is also an excellent ornamental tree.

P. Elliottii. Elliott's Pine. South Carolina and southward.

P. pungens. Table Mountain Pine. This species grows on the Alleghany mountains from Pennsylvania southward; abundant in some parts of Virginia and North Carolina. A tree of forty or fifty feet height, and of very vigorous and rapid growth.

P. muricata. Bishop's Pine. California. A small tree thirty to forty feet high; grows near the coast north and south of San Francisco, and in other localities in that State.

P. edulis. Pinon Nut Pine. Rocky Mountains. A low tree with a spreading habit, growing in Colorado and Utah, and in New Mexico, Arizona, and Southern California. It is universally known by the Mexican name of Piñon. It has an edible nut, which is much used as food by the Indians, and the wood is rich in resin, making it excellent fuel.

P. monophylla. Nut Pine. Sierra Nevada mountains. This species is almost limited to the eastern slope of the Sierra Nevada mountains, at altitudes of 2,000 to 6,000 feet. It is a small tree of twenty to forty feet height. The seeds are eagerly collected for food by the Washoe and other Indians. The wood is excellent fuel.

P. Parryana. Nut Pine. Near the Mexican border southwest.

P. ponderosa. Yellow Pine. Rocky Mountains. A very variable pine; several of its extreme forms have been considered different species. It occurs in Colorado, Utah, and the Black Hills of Dakota. It is remarkable for its heavy wood, which makes excellent lumber. It is generally called Yellow Pine.

P. ponderosa, var. *Benthamiana,* Hart. Sappy Pine. California. This variety grows in the Sierra Nevada mountains, in damp valleys, and near streams. It is generally slender and tall, with low limbs, black bark, and sappy, tough wood. Used for building timber, flooring, etc. It has several names, as Swamp Pine, Sappy Pine, Black Pine, and Bull Pine.

P. ponderosa. Var. *Jeffreyi.* Jeffrey's Pine. California. This variety also grows on the Sierra Nevada mountains, and on the Coast Range of California. It often attains a height of 170 to 250 feet and a diameter of six to ten feet. It differs much in the quality of the wood, but is used for all the purposes of other kinds. It is remarkable for the comparatively large size of its cones. It is called Yellow Pine, Pitch Pine, and Truckee Pine.

P. Australis. Long-leaved Pine. South Carolina and southward. A lofty tree, growing in the pine-barrens of the Southern States, attaining a height of seventy-five to one hundred feet. Next to the White Pine, this is perhaps the most valuable of the genus. The timber plays an important part in ship-building, is extensively used as a flooring, and in house-building. The chief value of this species is for the turpentine, tar, pitch, and resin which it supplies, and of which immense quantities are exported in addition to the home supply.

P. Coulteri. Coulter's Pine. California. A large tree of California, from eighty to one hundred feet in height, with large, spreading branches, and a trunk three or four feet in diameter. The cones are heavier than those of any other of the family, being frequently one foot long and six inches diameter, and weighing from four to six pounds. The large, nut-like seeds contained in the cones are nutritious, and used as an article of food by the Indians.

P. Sabiniana. Hard-nut Pine; Sabine's Pine. California. Grows on the foot-hills of the Coast Range and on the western foot-hills of the Sierra Nevada mountains of California. It is not very abundant, and is limited by the altitude of 4,000 feet. It grows from forty to one hundred feet high. The cones are large and heavy, and full of oily, nutritious nuts, which are used by the Indians. The timber is fit only for fuel. It is called Digger Pine, Foothill Pine, Gray-leaved Pine, etc.

P. Torreyana. Torrey's Pine. California. A species of Southern California, resembling the preceding, but smaller. The nuts are thick-shelled, but nutritious, and used as food by the Indians.

P. insignis. Monterey Pine. California. Grows along the coast south of San Francisco. Some old trees near Monterey are seventy or eighty feet high. It is quite an ornamental species, and is in frequent cultivation in California.

P. radiata. California.

P. tuberculata. Prickly-coned Pine. California. A small tree seldom attaining a greater height than thirty to forty feet, with a trunk of eight or ten inches diameter. It grows on the Coast Hills south of San Francisco, and in other places in the State.

P. rigida. Pitch Pine. Eastern United States. A medium-sized tree from thirty to seventy feet high, with dark, rugged-looking bark, and hard, resinous wood. The wood is knotty, and of little value for lumber, but gives an intense heat in burning on account of the quantity of resin which it contains.

P. serotina. Pond Pine. Southern States. This is closely related to the preceding, and is by some considered only a variety of it. It grows on the borders of ponds and swamps from Florida to North Carolina.

P. Tæda. Loblolly; Old-field Pine. Southern States. A species confined to the Atlantic States, growing mostly in damp, or in light, barren soil, frequently taking possession of old and neglected fields. It is variable in height, sometimes rising to seventy or one hundred feet high. The timber is said to be valuable, though less so than that of *P. australis.*

P. aristata. Prickly-coned Pine. Rocky Mountains. This species was first found in Colorado, near Pike's Peak, but it is now considered to be synonymous with the next.

P. Balfouriana. Balfour's Pine. Rocky Mountains. The specimen is from southern Utah, and grows on high, barren, sandstone mountains; it grows about fifty to sixty feet high. The tree is distinguished by its long branches, which are heavy, causing the ends to hang down. The tree is compact in appearance and of very dark-green color. It is thought by some that the tree of

Oregon, which has been described under this name, is a different species.

P. flexilis. Bull Pine. Rocky Mountains. This is the prevailing pine of the East Humboldt mountains, Nevada, and frequent in the Wasatch. It also grows in Colorado and on the San Francisco mountains of Arizona. In the Wasatch mountains it is found at high altitudes on limestone ledges, and has a branched and knotty habit, rendering it unfit for lumber. It is called by the inhabitants Bull Pine. It is a middle-sized tree, usually thirty to fifty feet high, but recorded by Fendler as sixty to eighty feet high near Santa Fe.

P. albicaulis. White-barked Pine. Rocky Mountains. This species, although closely related to the preceding, is believed to be different. It grows only at extreme altitudes. It grows on the Cascade mountains of Oregon, on alpine peaks in the Sierra Nevada mountains, and on high mountains in Idaho and Montana. The name is suggested by the color of the bark of the tree, which Dr. Engelmann says is as white as milk.

P. Lambertiana. Sugar Pine. Sierra Nevada Mountains. Found sparsely growing on the Sierras of California, through their extent, at altitudes of from 4,000 to 10,000 feet. It is often 150 to 220 feet high, with a diameter of eight to fourteen feet. It is highly prized and eagerly sought by lumbermen for all articles of building lumber, and is fast being exhausted. It is called Sugar Pine from the sweet resin which exudes from partially-burned trees. It is also called Mammoth Pine and Shake Pine. It has enormous cones.

P. monticola. Soft Pine; Little Sugar Pine. California. Grows sparsely on the high Sierras, at altitudes of 7,000 to 11,000 feet. It sometimes attains a height of 150 to 200 feet, with a diameter of five to seven feet. It resembles the Sugar Pine, but with whitish, much furrowed bark, and smaller cones. The timber is similar to that of White Pine, but is seldom used, because the trees are so inaccessible.

P. strobus. White Pine; Weymouth Pine. Eastern United States. An old, well-known, and useful tree, extending from Canada to Virginia, but plentiful in New England, New York, and Pennsylvania. It is a large tree, becoming 100 to 150 feet high. It is the source of much of the lumber brought from the Northern States. It is not only very valuable on account of its wood, but is one of the finest ornamental conifers.

P. Chihuahua. Southern Arizona and Northern Mexico.

Abies alba. White Spruce. New England and Alleghany Mountains. A small tree, native of the northern portion of the United States and Canada, extending northward to the extreme confines of vegetation. It grows from twenty to thirty feet high, according to soil and latitude. It is frequent in cultivation, and is considered a handsome tree.

A. nigra. Black Spruce. New England and Alleghany Mountains. This tree has much the same range as the preceding, occasionally being found farther south on the Alleghanies. In favorable situations, it forms quite a large tree, about seventy-five feet high, tall and straight. The wood is light, elastic, and strong, and valuable for many purposes.

A. Canadensis. Hemlock. New England to Wisconsin. A well known tree of the Northern States, extending northward to Hudson's Bay, and southward along the mountains to North Carolina. It is one of the most graceful of spruces, with a light and spreading spray, frequently branching almost to the ground. The wood is coarse-grained, but is used in great quantities for rough work. The bark is very extensively employed in tanning.

A. Mertensiana. Western Hemlock. California and Oregon. This tree closely resembles the *A. Canadensis.* It grows from 100 to 150 feet high, and forms a roundish, conical head. The timber is said to be soft and white and difficult to split.

A. Williamsonii. Williamson's Spruce. California and Oregon. Grows on the Sierras of California and on the Cascade mountains of Oregon, on high peaks of 8,000 to 12,000 feet altitude. A very graceful tree, attaining a height of 150 feet. The wood is of excellent quality, but is too rare and inaccessible to be much known.

A. Douglasii. Douglas's Spruce. Rocky Mountains This species grows through the Rocky mountain region from Colorado to Nootka sound. On the Pacific coast it sometimes attains the immense size of 200 to 300 feet in height, and a diameter of trunk of eight to fifteen feet. Its timber composes the great lumber wealth of Oregon and Washington Territory. The wood is soft and easily worked, much prized for masts, spars, and plank for ship building, and is equally valuable for other building purposes. A tree cut by Mr. A. J. Dufur, was six feet four inches in diameter thirty feet from the base, and 321 feet long.

A. Douglasii, var. *macrocarpa.* Large-coned Spruce. Southern California. This was collected many years ago on the mountains east of San Diego, Cal.; in 1874 sent to the Department of Agriculture by Mr. F. M. Ring, of San Bernardino, Cal.; and again collected later by Dr. Palmer at San Felipe Canon, east of San Diego. It has cones four or five times the size of *Douglasii*, and will probably be confirmed as a new species.

A. Menziesii. Menzies's Spruce. Rocky Mountains. This species has a wide range in the Rocky Mountains from Colorado and Utah to Oregon and Sitka. It grows mostly at high altitudes, 7,000 to 9,000 feet. In Utah, Mr. Ward says, it is easily distinguished from the other firs by the dense masses of its long, pendant, dark-brown cones at the top of the tree, which frequently obscure the foliage. The wood is fine-grained and white, and would be valuable for timber but for the numerous slight curves in the trunk which render it impossible to obtain saw-logs of any great length. In some places it is incorrectly called balsam, in others it is distinguished as spruce. Mr. Dufur, of Oregon, gives a somewhat different account of the tree as growing there. He says: It grows along the tide-lands and about the mouth of the Columbia river, and is seldom found at an elevation of more than 500 feet. The young trees make a beautiful evergreen of pyramidal form. The large trees grow from 150 to 200 feet high, and from two to six feet in diameter. The wood is soft, white, and free, much prized for lumber.

A. Engelmanni. Engelmann's Spruce. Rocky mountains. This species is found on the higher parts of the Rocky mountains, from New Mexico to the headwaters of the Columbia and Missouri rivers. In Colorado, it occupies a belt between 8,000 and 12,000 feet, reaching its fullest development between 9,000 and 10,000 feet. On the highest summits, it becomes a prostrate shrub. Mr. Ward, writing of the tree in Utah, says: Between 9,000 and 10,000 feet altitude it becomes a large and noble tree, and is of the greatest value for lumber, taking the place in that region of the White Pine of the Eastern States, and is alone known by that name among lumbermen. The wood is white, very light, and easily worked, and at the same time durable. Botanically, it is difficult to distinguish it from some forms of *A. Menziesii.*

A. balsamea. Balsam. New England to Wisconsin. This species grows in cold, damp woods and swamps, from New England to Pennsylvania, Wisconsin and northward. It is also a native of Canada and Nova Scotia. It generally grows about twenty to forty feet high. It is a very popular ornamental tree. A very aromatic liquid resin is obtained from this tree by incisions made in the bark, and is called Canada Balsam.

A. sub-alpina. Sub-alpine Balsam. Rocky Mountains. This is one of the tallest and handsomest firs of the Rocky mountains, often attaining a height of eighty or ninety feet; perfectly straight, and without limbs for a great distance. The wood is white, soft, and of little value for lumber. It is known among the lumbermen of the Wasatch mountains as White Balsam, or Pumpkin-tree. Its nearest affinity is to *A. balsamea* of the Eastern States. It reaches to great altitudes, being sometimes found near the timber-line. It has often been collected, and generally referred to *A. grandis*, the incorrectness of which has been but lately pointed out by Dr. Engelmann, who has proposed for it the name given above.

A. grandis. White Silver Fir. California and Oregon. This name is here applied to the tree of the Pacific coast. In Oregon, Mr. Dufur says, it grows on the low, moist land, along the small streams emptying into the Columbia river. Is seldom found at an elevation of more than 500 feet, and never on sandy or gravelly ridges. It attains a size of from two to four feet in diameter, and 200 feet in height. It has a light-colored, thin, smooth bark. It is a rapid grower, and the timber decays correspondingly fast when exposed to the wet. The wood is white, free and soft, but too light and brittle for general building purposes. It is used for clapboards, boxes, and cooperage.

A. concolor. White Silver Fir. Rocky Mountains. In the Wasatch mountains in Utah this tree is very valuable for lumber, and is called Black Balsam It is there a large tree, sometimes three or four feet in diameter and forty to fifty feet high. The wood is tough and coarse-grained, adapting it for building purposes and all substantial uses. It ranges from 8,000 to 9,000 feet in altitude. (Ward.) In southern Utah it is sometimes called Black Gum.

A. amabilis. Red Silver Fir. California and Oregon. Mr. Lemmon states, On the Sierra Navada mountains, it forms dense, scattered groves, at altitudes of 7,000 to 10,000 feet. The largest trees are 250 feet high and six to ten feet in diameter. A truly beautiful and magnificent tree, sometimes called the Queen of the Forest. Mr. Dufur says it is found extensively along the western slope of the Cascade mountains, on sandy, gravelly, rocky, and dry elevations. Its usual size is from 150 to 200 feet in height, and from one to four feet in diameter. The wood is rather coarse, but elastic, strong, and hard. It is used extensively for coarse building purposes, and also for masts and spars for ship building. The wood has a peculiar red color, and spikes, nails, and bolts hold firm and never corrode in the timber.

A. Fraseri. Frazer's Balsam. Alleghany Mountains. This species inhabits the highest parts of the Alleghanies in North Carolina. It is said to be a small tree, ranging from twenty to fifty feet in height. The cones resemble those of *A. nobilis* in miniature.

A. Nobilis. The Noble Fir. Oregon. This is one of the magnificent conifers of our country. It is a majestic tree, forming vast forests on the mountains of Northern California and Oregon. The Indians give it the name of Big Tree. The timber is said to be of excellent quality. It is nearly related to *A. Frazeri*, but has cones five times as large.

A. bracteata. Bracted-coned Spruce. Oregon. This species grows on the higher mountains of Oregon. It was also found by Dr. Coulter in Southern California. It is little known. The cones are very curious and remarkable, being handsomely fringed by long leaf-like bracts, entirely different from those of any other species.

Larix Americana. American Larch. New England to Wisconsin. This species is seldom found so far south as Virginia; its favorite localities being the New England States, northern New York, westward to Wisconsin, and northward to Canada. In Canada, it is called Hackmatack; in some portions of New England and New Jersey, Tamarack. The quality of the wood is represented as being superior to any kind of pine or spruce.

L. Lyallii. Lyall's Larch. Oregon.

L. occidentalis. Western Larch. Oregon. Mr. Dufur says this species is found abundantly in the Blue mountains in Eastern Oregon, also well up to the Cascade and Coast Ranges, but seldom at an elevation of less than 3,000 feet. It is often found 250 feet high, and attains a diameter of five feet, frequently being found 200 feet to the first limb. The timber is very strong and durable, free to split, and used for all kinds of fencing and coarse building.

Torreya taxifolia. Yew-leaved Torreya. Florida. A small tree from twenty to forty feet high, found on the east bank of the Apalachicola river in Florida. It is called by the inhabitants Stinking Yew, from the unpleasant odor of the bruised leaves. The genus was named in honor of Dr. John Torrey, the late eminent botanist of New York. It is considered to be a very ornamental evergreen in cultivation.

T. Californica. California Nutmeg tree. California. This species grows near the coast in California. It sometimes attains the height of sixty feet, with a trunk four feet in diameter, but is usually a round-headed, small, compact tree, twenty to forty feet high. The timber is said to be heavy and fine-grained. It is, like the preceding, called the Stinking Yew, from the unpleasant odor of the bruised leaves. The seeds have a rugose and mottled appearance, resembling a nutmeg, whence the name.

Taxus brevifolia. Short-leaved Yew. California and Oregon. A tree of California and Oregon varying much in height in different localities. Dr. Newberry saw it forming an upright tree fifty to seventy-five feet in height and two to three feet in diameter. Mr. Dufur says it is found on the lowlands of Willamette Valley, is of slow growth, and seldom attains a height of twelve to twenty feet and a diameter of a foot. It is very scarce in all parts of Oregon. The small, red berries remain on the tree till late in fall, and are used for food by the Indians. The wood is very hard and durable, is capable of receiving a fine polish, and is much prized for its fine grain, durability, and beauty.

T. Floridana. Florida Yew. Florida. This species, so far as known, is confined to a very limited field on the Apalachicola river in Florida. It is a small tree, from ten to twenty feet high.

Thuja occidentalis. American Arbor Vitæ. New England to Wisconsin. This tree is well known in cultivation, but in a native state is rarely found south of New York. In Canada and along the lakes, it is known as the White Cedar, which is the name given in New Jersey to the *Cupressus thyoides*. The Arbor Vitæ grows twenty-five to fifty feet high, forming a handsome, conical tree. The wood is light and soft, but durable, and is considerably used for building purposes. It is frequently employed as a hedge-plant and as an ornamental tree.

T. gigantea. Giant Arbor Vitæ. Oregon and Northwest coast. This tree is found in the greatest perfection on the western slope of the Cascade and Coast Ranges in Oregon and Washington Territory, at an altitude of from 500 to 1,000 feet. It attains not unfrequently the enormous size of from ten to fifteen feet diameter and 200 feet in height. The timber is very soft, smooth, and durable. It makes the finest sash, doors, moldings, etc., and all kinds of building lumber. The young trees are beautiful ornamental evergreens, and make a handsome hedge.

T. plicata. Nee's Arbor Vitæ. Pacific coast.

Cupressus thyoides. White Cedar. Middle and Southern States. This tree is found in swamps chiefly in the Atlantic States from Massachusetts to Florida. It has also been found near the Great Lakes. The tree rarely exceeds seventy or eighty feet in height, with a straight, tapering trunk. The wood is light, fine-grained, exceedingly durable, and easily worked. In New Jersey, it is largely made into shingles.

C. macrocarpa. Monterey Cypress. California. This is found in the vicinity of Monterey, Cal., where it grows fifty to sixty feet high, with a diameter sometimes of three to four feet. It is one of the finest cypresses known.

C. Nutkaensis. Nootka Cypress. Oregon and the Northwest coast. This grows at Vancouver's Island and near Nootka Sound. It is a tall tree of eighty to 100 feet high. The timber is white, soft, and valuable.

C. Lawsoniana. Lawson's Cypress. Mountains of Northern California.

C. MacNabiana. McNab's Cypress. Mountains of California and Oregon.

Taxodium distichum. Bald Cypress. Southern States. This tree is found in all the Southern States, extending into Delaware and into Southern Illinois. In rich, alluvial bottoms, it frequently grows to the height of 120 feet. The roots often form large conical excrescences, called cypress knees, which rise above the surface of the soil to the height of two to four feet. The wood is fine-grained, soft, elastic, strong, and exceedingly durable. Large quantities are made into shingles, and marketed at the North. Its foliage is delicate and beautiful, but it is dropped during the winter.

Sequoia sempervirens. Redwood. California. This is the mammoth tree of the coast of California, second only to the next species. It rises to the height of 200 to 300 feet, and sometimes with a circumference of sixty feet. The wood is dark red, rather light and brittle, but exceedingly durable, and makes valuable timber.

S. gigantea. Giant Redwood. California. This is the mammoth or big tree of California, growing in several groves on the western slopes of the Sierra Nevada mountains, at an altitude of 5,000 to 9,000 feet. The largest trees are over thirty feet high, and over thirty feet in diameter.

Libocedrus decurrens. Bastard Cedar. California. This is sometimes called Red Cedar, or Post Cedar It grows in the Sierras of California, at elevations of from 3,000 to 7,000 feet. It is a handsome tree, of low, conical form, tapering fast; four to six feet diameter at base; but only about 100 feet high. The wood is light and strong, and makes excellent cabinet work, boxes, etc.

Juniperus Virginiana. Red Cedar. Eastern United States. This is the Red Cedar of the eastern portion of the United States. It grows to the height of thirty or forty feet, generally with a compact, conical form. The timber is exceedingly valuable, being light, fine-grained, compact, and durable. The heart wood is of a handsome dark-red color. It is used for a great variety of ornamental work, and for fence posts is almost imperishable.

J. Virginiana, var. *Bermudiana.* Pencil Cedar; Florida Cedar. Coast of Florida. This variety, or species, as it is regarded by some, grows on the western coast of Florida. The wood is softer and freer from knots th n the common form, and the pencil manufacturers obtain their cedar wood from this source.

J. Virginiana, var. *Montana.* Rocky Mountain Red Cedar. Rocky Mountains. A form or variety of Red Cedar found in Colorado and Utah. In the Wasatch mountains, eastern Utah, this tree grows along the canons containing water throughout the year, and not in dry places. Its form is there quite different from the Red Cedar in the East, being taller and with a looser and less symmetrical top. The people there say that the wood is not durable, and do not use it for fence posts, etc., as is done with the eastern variety.

J. occidentalis. Western Cedar. Rocky mountains. California, and Oregon. This is undoubtedly the cedar named by Dr. Hooker *J. occidentalis.* It grows on the east side of the Cascade mountains in Oregon and also in California. It is of slow growth, seldom attaining more than a foot in diameter and thirty feet in height. The wood is nearly all white, and harder than the Red Cedar.

J. occidentalis, var. *Texana.* Rock Cedar. Texas and westward. This forms extensive woods on rocky soil in western Texas. The trunk is sometimes over one foot in diameter, yearly rings eccentric. It branches low, and forms almost impenetrable thickets. It is common fuel and fencing timber in western Texas. (Lindheimer.)

J. Californica. Sweet fruited Juniper. Southern California. A cedar growing from San Felipe Canon, in the Cuyamaca mountains, southern California, into Arizona and Mexico. It is a dwarf tree, and is very prolific of berries, which are as large as large peas, of a somewhat resinous but sweet taste. The Indians consume large quantities of them for food. The seeds are large, smooth, and free, one or two in each berry.

J. Californica, var. *Utahense.* Western Red Cedar. Utah and California. This is the prevailing cedar of the Wasatch mountains, and ranging into Nevada and southern California. In eastern and central Utah, this tree covers the slopes and foot hills at from 5,000 to 7,000 feet altitude. It is low and spreading at the base, with a dense pyramidal top, light-green foliage, and large, rather woody, berries, not so nutritious as those of the preceding kind. The wood is extremely durable, and used for fence posts. In southern Utah, the berries are eaten by the Indians. The bark was formerly used by them in manufacturing many articles of clothing.

PALMACEÆ.

Sabal Palmetto. Cabbage Palmetto. Coast of North Carolina and southward. The well known Palmetto tree of the Southern States, from North Carolina to Florida. It grows in sandy soil along the coast, with a stem from twenty to forty feet high. The leaves are five to eight feet long. In the Southern States, the wood of this tree, though extremely porous, is preferred to any other for wharves, and when constantly under water is almost imperishable, but when exposed to be alternately wet and dry, in the flowing and ebbing of the tide, it decays as rapidly as other wood.

Brahea edulis. Guadalupe Palm. Guadalupe Island. Guadalupe island is off the coast of Lower California, 200 miles from San Diego. It is about twenty-six miles long by ten wide. It is owned by a chartered American company for the raising of Angora goats. On the island there is a palm forest, of this species, of several thousand acres in extent. They grow from twelve to twenty feet high, and have a diameter of trunk of eight to fifteen inches. The fruit is about the size of a plum, hanging in clusters, like grapes, two feet long, weighing from thirty to forty pounds, growing from one to four bunches to a tree. The fruit is eagerly eaten by goats.

Pritchardia filamentosa. California Palm. Southern California, This palm has been in cultivation to some extent for several years, both in Europe and in this country, under the name of *Brahea filamentosa.* It has recently been decided to belong to a different genus, (*Pritchardia*). It grows on rocky canons near San Felipe, some seventy-five miles northeast of San Diego, Cal. It grows to the height of fifty feet. The fruit is small, (as large as peas,) black, and pulpy. Though containing little nourishment, they are used as food by the Indians.

Thrinax parviflora. Silver Palmetto. South Florida. This palm was found last fall by Dr. Chapman in south Florida. The stem is rarely six inches in diameter, yet they attain a height of thirty to forty feet. It occurs first at Cape Romans and is found sparingly on the mainland southward. It is more common on the keys, but I never heard of it before. (Chapman.) The wood is quite dense; the berries white.

LILIACEÆ.

Yucca brevifolia. Desert Yucca. Arizona and southern Utah. This singular tree grows in the deserts of Arizona and southern Utah. It is from ten to twenty feet high, with a trunk sometimes ten or twelve inches in diameter. It is fibrous in all parts, so that the whole plant may be converted to paper.

Y. Treculiana. Spanish Bayonet. Western Texas and westward. Sometimes with a stem over one foot diameter and fifty feet high, branching only near the summit, every branch bears a thyrsus of flowers three to four feet high, each consisting of several hundred white fleshy flowers, shining like porcelain. The fruit is edible, resembling the papaw. The leaves are two to four feet long, deeply channeled, and pointed by a sharp thorn. (Dr. Lindheimer.)

TRELLIS. Slats, wire, or other material, connecting two or more parts upon which any creeping or climbing plant is trained. When two trellises are connected together from the top it is called an arbor. Also any frame large or small, upon which a plant may be trained.

TREMBLES. This disease is known by a number of local names, one of the most common being milk-sick or milk-sickness It has been ascribed to a variety of causes, mineral and vegetable. It is essentially a disease incidental to new settlements, seldom found north of forty degrees, and then only near timber, or in regions interspersed with groves. When pastures are fenced it disappears. Horses, cattle, and sheep are affected with it, and from using the milk of cows it is communicated to the human family, producing distressing and alarming symptoms, and even death. It has now almost entirely disappeared in the West, where it was once prevalent, especially in central Ohio, Indiana, and Illinois. Prof. N. S. Townshend, of the Ohio Agricultural and Mechanical College, who had actual contact with the disease, in his medical practice, from his investigations says: a severe attack of milk-sickness is characterized at the outset by persistent nausea and vomiting, a sense of chilliness is commonly experienced, and great pain and tenderness are felt over the region of the stomach. After a time fever comes on, the tongue, which was at first coated and perhaps yellow, becomes dry and red, and sometimes cracks and bleeds. The vomiting continues; the matter ejected is at first bilious, but becomes dark, like coffee-grounds. There is obstinate constipation of the bowels. The examination of cases where death occurred before relief could be obtained, showed the disease to be acute inflammation of the stomach, such as might have been produced by an irritant poison. The inner surface of the stomach was crimson red, with patches of darker color, or of a dull, leaden hue. Similar evidences of inflammation, though in a less degree, were found in other portions of the intestinal canal. That milk-sickness, as it occurs in the human subject, is caused by using the milk from cows that are diseased or poisoned, or by eating the flesh of animals slaughtered while similarly affected, seems to be established by facts for which it would be difficult to find any other interpretation. Of a family of six persons, five who had used the milk of the same cow had milk-sickness—the sixth person used no milk or butter, and escaped entirely. At the time of the illness of this family, a yoke of oxen belonging to them were sick with trembles, and both died. The cow that furnished the milk used by the family, and which had pastured in the same stubble-field with the oxen, was at the time severely sick, but finally recovered, perhaps because the poison was eliminated from her system with the lacteal secretion. Neither the family nor the cattle used other water than that of Lake Erie. A thorough examination of the bodies of the oxen showed that both had died of inflammation of their stomachs and bowels. This inflammation had been manifested, during life by loss of appetite, and especially by chills or rigors, such as usually precede inflammation. The cold or trembling stage in cattle is always long-continued, and constitutes the prominent feature of the affection, and hence the name—Trembles. This case, and others essentially similar, leave little room to doubt that milk-sickness is a direct consequence of using milk or other animal products that have in some way become poisonous. To the question, What is it that produces such poisoning or disease of cattle? various answers have been given. Some have supposed the cattle to be affected by malarial fever; others have attributed the disease to bad water, or poor pasturage; and still others to some poisonous plant eaten by the cattle with their food. The latter opinion, that Trembles is caused by a vegetable poison, is that more generally received. But what is the plant that does the mischief? To this query many answers have been made. One says it is *Rhus radicans,* or Poison Ivy; another says it is *Rhus toxicodendron,* or Poison Oak, etc., etc. Probably the most satisfactory answer to the question is given in the Ohio Agricultural Report for 1858, in a communication from Mr. Vermilya, of Ruggles, Ashland county, O. In the same report, it appears that Mr. John Rowe, of Fayette county, had reached a similar conclusion many years previously. The results obtained by these gentlemen, and other observers to whom they refer, fix upon the *Eupatorium ageratoides* (sometimes called White-Snake Root), as the cause of Trembles in cattle, and, therefore, indirectly, of milk-sickness in the human subject. In the report referred to, a description and engraving of the plant are given. The *Eupatoriums*, of which Boneset, or *Eupatorium perfoliatum*, is a well known example, are some of them very energetic in their action upon the animal economy, as any one who has taken boneset tea has doubtless experienced. The species *E. ageratoides*, among the most active, is, without doubt, sufficiently so to produce decidedly poisonous effects if taken in considerable quantity. Regarding milk-sickness as simply an inflammation of the stomach, set up by an irritant poison, the appropriate treatment is plain enough, but, unfortunately, not always successful, for in too many cases the poison has done its deadly work before the nature of the difficulty is understood or relief obtained. Usually the stomach has been relieved of its contents long before the arrival of the physican, whose endeavor then is to allay the nausea and vomiting, and arrest the inflammation. For such purpose pounded ice should be given as long and as freely as it proves agreeable. To relieve the burning pain in the stomach, a strong mustard-poultice over the seat of pain will be serviceable. As soon as the stomach will tolerate any medicine, laxatives, such as Seidlitz powders, should be adminstrated; or, if the constipation is obstinate. injections, containing one or more drops of croton oil, may be required. A more thorough knowledge of botany by farmers seems to be desirable. The character of plants, noxious and beneficial, their effect upon animal life, the uses to which they may be put, and the injuries they are capable of inflicting, should be more profoundly and more generally studied. The *E ageratoides* rarely grows in cleared and enclosed pastures, but only in woods and protected places; and even there is not abundant or widely distributed, and cattle do not readily feed upon it, and are only induced to do so in seasons of drought when good herbage is deficient. Were the plant well known, a few hours would be sufficient to eradicate it entirely from any farm.

TRENCH. A deep ditch. Trenching, is the preparation of soils by digging two or more spades, or plowing two or more furrows deep, and exposing the soil.

TRENCH PLOWING. Deep plowing; subsoiling.

TREPAN or TREPHINE. Instruments for removing a part of the skull in disease or accidents.

TRICHINA SPIRALIS. This parasite, found principally in the flesh of swine, as among animals used as human food, but probably also in that of all vermin, insect and garbage eating animals, is worthy of special mention, from the fact that, of late years, trichinosis has been known in quite a number of instances as destroying human life. The chief source from which it is taken into the system of swine, is, being allowed to feed on vermin, as rats, mice, insects, and on the garbage of slaughter houses. In the corn zone of the West it is comparatively rare, really almost unknown, from the fact that swine are fed on Indian corn and grass exclusively. If a law were passed against the feeding of slaughter house garbage, it would probably be unknown altogether. It is true that the parasite is found in warm blooded animals generally, but yet, except in flesh or insect eating animals, to so light an extent as to make it altogether probable that their presence is due to taking them into the system accidentally. Rats and mice, supposed to be the great means of spreading this parasite —a supposition naturally founded, since they are well known to be generally infested; and cats, feeding upon them, are often infested to an enormous extent, as will be seen from the extracts further on. From an extended article in a report of the Department of Agriculture we find that, according to Dr. Cobbold, Mr. H. Peacock, so long ago as 1828 observed certain minute gritty particles in the substance of muscles in dissecting-room subjects, and made a preparation of muscle displaying them. Mr. Hilton next observed these specks, and first described the bodies as probably depending upon the formation of very small *Cysticerci*. Mr. Wormald also observed the characteristic specks in human muscle, and furnished Prof. Owen with the specimens on which he drew up his article. Paget first actually determined the existence of the entozoön while a medical student, and read a paper before a society one week before Prof. Owen presented his article; it is to Owen that we owe the first scientific description and the name of the *Trichina spiralis*. The immature parasites, as seen in muscles under the microscope, are worms about one-twenty-fifth of an inch in length, spirally coiled up within globular, oval, or lemon shaped transparent cysts, which, according to the length of time they have been formed, are more or less covered with calcareous matter. According to Leuckart, however, the cysts are to be considered rather as abnormalities, developed some little time after the larvæ have reached their destination, as hundreds of specimens have been seen to coexist entirely free from cysts. Fig. 1, 2 and 3 show the parasite in various forms highly magnified. The number found in any one subject varies, but Leuckart estimated that one ounce of cat flesh which he observed must have harbored more than 300,000 parasites. Even if we assume that the forty-five pounds of muscle which an ordinarily healthy man possesses were infested with only 50,000 *Trichinæ* to the ounce, they would still contain more than 30,000,000. The sexually mature male *Trichina*, according to Cobbold, is about one-eighteenth of an inch long, while the adult female is one-eighth; the body is rounded, slender, and the head very narrow and sharply pointed. The mode of reproduction is viviparous. The muscular parasite, when introduced into the alimentary canal of man or animal, is set free in the process of digestion, and in two day's time reaches the adult condition. Leuckart states that in six days more the female brings forth a numerous brood of minute hair-like larvæ; these soon begin their wanderings by piercing the intestinal walls, after which they proceed through the system till they reach the muscles, into which they penetrate; here they develop so that in two weeks more, that is, in about three weeks from the time the infested food was taken, they present the appearance of the ordinary muscular *Trichina spiralis*. The sexually mature worms probably produce more than one brood of young; they have been found

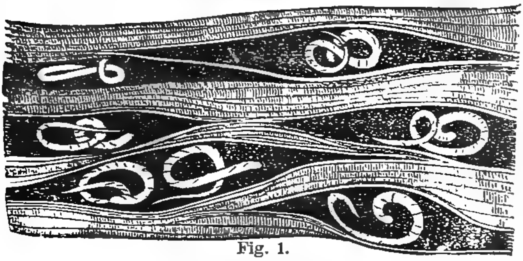


Fig. 1.

TRICHINA SPIRALIS.

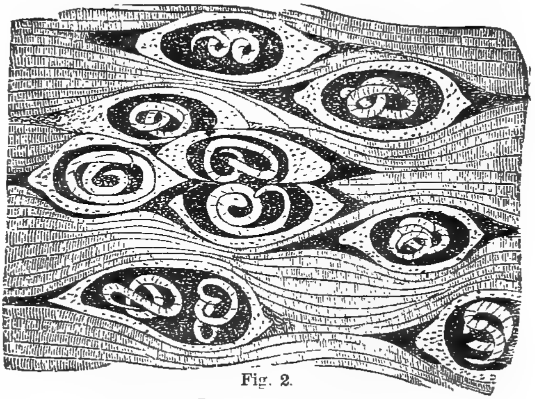


Fig. 2.

TRICHINA SPIRALIS.

alive in the intestines eight weeks after the ingestion of the flesh in which they are contained. The larvæ remain in the muscles they have reached, and shortly become encysted as heretofore mentioned Smoking the meat does not kill the parasites it contains; brine, if very strong and long applied, probably does; thorough cooking certainly does. Time also has its effect on them, though they are endowed with wonderful vitality. In some healthy subjects who died from accident, the larvæ and their enclosing cysts have been found to have undergone calcareous degeneration; but it is probably months, and even years, before the death of the parasite occurs; in illustration of which, Virchow states that in one case he found them alive eight, and in another thirteen and a half years after infection. Prof. Zenker first discovered the consequences to which the presence of this parasite in great numbers gives rise. In January, 1860, a servant girl died in the Dresden hospital, after an illness of about a month. The case, in the first stage, presented the following symptoms: Lassitude, depression, sleeplessness, loss of appetite and fever, so that it was thought to be a case of typhoid fever; but there supervened excessive pain in the muscles, especially of the limbs, contractions of the knee and elbow, swelling of the legs, and finally pneumonia, which ended the patient's sufferings. On post mortem examination the muscles were found crowded with enormous numbers of the *Trichina spiralis*, and to be in a state of very marked (fatty) degeneration. The girl had been a servant in a family where two pigs and an ox had been killed for the Christmas festivities. Zenker, knowing that both animals were liable to the presence of this parasite, examined their flesh with the microscope, and demonstrated the presence of numerous *Trichinæ* in the pork. He also learned that all the patient's fellow servants had become more or less ill about the same time, and that the butcher who slaughtered the animals had ever since that event been seriously ill, suffering rheumatic pains in his limbs, and seeming to be paralyzed over his whole body. It is a habit among German butchers to taste the raw flesh of the animals they slaughter, and from this circumstance Zenker was led to believe that he also was a victim to this parasite. Numerous experiments with trichinous flesh (this girl's among others) made on animals have proved that Zenker's discovery is correct. Virchow, Leuckart, Davaine, Turner, Thudicum, Cobbold, Dalton, and others, have verified the fact. Nor has other and more serious corroborative evidence been wanting. Wunderlich has reported four cases among the butchers of an establishment, who were taken ill after eating some raw pork. At Planen, in Germany, thirty persons were attacked, of whom one died. At Calbe seven out of thirty-eight cases were fatal. In October, 1863, the town of Heltstadt was the scene of an outbreak of trichinosis, following a hotel dinner where one hundred and three of the citizens had partaken of smoked sausage. In these cases the disease was distinctly traced to a pig which had been purchased for the purpose of making the sausage to be eaten at this festival, and which had been considered by the owner not to be in good condition. On the day after the dinner several of the partakers were attacked with diarrhœa, prostration, and fever, and the cases increased so rapidly that in one month twenty of the party were dead, and eighty more were suffering from the fearful malady. Examination of a portion of the sausage revealed the parasites, and portions of muscle from some of the living sufferers and from the dead victims demonstrated the cause of the outbreak. When the epidemic ceased the twenty-eight cases had died, every appliance of the medical art had been tried, and the disease had been observed with such extreme care that its various features can hereafter be recognized without difficulty. The violence of an attack seems to depend considerably on the number of parasites introduced into the patient's intestinal canal; something also depends, probably, on the length of time the parent parasites live, or the number of broods they produce. The previous constitution and strength of the sufferer also modify this as they do other disorders. Cases which have occurred in the United States have closely resembled those recorded in Germany, of which that of the servant girl above mentioned may be taken as a type. The disease makes its appearance a few days after the introduction of infested food, with abdominal pain and tenderness, nausea or vomiting, a feeling of lassitude, loss of appetite and high fever. This condition of things is due to the development of the larvæ in the intestinal canal, and to the irritation produced by their penetration of its walls and contiguous membranes. Later in the disease, and as the traveling parasites reach their destination in the muscles, occur vague but severe pains, with marked stiffness. The muscles swell, become tense and hard, and are exceedingly painful on movement. As the case proceeds, from the third to the fifth week, there is frequently great difficulty in breathing, probably dependent on the invasion of the respiratory muscles by the parasite. Paralysis from the degeneration of the affected muscular tissues is found in some severe cases, and sometimes continues in a more or less degree for some time after the other symptoms have disappeared. Death is generally preceded by extensive inflammation of the lungs, and sometimes by delirium. Convalescence, in cases terminating favorably, is slow. The duration of an attack may be stated to be from four to eight weeks; that of recovery as much longer. In this country, so far, the disease has been almost exclusively developed in our citizens of German birth. American cookery is much more thorough, at least in the case of meats, than is that of Europe, especially in the West, where most of the epidemics of trichinosis have occurred among our adopted citizens, and it is perhaps fortunate that an amount of cooking which makes beef almost totally indigestible, is necessary to render pork fit for human consumption, even when unaffected by parasitic disease. The treatment of trichinosis in the human subject has so far been unsatisfactory in its results. In order to clear away any mature parasites which may be in the intestinal canal, the use of cathartics, such as castor oil, is recommended. Mozler and Niemeyer unite in advising that benzine, in doses of one or two fluid drachms, in gelatine capsules, should be given for its supposed efficacy against the intestinal Trichinæ. The pain may be modified by long-continued hot baths. Quinine, in small doses, for the fever, stimulants for the prostration, and iron, in some form, for the anæmia during convalescence, are obvious resources. But far more good is to be accomplished by prevention than by treatment. Pork in every form, should be thoroughly cooked before being eaten. If all meats presented for sale in markets could be examined microscopically before being sold, it would be the most efficacious means of preventing future epidemics. In many parts of Germany, but more particularly in Prussia, legal means of prevention have been attempted with considerable success. Either the butcher is compelled to own and use a microscope for the examination of the meat of the animals slaughtered by him, or to submit such meat to the inspection of a government official provided with proper instruments of investigation. Microscopes for the especial purpose of detecting Trichinæ are now manufactured and for sale throughout Germany, accompanied by such directions and descriptions as will enable any one of ordinary intelligence to detect the parasite in any of its forms. Of course severe penalties enforce the examination of meat exposed for sale, and several butchers have been punished for neglect or violation of the laws in this respect. Late investigations have not shown anything essentially different from the foregoing. Investigations made by the editor some years ago, on pork fed on grass and corn, exclusively, failed to show the presence of trichinæ. The flesh of a hog fed on slaughter-house refuse, showed many trichinæ, as also did the flesh of a hog kept in a close pen and fed on city garbage, principally hotel waste. The conclusion was that in both cases the trichinæ came largely from rats and other verminous animals consumed. So the late investigations made in Europe, have failed to show that American corn-fed pork is noxious. In fact, the parasites, in a majority of instances, have been traced directly to home-fed pork.

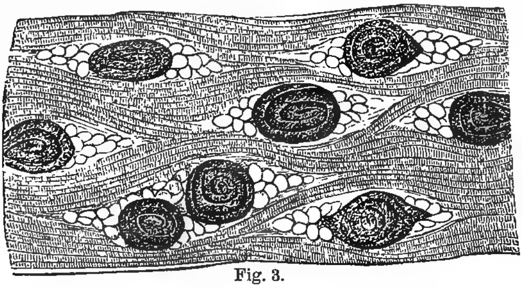


Fig. 3.

TRICHINA SPIRALIS.

TRIMERANS. A section of coleoptera, in many of which the tarsus contains three joints.

TRIMMER. In building, a piece of timber framed at right angles to the joists opposite chimneys or the well holes of stairs, which receive the ends of the joists intercepted by the opening.

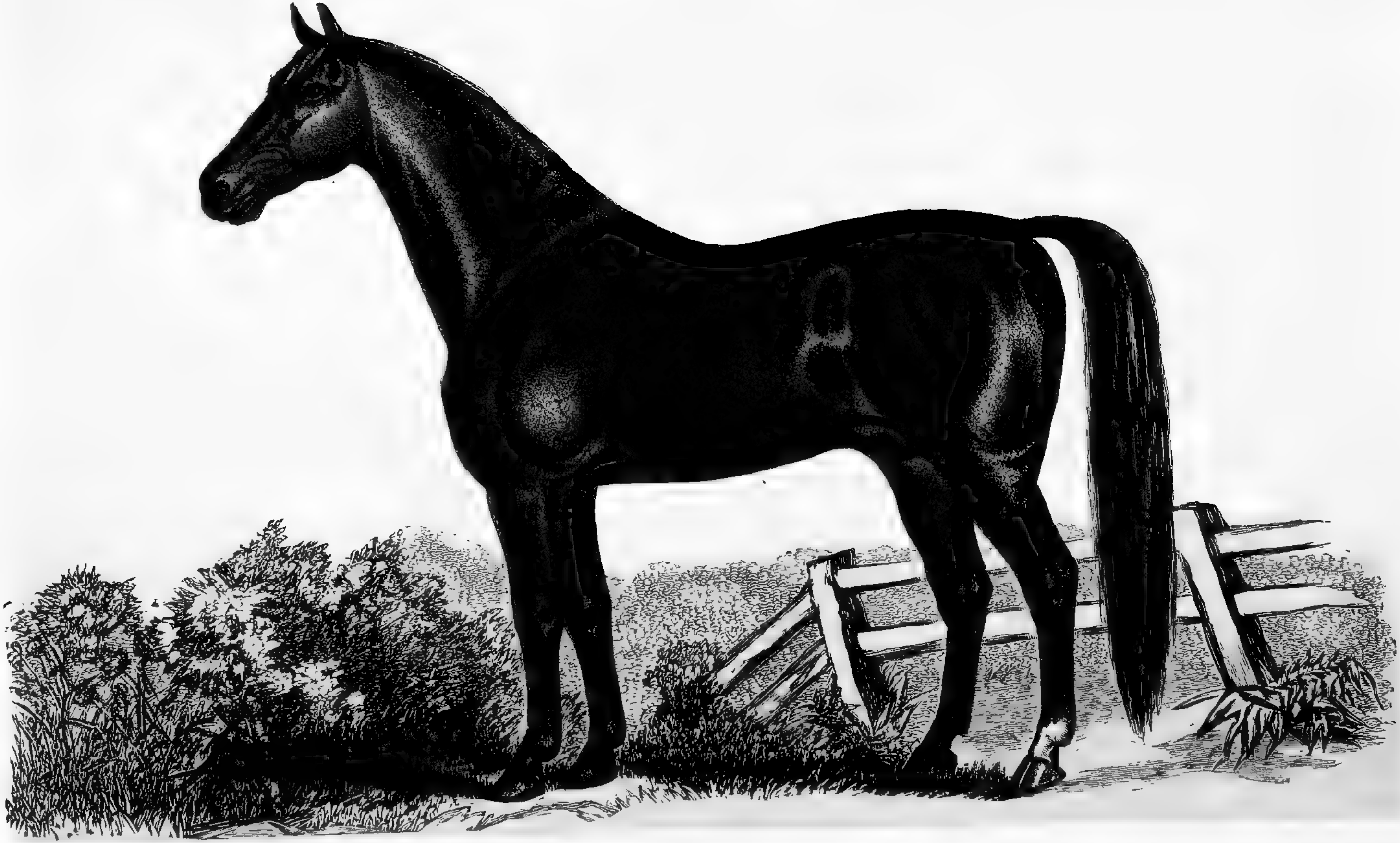
TRIMMING JOIST. In building, a joist into which a trimmer is framed.

TROCAR. These are puncturing instruments, either cylindrical or flat, composed of a canula and stilet, so the stilet may be withdrawn, leaving the tube remaining, and used where a puncture becomes necessary to relieve hoven, or any obstinate accumulation of gas in an animal, and also in dropsy to remove the water.

TROPHI. A name given to the different instruments or organs contained in the mouth or closing it, and employed in mastication or deglutition. They include the labrum, labium, mandibulæ, maxillæ, lingua and pharynx.

TROPŒOLUM. (See Cress.)

TROTTING HORSES. The use of trotting horses dates back many years. As long ago as 1823 a distinct notice of a trotting course appeared in the *American Farmer* newspaper of that day, and it is recorded that the first time a horse ever trotted in public in the United States for a stake, was in 1818, the prize money being $1,000. But it was not until 1830 that the fast course was established and public purses offered in this country. In 1823 the rules for the New York Association for the improvement of the breed of horses, were made, founded upon an Act passed by the Legislature of New York, in 1821. The principal clause is as follows: Be it enacted by the people of the State of New York, represented in Senate and Assembly, that from and after the passing of this Act, the training, pacing, trotting and running of horses, upon regulated courses and upon private property in the county of Queens, is hereby declared to be exempted and freed, for and during the period of five years, from the passing of this Act, from the provisions and penalties of the Act, entitled An Act to prevent horse-racing and for other purposes. While there have been many fast trotting horses whose blood could not be distinctly traced to thoroughbred strains of stock, and while it is true that any active horse may be trained to

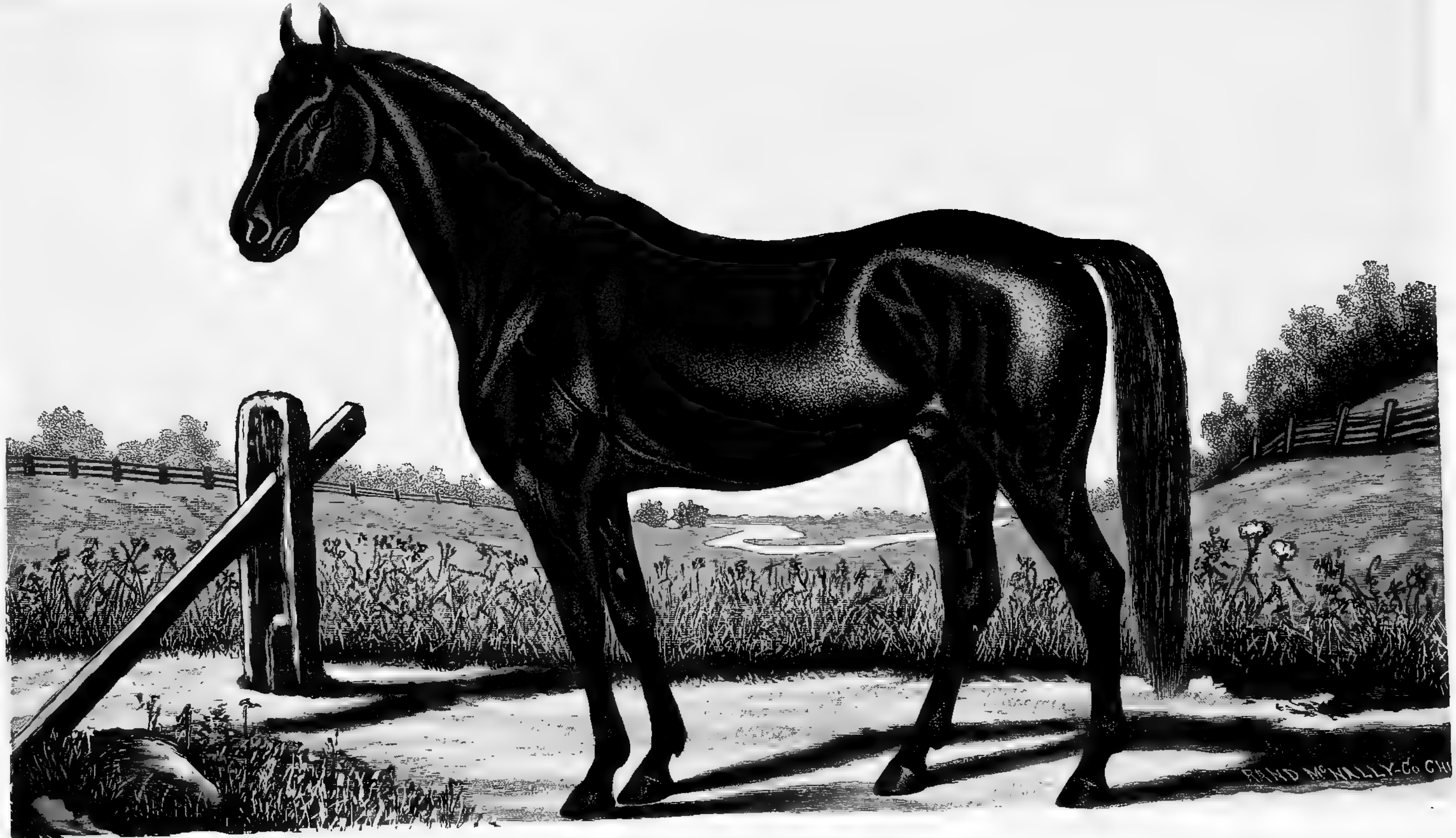


RAND-McNALLY-CO.

ADMINISTRATOR.

trot fairly well, the wonderful performances, of late years, of horses bred closely to strains of thorough blood that have developed fast trotting qualities themselves, or which has appeared in their descendants, would seem to show that the thoroughbred horse is as wonderful in his adaptation to trotting as he is to running and leaping. Our transatlantic horse fanciers therefore need not feel badly, or rather they may look with pitying contempt upon that class of ill-bred snob-Americans, of which there are many abroad, traveling for the good of their country, who think it smart to assert that there are no trotting horses outside of America. Running horses would soon pound themselves out if obliged to run at speed on English roads. When American roads come to be generally of stone pavement, McAdam, or Telford, it is quite possible that our magnificent roadsters may become a thing of the past, and our trotting horses be confined to feats of the turf exclusively. Another fallacy which some otherwise good horsemen in the United States have fallen into, for the purpose of aggrandizing the performances of our trotting stock, is the assertion, and this time taken from English snobs, that the horse has but two natural gaits, the walk and the gallop. We suppose there are plenty of persons who have seen colts of every breed and degree start off at a square trot, when at play, or who trot naturally and quietly alongside their dams, when driven over the road, who could testify in favor of a trotting gait. The fact is, the gallop is never used by the horse except when pushed to escape some fancied or real danger, or upon some emergency, when speed is required greater than the natural trot. Education has indeed much to do with the gait of a horse, consequently some trotting strains of blood gallop most reluctantly; and on the other hand, horses long bred for running, use the trot reluctantly, often breaking from the walk directly into the running gait. It might as well be said of the elk, that he can not run. They are natural trotters, and this gait is solely used, except when hard pressed, then they will leap like the deer. The original sources of fast trotting blood is undoubtedly the thoroughbred, and for the simple reason that their great powers of speed and bottom, caused by a rare combination of bone, muscle, and lung power, had only to be modified as to gait. This conceded, it will also be conceded that to Messenger is due more than to any other horse, the transmission of the fast trotting gait to the horse of America. Next in the list probably comes Bellfounder. Messenger had as his first sire Mambrino, second sire Engineer, and third sire Sampson. His first dam, according to the English Stud Book, was by Turf; second sister to Figurant, by Regulus; third by Bolton Starling, running back in his sixth dam to the New Castle Turk, in the seventh to Byerly Turk, in the eighth to Taffolet Barb, and in the ninth to Place's white Turk, and out of a natural Barb mare, and according to the stud book, Messenger ran back beyond Sampson to Blaze, Flying Childers, and the Darley Arabian. Among the more remarkable families descended from Messenger, the author of Roadsters and Trotting Horses enumerates the following: Trustee gained reputation by the performance of a son trotting twenty miles within an hour but the dam of the trotter was a daughter of Winthrop Messenger. The Morse horse, sire of Norman, sire of Blackwood and Swigert, was descended on the dam's side from two different son's of Messenger. Rhode Island, sire of Gov. Sprague, derived all the known trotting blood he possessed from his descent from Romp, a daughter of Messenger. The family Royal Georges and Panics descended from Ogden's Messenger, and perhaps have a cross from Hambletonian, son of Messenger. Mambrino Chief and his family descended from Mambrino and Messenger Duroc, whose dam was a daughter of Messenger. The American Star family come from two and perhaps three daughters of Messenger. The great Hambletonian was a son of Abdallah, and an in-bred Messenger. The Bashaw and Clay families come from a branch of the descendants of imported Grand Bashaw, that extended backward to a daughter of Messenger. The trotting family of Cadmus descend from American Eclipse, whose dam was Miller's Damsel, the celebrated daughter of Messenger. The Morrils, Knoxes and Ethan Allen, the best of the trotters of Morgan descent, have crosses of Messenger blood. Coming to Bellfounder, about which horse there has been many conflicting statements: He was imported into Boston, in 1822. He was horse of fine trotting power, for that day, both at short and long distances, he having been recorded as having trotted, in England, two miles in six minutes, and also nine miles, some twenty-two seconds inside of thirty minutes. His dam, Velocity, is recorded to have trotted, in 1806, sixteen miles in a hour, and, in 1808, twenty-eight miles in an hour and forty-seven minutes. A direct descendant of Bellfounder, brought to Chicago about 1853, proved a getter of fine trotters. The Editor, at that time a breeder of blooded horses and cattle, had this Bellfounder horse stinted to two of his best mares, the colts both proving fast and easy going, smooth trotters, as elegant in form as they were fast. Duroc also is conceded to have exercised a good effect in forming some of our trotting families. He was a large horse, of great bone and muscle, courageous and resolute. At one time the wide-gait behind was eagerly sought for. This was a characteristic of the Duroc blood. The horse possessed some infirmities of blood, which showed themselves in a disposition to curbs. ringbones and sprains. The Duroc-Messenger especially, is noted as nicking kindly with the blood of almost any of the trotting families. The following description of some of the most famous, of the various high cast trotting families must suffice to close this article. They are taken from Roadsters and Trotting Horses, by Mr. Helm, previously quoted: By right of acknowledged. pre-eminence, Hambletonian claims our consideration as the first on the list of great stallions. He was foaled on the 5th of May, 1849, at Sugar Loaf, Orange county, N. Y., and is now (March 1, 1876) nearing the day when he shall have attained the full age of twenty-seven years. With proper care and treatment he may survive several years longer, but his fame, and the renown of his family, will live in the breeding annals of this country for many generations yet to come. Having been employed in service to an extent greater, perhaps, than any stallion ever produced, his back has become much swayed, and this has worked a change in his form, constituting a wide departure from the magnificent original. For some months past he has also suffered from the effects of epizootic catarrh, which has operated much to depress the otherwise vigorous health of this most remarkable animal. But in the face of all the assaults of age, and these infirmities, incident to long service, and the inclemency of the season, he stands to-day a splendid exhibition of equine perfection. His coat is, ordinarily, of the brightest bay, his legs black, the black extending above the knees and hocks, with white socks behind (in size precisely alike), and a small white star in his forehead. His feet are neither small nor large, and as near the right model as I have seen anywhere. His pasterns not long or short, and from the sole of his foot upward he is as near perfection as I have ever known. His ankles and knees are large, and his cannon-bones flat, clean and hard to the touch, fine in texture and smooth on the surface. His hock is the firmest and the cleanest I ever grasped, and the large tendon, extending above, is very large and firm. I have not seen a horse, of any age, whose limbs and joints showed a finer texture or quality—more total absence of that gummy coarseness of cellular tissue which marks some even of the noted stallions of the day—his joints showing that perfect absorption of their synovial fluids, without which such an advanced age can not be obtained without great infirmity of limbs, and the development of marks and blemishes indicative of the imperfections so common in horses everywhere. There has been no firing nor blistering, and no resort to anything to stimulate absorption of synovial fluids, his own superior quality of bone, tendon, sinew, muscle, fiber and nerve, having been sufficient to exclude all approach of disease or tendency toward infirmity. He constitutes the best illustration I have ever seen of the highly-bred and finely-textured horse, as contrasted with the coarse-grained, soft, low-bred, beefy-limbed and gummy-jointed plug. His own perfection will be seen to better advantage, and more clearly illustrated, when we come to consider the qualities, high and low, of other stallions, even though some of them be the sons of this royal sire. Hambletonian has a knee thirteen and a half inches in circumference, a hock seventeen and a half inches; is fifteen inches around the smallest part of the limb and back tendon above the hock. From the center of the hip-joint to the point of the hock he is forty-one inches; from point of stifle to point of hock the length of his thigh is twenty-four inches; from the point of hock to center of ankle-joint he is sixteen inches; from center of foreankle to center of knee, eleven and a half inches; from center of knee to top of forearm joint, twenty and a half inches. His neck, from the notch in the vertebra on his withers to the extreme poll, is thirty-two inches, and on the underside his windpipe is only sixteen inches, giving him the appearance of a horse with a fine crest, but a very short neck. His shoulders extend forward at the point, very far and very strong and prominent, giving him a square, massive appearance, and one of great power. From hip to hip he is twenty-four inches, and in his back of medium length, round barrel, and massive, powerful hind-quarters, are found the completion of the powerful outline of this horse. Speaking of the Bellfounder blood Mr. Helm says: It is quite probable that the true character and genius of Bellfounder did not shine out in Hambletonian. In the Charles Kent mare and Abdallah blood, elements met which had some positive ingredients of dissimilarity. Although there is good reason, founded on many facts that come to my mind, for believing that Bellfounder and Messenger had a kindred origin, they had run in channels so far apart as to acquire certain diversities of quality, and their union in Hambletonian did not at the same time furnish the conditions to call out in full force the expressive and distinctive qualities of each. Both were there, but they could not both shine out with original brilliancy. Subsequently, in Goldsmith Maid, the Abdallah blood rose to its zenith, and shines to-day with a light that tells us how much has lain latent or hidden in the union of two bloods, whose brilliancy is often concealed by the very combination that is at the same time essential to the greatest fame and excellence of each. Thus it has been with this Bellfounder blood. Hambletonian was not a great success with mares strong in Bellfounder blood; but several of his sons have shown great success with mares remotely descended from Bellfounder. The dams of Bodine, St. Julien, Gazelle, Prospero, Reform, and others that have been previously named, run back to Bellfounder, and in their success testimony is found to prove the outlasting merit of this blood. It is one of the noteworthy facts in breeding that in regard to several of the important sources from whence we have derived our trotting blood the original fountain did not seem to give us as rich and beautiful currents as those that have sprung from later or more diluted branches. The native germ of excellence lay in the parent stock, but the most excellent manifestations of the blood are seen after it has been filtered through other forms and in part toned down or modified by other elements. It was so with the blood of Messenger. In itself, while it had two tendencies the trotting inclinations had to be freed in a measure from their native combination with the Arab elements that were blended with them. His success as a trotting sire is seen best in his more remote descendants, since the alliance of his blood with the other trotting elements have eliminated its real trotting excellence and presented the same ready for acceptable use in any combination. Likewise such was the case with Pilot the pacer. His blood was foreign and had to be naturalized by a commingling with that of the thoroughbred, after which it became an acceptable cross for any and all bloods which had original consanguinity with or toward the warm blooded families. Our experience with the blood of Bellfounder shows clearly that in its original form as presented fresh from the Norfolk trotter it possessed one element, a real drug that did not fuse readily in any combination. He was not, in his own immediate efforts in the introduction of his blood on this continent, an absolute success. Tested by his first fruits, and the essential transmitting qualities his own descendants seemed to possess, he was a failure. True, the Charles Kent mare was a trotter, and her power to transmit these qualities of the Bellfounder blood were enough to save him. The same may be said of the daughter that produced Harry Clay. Something may also be said of like import of one or two others, but these were all out of twenty years' service and a current popularity that surpassed any contemporary stallion. Abdallah was unpopular—almost discarded—

yet he left his powerful impress everywhere. Nevertheless of Bellfounder it may be said his success lies in the fact that he planted the germ, and in the later crosses of that blood its real force and value is coming out. Doubtless some of the sons of Hambletonian will in breeding display the richer qualities of the Bellfounder blood in greater force than it was displayed by him. The only trotters he left from mares of that blood that attained any distinction are Gazelle, and James Howell Jr., and their dams were by Harry Clay. His sons have been more successful in the same union thus far than he was. He has left several entire sons who were strong in the blood of Bellfounder, but not one of them has yet produced a 2:30 trotter; Rysdyk's Bellfounder, Manhattan, Idol, Electioneer—not one son of Hambletonian and a mare of Bellfounder blood has yet produced a 2:30 trotter; and only two of his own produce from such mares have trotted in 2:30, excepting, of course, daughters of his own sons. On the other hand, Volunteer has produced Bodine 2:19¼, St. Julien 2:22½, Goldsmith's Abdallah 2:30, his grandam being a mare of Bellfounder blood, and he has produced Hickory, 2:30. Messenger Duroc has produced Elaine, 2:28, three years old; Hogarth, 2:26, four years old, and Prospero, 2:20. Jay Gould has produced King Philip, 2:21; all from mares of that blood. Belmont, by Alexander's Abdallah, was from a mare of Bellfounder blood, and he has produced three trotters with records respectively 2:23½, 2:24½, and 2:29. And one of the most promising two year olds by Almont was from a mare of similar composition. The value and true richness of the blood is now coming out in the more remote descendants, and that which has sustained so much odium is now returning to the flood tide of popularity. To-day it is the ascending current in popular estimation. By its union with other bloods, and especially with what would seem to be its kindred blood in the Messenger family, it has eliminated from itself the gross and cold elements which came from some inferior English road stock, and has also by the alliance thrown into the back ground the Arab tendencies of the Messenger strains, and the fusion thus presented now displays its trotting quality and its prepotent breeding capacities in far greater degree than they were seen in the first or original combinations. The dam of Florida having so much of this blended Messenger and Bellfounder character has presented in Florida an exact medium or intermediate between Hambletonian and Volunteer. He is much like each. Volunteer has been acknowledged by all to show more in his outward form and appearance of the Bellfounder type than any of the older sons of Hambletonian, which is, perhaps, owing to the fact that in the composition of his dam those conditions appeared that were required for calling into active force the essential Bellfounder elements; but in the dam of Florida, a daughter of this same Volunteer, were found still more nearly the essential conditions requisite to call into action the nerve force, temperament, physical and mental characteristics of the Bellfounder horse, as we have nowhere else seen them since the days of the original and greatly admired Norfolk trotter. I have seen in Kentucky a two year old—the Cromwell filly—by Almont, the grandam of which was by Bellfounder Jr., a son of the Ohio Bellfounder, that displayed in living colors the genuine Bellfounder type, as shown in a gait that will some day call to mind memories of the old Norfolk trotter, and at the same time will shine out with an original brilliancy in a new constellation that has appeared in the galaxy since his star went beneath the horizon. To an eye that has learned to revel in the excellence of this most lovely of trotting gaits, it is no rare sight to witness an exact and faithful exhibition of it at the rate of 2:40, in a two year old filly. Marvelous indeed must have been the high qualities of that sire that could, in his daughter, Goldsmith Maid, exhibit the purity and elastic richness of the finer Abdallah gait, and in his granddaughter, through the interposition of a remote cross, produce the genuine Bellfounder gait in all its nervous richness, and exhibiting a poise of body, and a steady, quick, and almost flying stroke, scarcely seen since the days of the great original. So of the Duroc-Messenger blood, writing of Administrator, Mr. Helm states as follows: His dam was by Mambrino Chief, whose dam may be set down as a granddaughter of Duroc. His third dam was by Duroc Messenger, a grandson of Duroc. This gives this horse two crosses of Duroc blood, which is visible in only one particular in his entire composition. He has a thigh twenty-four and one-half inches in length, but has scarcely a trace of the Duroc element in his gait. Instead of swinging his hocks wide out, and trotting with a sprawling, wide, open gait, as it is called, he trots as close and true as Lady Thorn with her twenty-three-inch thigh. His length from hip to hock, for so large a horse, is not great—thirty-nine and one-half inches—but he lifts his foot up squarely, and spreads out his stifle, and sets each foot forward as truly in line as any son of Hambletonian in the land. This is entirely owing to the muscular conformation of his quarters, and their great proportions. His flank room is ample, and his muscle so works as to throw his stifle out wide, and yet his hocks are not widened enough to give him the appearance of a sprawler. His gait for a large horse is greatly admired and approved by all horsemen. This is contrary to the average Duroc characteristics, which generally are found in a flank of insufficient depth, and muscles so apportioned as to either beat the belly with the stifles, or go with wide, open gait. A gait of fair and reasonable width is desirable for clean, non-interfering action, but beyond that it is objectionable. In trotting he throws his feet well out in front, and bends his knees admirably without lifting them too high, and his hind feet extend well backward, but not so noticeably as in the Clay and Patchen families generally; while the steady and powerful stroke with which they are brought up under his body and sent forward, gives him the momentum of a very powful trotter; yet for all that, his way of going betokens the greatest ease. The muscles of the body and of the limbs and quarters work in such perfect harmony as to secure this easy and steady appearance in his trotting action. While it is true that his double lines of Duroc blood are not the controlling elements in his composition, the real force and value of that blood is present in him in as rich a combination as can anywhere be found in this country. He is, in fact, a beau-ideal of a Duroc-Messenger. The three elements of his composition—Messenger, Duroc, and Bellfounder—are so finely inwrought and so completely blended as to form a perfect and homogeneous union, and work together in entire harmony and in the exuberance of the most absolute healthfulness. Not an infirm trait or tendency is manifest in him. He is a great strong horse, positive in his Messenger characteristics. He has that ready fusible and ever affiliating caste which distinguishes the union of the Messenger and Duroc bloods. He has also the rich qualities of the Bellfounder blood in a form and degree where they are more readily reached and applied—more yielding and fusible perhaps than they existed in Hambletonian himself. The composite of the first two bloods formed the truest and most suitable soil in which to reproduce the best fruits from the more uncertain and unyeilding Bellfounder. While a Duroc-Messenger mare may not have been the equal of a Bellfounder in genuine trotting quality, such a mare would have furnished a field far more yielding and fruitful to the impress of any other blood. It was notably a union that readily impressed all other bloods and as readily swallowed them all up in any composition into which they all entered. We have never had an element in the American trotting horse that was so universally successful in uniting with any and all other bloods—in imparting richness to them, and in receiving all their good qualities—as this same union of Duroc and Messenger. The Bellfounder blood was a very coy element. It had no readiness for other strains, and it was not until it was filtered through distant and remote crossings that its dross was so far eliminated as to give us its pure gold, but when that state was reached, no gold Ophir, of the Sierra Nevada ever shone with such a radiance and enduring lustre. The strong Duroc-Messenger caste of the dam of Administrator was the field of more than alluvial fertility to the pent-up excellences of Hambletonian. The excellence of the union of the blood of Duroc and Messenger, for trotting purposes, was seen at an early day in the Eastern States. Duroc was taken to Long Island at a time when the daughters of Messenger were very abundant. The success of American Eclipse as a race-horse justified the opinion that they would excel on that branch of the turf. The large numbers of such mares that were sent to Duroc, and the early promise of the union for road purposes, served to make the cross a popular one. Steven's Messenger Duroc, and Stockholm's American Star, were both used for racing purposes at an early age, and both gave evidence of special adaptation to the trotting gait and of great excellence for road purposes. The former stood in the central portions of the State of New York, and gave us the dam of Mambrino Chief—a matter of which there can be hardly any reasonable doubt in the mind of the student of horse breeding who carefully and fairly considers the matter of locality, chronology and blood qualities in the respective families. The latter, known as the first American Star, from a daughter of the little Diomed horse, Henry, son of Sir Archy, gave us Seely's American Star. The grandam being by Messenger, the essential Duroc characteristics are in this family slightly modified, both by the Henry cross and the increased Messenger, but the Duroc-Messenger caste and type in the family prevails in such strong degree as to give the whole or predominant character to the family, even to the descendants of Hambletonian, that have come from Star mares—they are essentially Duroc-Messenger in their type qualities, both in matter of gait and blood traits. The high trotting quality of the Duroc-Messenger blood is displayed in eminent degree in the various branches of the families thus descended. They are bold and free drivers, going with a ready, open, and sweeping stride. They display their readiness for the trotting gait at a very early age, never lacking for courage and resolution, and showing much less nervous intractability than many other families. They bear early training, and can be forced to the utmost displays of speed with an ease and freedom from excitement shown by few families. They display a total absence of that hot-headedness which characterizes some otherwise valuable strains. While they require but little of the lash, they will bear it, and let out the last links they possess. These qualities render the Duroc-Messenger a class that bear training early, hence the earliness of their fame as trotters. They excel in the class of two and three-year-old performers. Their courage and pluck in the severe contests of a race never fail, and the name of quitter can not with any degree of propriety be applied to them. They are also distinguished for the success of this blood when crossed with other stock that are totally deficient in trotting action. The produce of stallions from this cross on thoroughbred and other highly bred mares is often marked with a high degree of excellence. Of Dexter, a Star-Hambletonian, it is only necessary here to give mention. His fame is one of pride to every lover of the American horse. Goldsmith Maid, of Abdallah blood, was in every respect a phenomenon. Her biography is given as follows: This Queen of the Trotting Turf, was foaled in 1857. She was bred by John B. Decker, of Sussex county, N. J. Her dam was one of those yellow-bay mares so common in the produce of old Abdallah. She was undersized, fretful, and of a nervous temperament, and up to the age of six years had performed no work of any kind, except to run occasional races about and on the farm, for the amusement of the boys. In 1863 she was sold by Mr. Decker for $260; the purchaser selling her again, on the same day, to Mr. Tompkins, for $360; and she was soon afterward bought by Mr. Alden Goldsmith, for $600. The eye of the practical horseman discovered that she was worth the handling. He discovered her ability, and soon brought the world to a knowledge of her value; under his careful and patient management, and the skillful drivers employed by him she soon displayed such speed and extraordinary qualities of game and endurance, that he was able to sell her, at about the age of eleven years, for the sum of $20,000. She was subsequently sold for the sum of $37,000. She has been matched against all the great trotters of her period; and, while she has occasionally lost a race, she has ultimately vanquished all competitors, and steadily lowered the record for trotting performances, and, at the age of eighteen, marked the marvelous, and thus far unapproachable, record of a mile in 2:14. Twice during the year 1876 she trotted in a race in 2:15, and although in her first race against the renowned Smuggler she was beaten, she by no means surrendered her queenly sceptre, for again, at Buffalo, she



RAND-MCNALLY-CO.

VOLTAIRE.

asserted her supremacy in the three fastest successive heats on record. Proudly does she command the sympathy and applause of all beholders when she hurls at her powerful competitor the defiant challenge, You may become King, but I am yet Queen. Goldsmith Maid is a bay mare fifteen and a quarter hands high, no white. She appears, at first glance, to be rather delicately made, but this conception is drawn from the form rather than the quality of her make-up. Her head and neck are very clean and blood like; her shoulder sloping and well placed; middle piece tolerably deep at the girth, but so light in the waist as to give her a tucked-up appearance, and one would say a lack of constitution, but for the abundant evidence to the contrary; loin and coupling good; quarters of the greyhound order, broad and sinewy; her limbs are clean, fine-boned and wiry; feet rather small, but of good quality. She is high mettled, and takes an abundance of work without flinching. In her highest trotting form, drawn to an edge, she is almost deer-like in appearance, and when scoring for a start and alive to the emergencies of the race, with her great flashing eye and dilated nostrils, she is a perfect picture of animation and living beauty. Her gait is long, bold and sweeping, and she is, in the hands of a driver acquainted with her peculiarities, a perfect piece of machinery. She seldom makes an out-and-out break, but frequently makes a skip, and has been accused of losing nothing in either case. Aside from the distinction of having trotted the fastest mile on record, she also enjoys the honor of making the fastest three consecutive heats ever won in a race, which renders any comments upon her staying qualities unnecessary. She continued on the turf until past twenty years old, and after completing that age she closed her public career with the year 1877 by trotting during that year forty-one heats in 2:30 or better, and making a time record of 2-14½. Her record stands at the close of her career at 2-14, with 332 heats in 2:30 or better. Her record and her career are the marvel of the age Of Voltaire Mr. Helm says, he is a stallion worthy of a place and a sketch among the first of his race and the age in which he lives, and adds: I find a sketch of Voltaire in a public print, which, with slight change, I here reproduce as part of my notice of this now justly celebrated stallion: Voltaire is a ten-year old dark bay stallion, by Tattler; dam Young Portia, by Mambrino Chief; second dam by Roebuck; third dam by Whip. He is a very dark bay, with no white; stands fifteen and a half hands high, a horse of great substance for his inches, weighing nearly one thousand one hundred pounds, in good road condition. He is upheaded, goes in great style, and is a hard one to whip in any class. Starting in June, without a record, he met and defeated some of the best horses on the turf, winning six successive victories, without a defeat, and winding up his trotting season at the National Breeders' Meeting, by winning the 2:20 stallion purse, beating such good ones as Blackwood, Jr., and Nil Desperandum, and lowering his record to 2:21¼. His breeding represents three trotting crosses, and the balance thoroughbred blood, which helps to account for his wonderful staying qualities. He has beauty of form and color, very rapid action, fine disposition, and is as game a horse as ever looked through a bridle. As a five-year-old he was started in one race which was won by the then famous Clementine, Voltaire's time being 2:34½. As a six-year-old he did not appear in public, but in his seven-year-old form he trotted two races in one week, and was beaten by such horses as St. Julien and Orient, either of whom could trot close to 2:20. He did not start in 1876, being badly handled, and made his first appearance in 1877 at Mystic Park, Boston, June 5, in the 2:50 class, which he won after a had-fought contest of five heats, beating Powers, the hitherto invincible son of Volunteer, and gaining a record of 2:24. At Beacon Park, Boston, June 12, he again defeated Powers in a race of five heats, and trotted in 2:24. At Granite State Park, New Hampshire, June 19, Voltaire and Powers renewed the struggle, and Powers again met defeat, after a five-heat race, Voltaire winning the last three heats. August 28, at Charter Oak Park, he met and defeated such horses as Honest Harry, Tom Keeler, Richard, and Alley, another fast son of Volunteer. This race created great excitement, and was won by the pluck and indomitable courage of the Hartford stallion, in spite of a strong combination to beat him, and an effort to break down his sulky. This, as usual for him, was a five-heat contest, but it was in reserve for him to win an easy victory (the first of the season) the following week, at Mystic Park, which he did in three straight heats, over the same field of horses as at Hartford, and trotting the third heat in 2:24½, the fastest of the race. His race at the National Breeders' Association Meeting, at Hartford, was won in great style, trotting the last three heats without a break, lowering his record to 2:21¼, and placing himself in the foremost rank of trotting stallions. He had in 1877 the fatest record in the State, beating Jefferson's record one and three-quarters seconds, and the second fastest record in New England, the famous Smuggler standing first. His career marks him as one of the most successful trotting stallions that have ever appeared on our trotting turf. Of Almont, Mr. Helm says: We now reach for consideration one of the most remarkable trotting sires this country has yet produced—a princely son of a royal sire, and worthy of a place in a household of kings and queens. Almont was bred at Woodburn Farm, the home of Alexander's Abdallah, either by Mr. Alexander or Mr. D Swigert—at that time the superintendent—and was foaled in 1864, and sold by Mr. Swigert, when four years old, to Col. Richard West, of Scott county, Ky. His dam was by Mambrino Chief; second dam by Pilot Jr.; and third dam, a very highly bred mare owned by Wm. H. Pope, of Louisville, Ky. For the latter mare no pedigree was given, but she was one of those very highly bred animals whose blood being unknown was often claimed for thoroughbred—and while, perhaps, not entitled to that rank, was nevertheless one of the best possible selections on which to start a structure composed of the best of trotting bloods and to culminate in a trotting sire of rare distinction and enduring fame. The next link in the chain is that of Pilot Jr., and he by the Canadian pacer Pilot, from a mare having much the same claims to high blood as the one above referred to. This Pilot Jr., cross, which will receive further attention during the progress of these chapters, was one that had the happy and very fertile faculty of fusing and harmonizing well and readily with any trotting or even racing blood, and giving the product a ready tendency to the trotting gait, and at the same time interposing no real impediments in the way of cross-bred or conflicting anatomy. It lacked fixedness and obstinacy, and served as a sort of amalgam to render opposite and unyielding fields pliant and fruitful, in union with more positive and controlling elements. It was an element that seemed to have affinities for every other, and all tending in a direction to promote ready trotting action, no matter what the combination. It possessed qualities that are difficult to comprehend. While the trotting quality came from an inferior and coarsely bred animal, it had, nevertheless, the faculty of engrafting a trotting action, to a very great degree, on the produce of other bloods far higher in quality. It even succeeded with thoroughbred crosses when the Hambletonian blood failed. Thus, for instance, the grandam of Crittenden, raised two daughters, one by Alexander's Abdallah, that has never been a success, and another by Pilot Jr., that breeds a colt of trotting action approaching the highest type—the latter is the dam of Crittenden. This is the only aspect or manifestation of the Pilot blood that is clearly visible in Almont, as we shall see further along. The next link in his pedigree brings us to his own dam by Mambrino Chief. Here we have a cross of royal trotting blood in the foreground, and one that was, like the Pilot blood, also noted for its readiness to amalgamate advantageously with any and all other elements, whether of the trotter or the thoroughbred. It was a blood that reached back in straight and short lines to old Messenger, by that process of reuniting, after a certain interval, two or more currents of the same blood, which, in breeding, is often found to secure an intensified manifestation of the leading or controlling qualities of the particular blood. This is nowhere better illustrated than in the case of the various families of trotters bred or descended from the Messenger family. Although it is true that now and then an able and intelligent critic of rare accomplishments, such as the fluent and versatile editor of the *Sportsman*, is found ready to detract from the great merits of the blood of Messenger as a trotting constituent, the concurrent testimony of so many others, and such vast numbers of great performances on the trotting turf, do attest the fact that the great trotting blood of the world is that which has come down to us from the great horse, imported Messenger. Almont is a deep or solid bay horse, standing fifteen hands two and one-quarter inches on his withers, and one inch higher on the rump, and weighs, in ordinary condition, 1,175 pounds. His points are black, and the color extends to and includes the knees and hocks; he has the Mambrino Chief badge of a grey right hind leg from the foot to the hock, although not yet very plain, but increasing with age. His mane is medium and his tail rather light. In his measurement and in his proportions he is almost exactly like Thorndale—his head is in length, twenty-six; his neck the same, thirty-five; his hindquarter is thirty-eight and one-half from hip to hock, and twenty-four and one-half in length of thigh—slightly longer; and in his fore leg his relative proportion is just enough different to make their gaits and that of all the Almonts clearly different—eleven and twenty-one; and let it be borne in mind that in this particular the variation of one-half inch makes a vast difference in the gait of a horse. It will be noticed that Almont is almost precisely the same in his fore leg measurement as Volunteer, and the old-time objection that I heard against the Almonts before I ever saw one of them, was that they pointed or dug too much with their forefeet. It is true that, like the Volunteers, they trot best with a light weight; but, as was shown in the case of that family, this clamor about not bending the knees is false in theory and needless in practice. Both families bend their knees enough to get to the end of the race in fast time. But the difference in the matter of elevation of the forefeet, between Thorndale and the Almonts, is very perceptible; while Almont might, without detriment, raise them a little more, Thorndale shows his well up and out in front in vigorous style. In the neck Almont appears slightly heavier than the Hambletonian model—his shoulder is heavy and very powerful, and extends well forward; his middlepiece is excellent, and, with his back and loin short and powerful, gives him the appearance of great compactness and power; but, like all of the best Hambletonians, the excellence of the animal appears to the greatest advantage in the hindquarter. His quarters are exceedingly muscular; and he carries it both on the outside and on the inside—and in this connection there is a family peculiarity pertaining to the Hambletonians worthy of notice. Many of our powerful trotters, especially those coming from Messenger, Hambletonian or Mambrino Chief blood, on Diomed or Archy crosses, show a great and very powerful muscular development of the outer quarters, and low down on the thigh or gaskin. Many of them widen out at a range with the stifle; but the Hambletonian family are marked from all others in the excessive development of the inside of the quarters and the back part of the great muscle of the quarters—I describe Hambletonian in that part as simply immense. The following record of performers in harness, unless saddle is mentioned, will show the capabilities of the trotting stock of America, both at short and long distances:

ONE MILE, IN HARNESS.

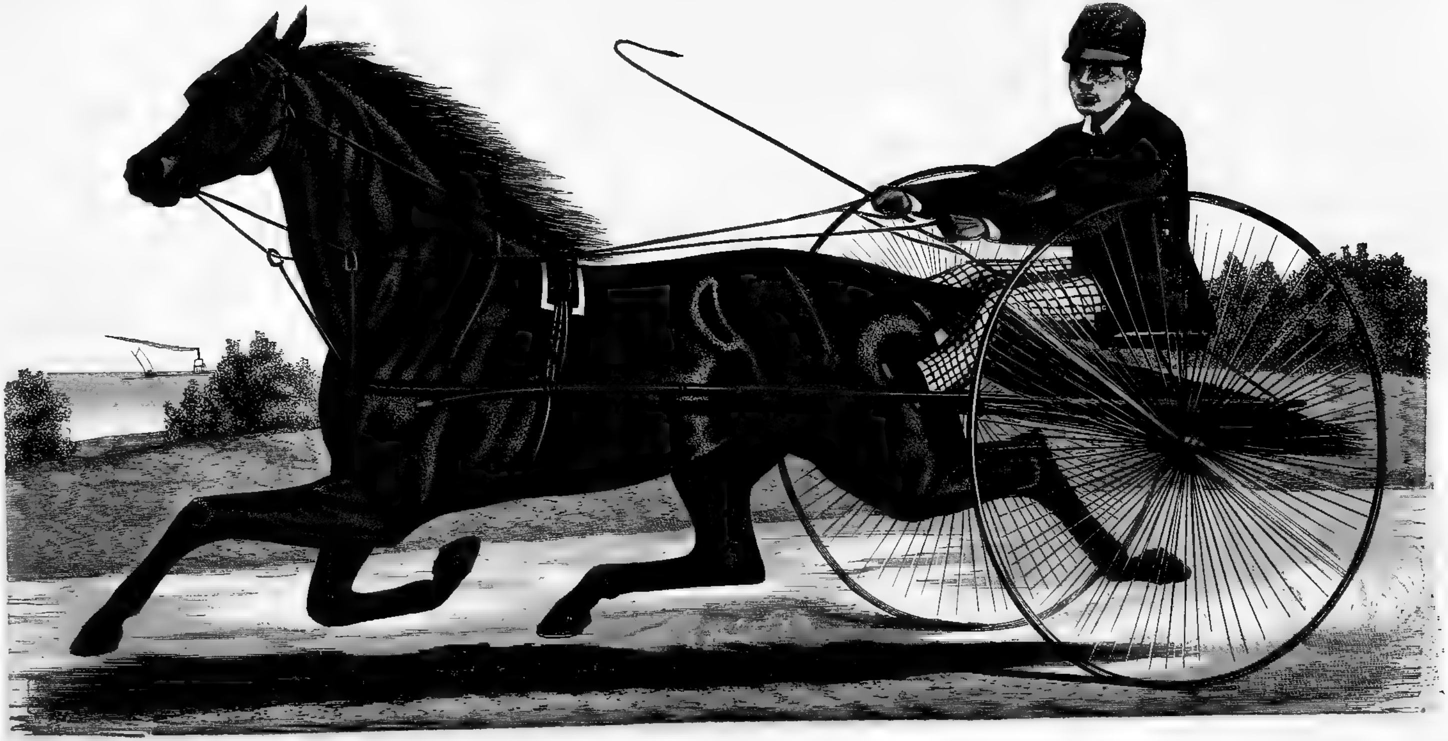
Maud S.	2:10¼
Goldsmith Maid	2:14
Rarus	2:14¼
Lula	2:15
Smuggler	2:15¼
Lucille Golddust	2:16¼
American Girl	2 16½
Occident	2.16¾
Gloster	2:17
Dexter	2:17¼

ONE MILE, TO SADDLE.

Great Eastern	2:15¾

TWO MILES, IN HARNESS.

Flora Temple—Eclipse Course, L. I., Aug. 16, 1859; 4:50½.
Dexter—Fashion Course, L. I., June 14, 1867; 4:51.
Geo. M. Patchen—Union Course, L. I, June 12, 1860; 4:53¼.
Reindeer—Louisville, June 21, 1860; 4:58.
Gen. Butler—Fashion Course, L. I., July 23, 1867; 4:59.
Dreadnaught—Fleetwood Park, N. Y., June 29, 1870; 4:59½.
Tennessee—June 11, 1872; 5:00.
John Morgan—Louisville, Oct. 25, 1860; 5:00½.
Stonewall Jackson—Fashion Course, L. I., Oct. 4, 1864; 5:01.
Princess—Eclipse Course, L. I., June 23, 1859; 5:02.



RAND-McNALLY-CO.

GOVERNOR SPRAGUE.

TWO MILES, TO SADDLE.

Geo. M. Patchen—Fashion Course, L. I., July 1, 1863; 4:56.
Lady Suffolk—Centreville, L. I., Sept. 24, 1840; 4:59.
Shark—Union Course, L. I., June 27, 1866; 5:00½.
Tacony—Union Course, L. I., Sept. 27, 1852; 5:02.
Silas Rich—Chicago, Sept 9, 1867; 5:04.
Edwin Forrest—Philadelphia, May 6, 1840; 5:05.

TWO MILES, TO WAGON.

Gen. Butler—Fashion Course, L. I., June 18, 1863; 4:56¼.
Dexter - Long Island, Oct. 27, 1865; 4:56¼.
Flora Temple—Centreville, L. I., Oct 17, 1855; 4:57.
Geo. M. Patchen—Fashion Course, L. I., June 18, 1863; 5:04.

THREE MILES, IN HARNESS.

Huntress—Prospect Park, L. I, Sept. 23, 1872; 7:21¼.

TEN MILES, IN HARNESS.

John Stewart—Riverside, Boston, June 30, 1868; 28:02½.
Prince—Union Course, L. I, Nov. 11, 1853 28:08½.
Captain Magowan—Cincinnati, O., Nov. 3, 1860; 28:11½.
Gipsy Queen—Louisville, Ky., Oct. 27, 1861; 28:39.
Julia Aldrich—San Francisco, June 15, 1858; 29:04⅓.
Mattie Howard—San Francisco, Dec. 25, 1873; 29:13¼.
Duchess—1856; 29:17.
Gen. Taylor—San Francisco, Feb 6, 1857; 29:41½.
Fanny Jenks—Oct. 2, 1844; 29:59.

TEN MILES, TO WAGON.

Princess - San Francisco, March 2, 1859; 29:10¾.

TWENTY MILES, IN HARNESS.

Captain Magowan—Riverside, Boston, Oct. 18, 1865; 58:25.
John Stewart—Fashion Course, L. I., 1868; 58:30.
Trustee—Union Course, Oct. 20, 1855; 59:35½.
Lady Fulton, Centreville, L. I., July 12, 1855; 59:55.

TWENTY MILES, TO WAGON.

John Stewart—Fashion Course, L. I., Sept. 22, 1868; 59:23.

FIFTY MILES, IN HARNESS.

Black Joke—Providence R. I., July, 1835; 3h, 57m.
Ariel—1846; 3h, 55m, 40½s.

FIFTY MILES, TO WAGON.

Spangle—Oct. 15, 1855; 3h, 59m, 4s.

ONE HUNDRED MILES, IN HARNESS.

Conqueror—Centreville, L. I., Nov. 12, 1853; 8h, 55m, 53s.
Fanny Jenks—Albany, N. Y., May 5, 1845; 9h, 38m, 34s.
Fanny Murray—Albany, N. Y., May 15, 1846; 9h, 41m, 26s.
Kate—Centreville, L. I., June 7, 1850; 9h, 49m, ¾s.
Tom Thumb Sunbury Com., Eng., Feb. 2, 1829; 10h, 7m.

ONE MILE, IN DOUBLE HARNESS.

Joe Clark and Mollie Morris—Mystic Park, Sept. 3, 1874; 2:26½.
Jessie Wales and Darkness—2:27¾.
George Wilkes and Honest Allen—Boston, July 4, 1871; 2:28.
Kirkwood and Idol—Prospect Park, May 31, 1870; 2:29.
Jessie Wales and Honest Allen—Boston, Sept. 30, 1869; 2:29¾
Black Harry and Belle Strickland—Narragansett, Oct. 5, 1869; 2:30.
Honest Allen and Kirkwood—Prospect Park, July 21, 1870; 2:30.
India Rubber Ben and Mate—Milwaukee, Sept. 30, 1869; 2:31¼.
Jessie Wales and Ben Franklin—Boston, Sept. 20, 1867; 2:32
India Rubber Ben and Lady Walton—Boston, June 16, 1869; 2:32.
Kirkwood and License—Boston, June 9, 1870; 2:32½.
Nabocklish and Medoc - Buffalo, July 31, 1868; 2:32¾.
Honest Allen and Myron Perry Boston, June 16, 1869; 2:33.
Dot and Ironsides—Philadelphia, Nov. 1, 1870; 2:35½.
Lantern and Whalebone—1856; 2:42.

ONE MILE, WITH RUNNING MATE.

Ethan Allen and Mate—Fashion Course, L. I., June 21, 1867; 2:15.
Honest Allen and Mate—Prospect Park, Sept. 15, 1870; 2.17¼.
Brown George and Mate—Milwaukee, Sept. 16, 1867; 2:20.

TWO MILES, WITH RUNNING MATE.

Lady Palmer and Flatbush Maid—Fashion Course, L. I., May 13, 1862; 5:01¼.
Lady Suffolk and Rifle - Philadelphia, May 31, 1842; 5:19.

TROUT. (See Fish Breeding.)

TRUCK FARMING. A name applied to that class of gardeners who make a speciality of raising those vegetables commonly consumed in families, and in contradistinction to the term gardener, as applied to those who cultivate all plants grown in gardens including flowers; just as the term florist is applied to those who grow or deal exclusively in flowers and flowering plants.

TRUFFLE. A subterranean fungus, of a roundish, oblong form, and a blackish brown color, much employed in cookery. It is found by dogs and swine, trained for the purpose, in soil beneath trees, especially beeches and oaks; it is, however, very local. It is propagated by spores included in sinuous chambers in the interior; but has never yet been cultivated with success, notwithstanding many attempts that have been made. The common kind is *Tuber cebarium.*

TRUNCATED. With the smaller parts cut off or removed.

TRUNCHEONS. Stout stems or trees, with the branches lopped off for rapid growth.

TRUNK. The shaft of a column; the body without extremities; the large stem of a tree. In entomology, the segment which lies between the head and the abdomen.

TRUSS. A bundle of hay or straw. A frame of timbers for supporting a beam or piece. Any bandage intended to support a part of the body, as in hernias.

TUBE. A pipe.

TUBER. The name applied to thickened, underground stems, as the potato, artichoke, dahlia, etc., having true buds, covered with scales. In the case of sweet flag, Solomon's seal, iris, the creeping grasses, etc., they are called root stalks. When the base of the leaves is thickened, as in the hyacinth, onion, lilly, turnip, etc., they are called bulbs. They are important in agriculture as furnishing food for both man and beast.

TUBERCLE. A roundish tumor of small size, and of the consistence of cheese, found in diseased structures.

TUCKAHOE. Indian loaf. An underground fungus, often two feet deep, but sometimes partly exposed, and from the size of a nut to a man's head, roundish and of a brown color. The *Lycoperdon solidus.* When fresh, it is of an acrid taste, but becomes eatable when dry.

TUFA. A volcanic rock, consisting of cemented scoriæ.

TUFO. A light, calcareous stone.

TULIP. A class of bulbous, hardy perennials, once among the most famous of garden flowers, and celebrated for the extraordinary prices once paid for particular varieties, and for the mania exhibited in the efforts to procure them. They are among the most brilliant of spring flowers, and of late years more and more attention is being attracted to them. They should form a part of every collection, since they are of the easiest cultivation, and are now very cheap.

TULIPTREE. *Liriodendron tulipifera.* White wood. It attains a great size on fertile bottoms, measuring even 150 feet in the Middle States, with a trunk of sixty to eighty feet without branches. The flowers are very attractive to bees and other insects. The wood is white or yellowish, and very soft; it is much used by cabinet makers and in building, under the name of poplar.

TUMBREL. A rough cart.

TUMOR. An unnatural enlargement. This term was formerly used to express any swelling or enlargement, as that of an abscess, or from a bruise; but it is now more strictly applied to enlargements of a more permanent nature, in which a change of structure takes place, or a new substance is produced, as fatty, fibrous, or bony tumors, in which the swellings are respectively formed of fatty, fibrous, or osseous matters. These being organic diseases, are not to be treated by poulticing or lancing, and seldom give way to any treatment but an entire removal by the knife.

TUN. A measure of 252 gallons, or four hogsheads. In weighing, 2,000 pounds.

TUNIC, TUNICA. A membrane or coat covering an organ.

TUPELO. The name given by Michaux to several species of *Nyssa*, or black gum.

TURBINATE. Whirled, and of a conical figure.

TURF. A term often applied to the green surface or sward of grass lands. Also the name given to peat, used as fuel. It varies much in its nature in different places, being sometimes hard and of a dark or black color, while in others it is soft and spongy.

TURKEY. *Meleagris.* Of this magnificent domestic fowl there are but two species. *M. gallapavo*, the common wild species, and from which our domestic varieties are descended, and *M. ocellatus*, a wild species, a native of Honduras, and indeed extended over various parts of Central America. In Mexico, is found *M. Mexicanus*, much resembling the common wild turkey. Since the discovery of America the wild turkey, as represented by the domestic varieties, have been carried to almost every civilized nation of the earth. Of the wild turkey, Mr. D. G. Elliot says that, the turkey was first introduced by the Spaniards from Mexico into Spain, and thence carried to England. In the reign of Francis the First, they were imported into France, and the first one eaten in that country was served up at the banquet given at the wedding of Charles the Ninth, in 1570. Bred with much care they rapidly increased, and soon were taken into Asia and Africa. It would be difficult to ascertain why its popular name was given to this bird, and it is to be somewhat regretted that such an appellation should ever have fallen to its lot, since it is apt to give rise to the supposition that it originated in Asia instead of America, the eastern in place of the western hemisphere. Not so much to be regretted, however, at the present time as formerly, for, since ornithology has taken its rightful place among the sciences, and its hidden things are investigated and explained by the researches of so many able minds, the results of whose labors dignify and elevate their subject, the origin of so noble a bird is not likely ever again to be lost sight of. At one time the turkey was pretty generally distributed throughout the United States, but like the Indian, it has gradually disappeared before the onward march of civilization, until now one must look for it amid the unsettled portions of our Western States, and the vast regions through which the Mississippi, Missouri, and their tributaries flow. It is still quite plentiful in the Southern States, many parts of which are yet covered with the virgin forest, while in the middle and Northern States it has almost if not entirely disappeared. The turkey may be considered as both migratory and gregarious; the first of these circumstances arising mainly from the exhaustion of their favorite food in any particular section of the country, or upon the opposite fact, of there being a great abundance of it in some other place. When this last is the cause of their migration they seem to be insensibly led towards the land of plenty by finding the supply increase as they advance, and not from any particular instinct of their own. Their food consists of maize, berries, fruits, grasses, acorns, and in that part of the country where it abounds, the pecan nut is preferred by them to everything else. When migrating, if they reach a river over which they desire to cross, they generally remain near the bank for a day or two previous to making the effort; seemingly either to consult upon the means of accomplishing their intention, or to recuperate their strength before undertaking the difficult feat. While they are thus waiting the males employ their time chiefly in gobbling continually, or in strutting pompously about with lowered wings and expanded tails, the females sometimes even imitating them in these movements. When they consider that the time has arrived for proceeding on their journey, the entire flock mount to the tops of the highest trees, and, at a given signal of their leader, launch themselves into the air and fly to the opposite shore. The old birds easily cross, but should the stream be wide, the young and feeble frequently miss the desired point and fall into the stream, when they proceed to swim ashore, which they accomplish with considerable dexterity, by closing their wings, using their expanded tails for support, and striking out rapidly with their long and powerful legs. Sometimes if the shore should be very steep, some are unable to ascend, and falling back from their unsuccessful attempts, perish in the water. Toward the latter part of February, the pairing season commences, and, then the females separate and endeavor to hide from the males, while the latter, with almost unintermitted gobbling, seek for them in all directions. Whenever the males meet while thus occupied, fierce battles ensue, ending, generally, in the death of the weaker party, unless he is fortunate enough to escape by flight. Of these fights Audubon says: I have often been much diverted while watching two males in fierce conflict, by seeing them move alternately backward and forward, as either had obtained a better hold, their wings drooping, their tails partly raised, their body feathers ruffled, and their heads covered with blood. If, as they thus struggle and gasp for breath, one of them should lose his hold, his chance is over; for the other, still holding fast, hits him violently with spurs and wings, and in a few minutes brings him to the ground. The moment he is dead, the conquerer treads him under foot; but what is strange, not with hatred, but with all the motions which he employs in caressing the female. The males do not always confine their attentions to one female; sometimes several of these may be seen accompanying one gobbler, until they commence to lay, when they hide themselves for the greater part of the day in order to save their eggs, which he would destroy whenever he obtained the opportunity. The nest, a very simple structure, is generally placed in some thicket to conceal it from the prying eyes of its various would-be despoilers, and the hen approaches it with great caution, rarely entering it twice from the same direction. The number of eggs deposited varies considerably, some nests having ten, others as many as twenty. They are of a dull cream color, profusely sprinkled with red spots. The young, when first hatched, are covered with a delicate hairy down, and are very tender; so susceptible to the influence of the weather that, should the season be rainy, great difficulty is experienced by the hen in raising them, for they rarely survive a thorough wetting. To guard against such a catastrophe the first night is generally passed by the young brood in the nest, and the mother then leads them to elevated dry places, reposing them at night under her outspread wings until they are two weeks old, when they roost upon the broad branch of a tree, still covered, however, by their watchful parent's wings. The turkey has many enemies beside man, and among those most feared by it are, perhaps, the lynx and great horned owl. The former sucks their eggs, and seizes both the young and old birds, his stealthy, noiseless progress enabling him to approach even so wary a bird unnoticed. The owl is equally dreaded, his soft plumage permitting him to fly about their roosting place without a sound, like some midnight sprite. The manner in which his attacks are evaded is both ingenious and successful, and is accomplished in the following way: As soon as the warning cluck of some watchful turkey has placed the whole number on their guard, they immediately stand upright upon the limb and observe every movement of their foe, who, soon selecting one of them for his prey, swoops upon it with the velocity of an arrow, and it would seem that the fate of that one was inevitable; but as rapid as was the owl's movement, still quicker is that of his intended victim; for, lowering his head and inverting his outspread tail upon his back, he meets his enemy with this inclined plane, over which he glides harmlessly, and the turkey drops to the ground and insures safety by running away. Many are the means employed to obtain possession of these birds, some of which are too often eminently successful; and also equally reprehensible, and although there may be instances, where turkeys are very numerous, that they may, to a limited extent, injure the growing crops, yet they are never so destructive as to render their almost complete extermination necessary. Many are trapped, sometimes whole flocks are captured at once in pens constructed for that purpose; and, in some parts of the country, man's ingenuity is exhausted in, seemingly, how to arrive, in the shortest possible time, at their extinction. The turkey is an extremely shy bird, taking alarm at the slightest sound; hence it can be readily understood how they would naturally shun man's presence, and prefer the depths of our great forests, or the solitude of the vast plains, and that, as a matter of course, they should become scarcer as the population near them increased, even though artificial means should be wanting to lessen their number. Audubon states that when he removed to Kentucky, rather more than a quarter of a century ago, turkeys were so abundant that the price of one in the market was not equal to that of a common barn fowl now; and that he has seen them offered for the sum of three pence each, the birds weighing from ten to twelve pounds. The average weight of this splendid bird is about fifteen to eighteen pounds (for the mature males), and the female from nine to ten. Some gobblers have been known to weigh much more than this estimate, and instances are not wanting where individuals have been obtained weighing thirty and forty pounds each; but this is rare. When full grown the male will measure four feet in length and nearly five feet in the stretch of its wings. The naked skin of the head and neck is blue, with the wattles red, as are also the legs. The feathers of the neck and body generally are a coppery bronze, changing in some lights to a greenish or purplish shade, and margined with an opaque line of velvet black. The back and rump are also black, with little reflection, while the sides, together with the upper and under tail coverts, are dark chestnut, barred with black near the end, and having metallic reflections of a rich purplish hue, while the extreme tips are opaque purplish chestnut. The tail feathers are dark chestnut barred with black, and tipped with a light chestnut. Near the end is a band of black, broadest on the outer feathers, and narrowing as it approaches the central ones. Between the bars on the feathers is a confused sprinkling of black. Neither upon the tail nor its coverts is there any white, and this is one of the ways by which the wild bird can always be distinguished from the domesticated. From the center of the breast hangs a long coarse hairy tuft, sometimes not found in the other sex. The female differs principally in being smaller in size, less brilliant in coloring, absence of the spur, and the small fleshy process at the base of the bill. But three species of this genus are acknowledged generally, the common wild turkey, already described, the Mexican Wild Turkey (*Meleagris Mexicanus*,) an inhabitant of New Mexico, resembling the preceding bird so closely that it would probably be considered identical by the casual or unscientific observer, and with habits also similar. The third species, called Ocellated Turkey (*Meleagris ocellatus*,) is a native of Honduras and other parts of Central America, is one of the most beautiful birds known to ornithologists, its feathers fairly blazing with metallic reflections of gold, green, blue, and bronze, while four series of ocellated spots, are found upon the tail and its upper coverts. But little is known of its habits, and comparatively few specimens have been obtained for scientific or other purposes. Careful breeding greatly improves the size of the turkey, especially in its native country. The heaviest turkey that has been known in England previous to 1853 weighed at death, thirty-two pounds. But that weight has been nearly doubled in this country. This result has been brought about by judicious crosses, and by reserving the best formed and heaviest birds of each year's raising for future breeding purposes. Experience also teaches conclusively that turkeys from two to five years of age are much better for breeding than young birds. The person who aims to breed good turkeys should select from two to six of the best females that he can procure, from two to three years of age; then procure a male turkey, not less than two years of age, and not related to either of his hens. Breed from the same birds for three or four years. During this time save a few of the finest young hens for future breeding, then when the old ones are discarded, procure another male turkey not related to the young hens. Afterwards it will only be necessary to procure a male bird once in three or four years, but never mate him with any of his own young. As to color, the breeder must select according to his own taste. Size of the young depends as much upon the hens as the cock. By following this simple rule, with high feeding and good care when young, the breeder will most assuredly have the satisfaction of increasing the hardiness and strength of the young chicks and the size of his mature Christmas roasters. The hen turkey possesses fair laying qualities, sits very steadily, and hatches in from twenty-eight to thirty days. As soon as the young poults are hatched, confine the turkey mother or hen in a large coop in a very dry, sunny place; never allow the young to run till after the dew is off, nor during rainy weather. One year old turkeys are found to be the best mothers, and gobblers should not be kept more than three years. The first day the chicks require no food. The second day they may have equal parts of egg and milk beaten together and baked into a custard, also what cracked wheat they will eat. This may be alternated with boiled oatmeal and milk. Green food must also be given them, such as chopped dandelion, lettuce, etc. They should be fed at least four times a day. The greatest care is required during the first two weeks of their growth, after which they may be allowed to ramble at will with the hen, being careful to feed them morning and evening. During the grasshopper season they will pretty well take care of themselves. The usual plan in the West is to allow the hen turkey to select her nest, hatch her brood, and pretty much care for them. In dry, warm, summer climates like the West, where there is plenty of range, we have found this the best, being careful to feed twice a day. In the autumn they may be fattened on whole corn or, better, be put in a tolerably dark place and fed with what cornmeal and oatmeal mush they will eat, being careful to supply them with clean, pure water. In raising turkeys they should be proportioned about ten or twelve hens to one cock. To save the trouble of watching them while seeking nests, prepare a yard of one-eight of an acre for every fifteen birds, wherein nothing else is allowed to go. The best arrangement for a nest is small houses, about three feet by three, gable-shaped, and three feet high in the center. Nests should be scattered about the yard, and, if convenient, partially hidden by brush. Turkeys, North, lay in April, and if two or three incline to one nest, set another box at right angles and adjoining the one they covet. Take away the eggs every night, and place them in parcels of sixteen or eighteen. Set several turkeys at the same time, as half a dozen flocks can be as easily cared for as one, and those hatched and taken off about the same time usually run together without fighting. As soon as they leave the nest, they should have a yard twelve feet square for every two turkeys, by setting up boards, a foot wide, endwise. The mother must be washed with tobacco-juice, and the young chickens dusted with snuff, to kill the lice, or sulphur and snuff, mixed in equal parts, sprinkled over the nest soon after the turkey begins to sit, and, as opportunity affords, dust the turkey herself. The young ones must be fed sparingly, at intervals of an hour, with coarse-ground Indian meal mixed with scalded sour milk curds, and fine-chopped hard-boiled eggs; in six or eight weeks they will be able to master grains of corn. They require watching for two or three weeks after being turned into the fields, lest they wander into heavy, wet grass and perish; and should be driven up every night and shut into a stable or barn. They will soon get accustomed to coming home, and in due time will aspire to a roost.

TURMERIC. The root of the *Curcuma longa.* This root yields a fine yellow powder, which is occasionally used as a dye-stuff and in medicine; it also forms one of the ingredients of curry powder. Paper stained with turmeric is often used in the chemical laboratory, as a test of the presence of free alkalies and their carbonates, by which its yellow color is converted into brown.

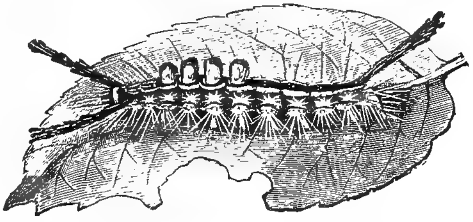
TURNER'S CERATE. Melt half a pound of yellow wax with two pounds of lard, and when cool work into the mixture half a pound of prepared calamine. It is used for excoriations, or galled places, burns, and is a mild astringent.

TURNIP. In England the turnip has been called the basis of successful agriculture. In the United States it is but little cultivated except as a culinary vegetable. There are three principal reasons why the turnip can not be made profitable in the United States, either of which would be fatal to its cultivation: 1. It requires a moist cool season for its development, found only in some extreme northern sections of the West, and the Atlantic coast. 2. The cost of cultivation as contrasted with corn. 3. The impossibility of feeding on the land as in England, in consequence of the extreme winter weather. Hence Indian corn is almost exclusively used, as a feeding crop, as it is also one of the most important of our cleaning crops as preparatory to wheat. In garden cultivation the seed is sown early in the spring on sandy soil, in drills eighteen inches apart and thinned to three inches in the row, kept clean, with level cultivation, and the bulbs pulled when two inches or larger across. For late use they are either drilled or sown broad cast, from July twentieth to August first, succeeding other crops. They are difficult to keep over the winter, owing to the fact that they sprout at a very low temperature. Hence they must be kept dry, and cooled down to as near the freezing point as possible. To save seed select the finest bulbs, set them in rows two feet apart by one foot in the row, just so the crowns show, and gather when the first pods show signs of opening—dry and thresh. The best garden varieties are Early Flat Dutch, Purple Top and White Top Strap Leaf.

TURNIP CABBAGE. Kohl rabi, which see.

TURPENTINE. A transparent, oleo-resinous substance, which exudes naturally, but is chiefly obtained by incision, from various species of pine. There are several kinds of turpentine, namely, Common, Bordeaux, Canadian, Strasburg, Venice, and American White. The Chian turpentine is the product of the *Pistachia terebinthus;* but all of them possess the same general and chemical properties.

TUSSOCK MOTH. The white marked tussock moth (*Orygia leucostigma*) is often most destructive in orchards Dr. Riley, in his First Missouri Report, describes them as follows: During the winter little bunches of dead leaves are found to be quite numerous on our apple trees. They are generally fastened to the twigs, and upon examination are found to contain gray cocoons. The greater portion of these cocoons have an egg mass glued to them, which is composed of numerous perfectly round, cream-colored eggs, of about 0.03 diameter, and partly covered with glistening white froth-like matter; while the other proportion of these cocoons have no such egg mass. About the middle of the month of May these eggs begin to hatch in different parts of the orchard for over a month. The young caterpillar which hatches from these eggs at first measures 0.10 in length, and is of a dull, whitish gray color, with the underside paler or of a dirty white, and with the tufts on the back of a dark brown. In two days after hatching, orange spots commence to appear along the back. On the seventh day after having remained stationary for about two days, fastened to some part of the tree with silk, it casts its skin for the first time, after which operation the hairs are more numerous, the dark portions more intensely black, the orange parts of a brighter orange, and the two tufts near the head longer. As it approaches the time of the second molt, the underside becomes more glaucous, a yellow line begins to appear at the sides, and in some cases the orange marks become yellow, with the exception of a small, perfectly round spot on the ninth and tenth segments, which always remain orange; the neck or first segment, where it joins the head also becomes orange or yellow. Six days from the time of the first molt the second molt takes place, the worm having become lighter colored by regular stages, each day. Six days after the second molt the third molt takes place with but little change in the appearance of the caterpillar, further than that the different colors become still more bright and distinct and the different tufts still larger. Up to this time all the individuals of a brood have been alike, and of a size, so that it was impossible to distinguish the sexes. Six days from the third molt, however, the males measure not quite three quarters of an inch, and begin to spin their cocoons; while the females undergo a fourth molt about this time, and in about six days more they also spin up, having acquired twice the size of the male when he spun up. The annexed figure represents the full grown female caterpillar, it differing from the full grown male only in its larger size. At this stage of its existence the caterpillar is a most beautiful object, with its vermilion-red head and collar, its cream-colored brushes and its long black plumes. When young these caterpillars make free use of a fine web which they spin, and by which they let themselves down when disturbed, and it is quite amusing to watch them ascend again whenever they have become sufficiently assured that there is no danger. It may puzzle some persons to divine how such a hairy and tufted caterpillar can possibly cast off its skin and yet retain these pretty appendages. After having remained stationary without food for about two days, the old skin becomes dry and somewhat loose. If at this time this old skin be carefully removed, it will be found that an entirely new set of these appendages has been forming underneath it; the two long plumes curled over the head, down by the feet and up again to near the scaly collar; the four white brushes folded close together inwardly crossing each other; the anal plume folded below the anus, and all the other hairs laid in thread-like bunches close to the body in a posterior direction. In due time the old skin splits on the back, near the head, and the caterpillar gradually works it off posteriorly. The moment they are exposed the appendages which had been compressed, as described, to the body, commence to straighten out, and in a few minutes the new dress is displayed in all its beauty and freshness. The long plumes at the head do not straighten out of their own accord, however, for the caterpillar by a curious curling of the body, while resting on a few of its abdominal prolegs, cunningly brushes them with its tail end, first on one side, then on the other. It furthermore presses them, for the same end, one after the other, against any surface on which it is at the time walking, and having once thoroughly straightened out its toilet it rests a few minutes from its efforts and then commences to feed with surprising vigor, apparently determined to make up for its two days' fast. The male cocoon is white or yellowish, and sufficiently thin to show the insect within it. It is formed of two layers, the outer one having the tufts and plumes which adorned the maker, scattered through it. The female cocoon is twice as large and more solid and dense. Soon after completing his cocoon the male changes to a chrysalis. The female, in due time, changes to a very different chrysalis. In about two weeks after spinning up, the moths begin to issue. In this state the sexes are still more dissimilar. The male produces a winged moth, while the female is furnished with but the merest rudiments of wings, and is destined to simply crawl to the outside of her cocoon, where, after the male has met her, she deposits her eggs, gluing and protecting them with the white frothy matter, which, has every appearance of spittle. In relation to remedies, Dr. Riley says: Dr. Fitch has described two parasites, which attack this caterpillar, and that he is acquainted with seven others, making in all nine distinct parasites, which prey upon this species. In collecting the

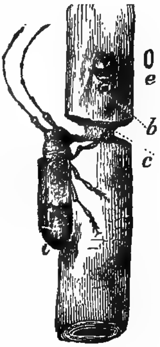


TUSSOCK MOTH CATERPILLAR.

cocoons in the winter in order to destroy them, none but those which have the egg-masses on them should be taken, as all the others, either contain the empty male chrysalis or else some friendly parasite. From the fact that the female never travels beyond her cocoon, it becomes obvious that, since the insect can only travel in the caterpillar state, it would require over a century for it to spread even a hundred miles. Hence we may rightly conclude that it has been introduced to different parts of the country in the egg-state on young imported trees. How essential it is then to examine every tree in planting out a young orchard, and how easy it is with the proper precautions to forever keep an orchard free from its destructive work. As already stated, the young worms let themselves down upon slightly jarring the tree, and though after the third molt they lose this habit to a great extent, yet they may always be brought down by a good thorough shake, and where they have once invaded an orchard, this will be found the most feasible mode of killing them; though prevention by destroying the egg-masses in the winter when they are easily discerned, is infinitely the best and surest remedy against its attacks. In dealing with all insects destructive to vegetation it is necessary to take them early, since then two ends are served: the product upon which they feed is saved and the insects are prevented from doing further damage. Hence the persistence with which the best cultivators hunt and destroy the perfect insect or egg of any species. This is the easiest and best plan in any case, for from the great number of eggs laid by individual species, the destruction of the female moths, butterflies or beetles, as the case may be, would soon decimate the species.

TUSSOCKS OF GRASS. Clumps or hillocks of growing grass.

TWIG GIRDLER. Dr. Le Baron, in his Fourth Illinois Entomological Report, says, of twig girdlers, the genus *Oncideres* contains three North American and many South American species. That known as the twig girdler, (*Oncideres cingulatus*) is the one known in the West, a cut of which is given: *b* shows the hole made by the insect; *c*, the manner of girdling below; *e*, egg natural size. The name is given from the habit of the female in girdling twigs below where she has deposited her eggs. It usually breeds in the hickory, but it has been known to girdle the twigs of the apple, the pear and the persimmon. The best remedy is to seek out and destroy the eggs, or better the female insect, wherever found.



TWIG GIRDLER.

TWITCH GRASS. Couch Grass.

TYMPANUM. The membrane of the ear which receives the vibrations of sound.

TYPES. In chemistry, a certain number of elements combined together, every one of which may be replaced by another and, indeed, every one in its turn, the arrangement of the elements in every case remaining the same with regard to each other, the type being no precise compound, but the manner of grouping. These new compounds (as when chlorine replaces hydrogen) have often the same properties as the original.

TYPHUS. Continued fevers, attended with great debility. They arise from impure air, bad food, etc., and are therefore often epidemic. Typhoid fevers, are those in which there is a tendency to great debility.

U

UDDER. The glandular organ of a cow, mare, ewe, or other animal which is destined for the secretion of milk. There are two or four teats, each of which consists of granular lobated glands, comprehending blood vessels, nerves, etc.

UDDER, INFLAMMATION OF. (See Garget.)

ULCER. An open sore discharging matter.

ULTIMATE ANALYSIS. The determination of the elements of an organic body.

UMBEL. In botany, a form of inflorescence in which all the pedicels proceed from a single point. If there is no subdivision, the umbel is called simple; but if the pedicels produce other umbels, as in parsley, the umbel is compound.

UMBELLIFEROUS PLANTS. *Umbelliferæ.* A race of great frequency in all cool or temperate climates, and even occur in hot ones, though much more rarely. They are known in general by their flowers being disposed in an umbel. They have an herbaceous stem; leaves usually much divided, often inflated when they join the stem; and they have universally a dry fruit, which divides into two seed-like pieces. Some of them are poisonous, as hemlock, fool's parsley and water dropwort; others are esculents, as celery, carrots and parsnips; many yield aromatic fruits, as caraway, coriander and anise; a few secrete a fœtid gum resin, of which assafœtida, ammoniacum and galbanum are examples. The species are extremely numerous, and difficult to recognize with accuracy; but those which grow in damp or wet places are to be suspected, whereas those that are aromatic and found in dry soils are often innocuous.

UMBILICAL CORD. In animals, the cord of blood vessels which passes between the placenta and fœtus; the navel string. In botany, the thread which attaches the seed to the carpel or placenta.

UMBILICUS. The navel.

UNCIFORM BONE. One of the bones of the wrist.

UNCONFORMABLE STRATA. The strata which do not incline or dip in the same direction as those below or above them.

UNDERDRAINING. A term applied to any covered drains, in which the flow of water may be more or less continuous. Stone, brush, slabs, boards, and other material facilitating the flow of water may be used, but tile is the best, as it is the cheapest material in the end where they may be procured. (See article Draining).

UNDERWOOD. Coppice, small trees, or shoots from old stools. Any thick undergrowth in forests.

UNGUIS. The claw or small extremity of a petal, where it is inserted into the stem.

UNGULATES. Those quadrupeds furnished with a hoof.

UNILOCULAR. Seed vessels which contain but one cavity.

UPAS. A Javanese tree (*Antiaris toxicaria*) from which the Upas poison is secreted.

UPONG. *Ilex vomitoria* and *cassena*. The black drink, medicine, or tea plant of North Carolina, used by the Indians.

UPRIGHT CHESS. (See Chess.)

UREA. A peculiar crystallizable substance held in solution in the urine. Urea is readily soluble in water, tasteless, inodorous, and when mixed with the other contents of the urine, very prone to putrefaction, the principal result of which is carbonate of ammonia.

UREDO. (See Fungus.)

URETERS. The tubes which convey urine from the kidneys to the bladder.

URETHRA. The passage from the bladder outward, for the discharge of urine.

URIC ACID, LITHIC ACID. An acid occurring in large quantity, combined with ammonia, in the urine of birds and reptiles, and to a small extent only in the urine of carnivorous quadrupeds. In the pure state it is a very insoluble white powder; it dissolves in nitric acid, and when evaporated to dryness and mixed with a little ammonia, gives a rich red color.

URINARY ORGANS, DISEASES OF. The diseases of the urinary organs are, in the horse, stone in the bladder, retention of urine or strangury, and profuse staling or diabetes. For stone in the bladder, a rare occurrence, a surgeon should be employed. The symptoms of the first are, stretching out, in an ineffectual attempt to urinate, with exhibition of pain. Sometimes the water will flow readily, and at other times scantily, or not at all. The ox tribe are also sometimes affected thus. In the latter case, it is better at once to fatten and kill. Strangury is occasioned from various causes, as paralysis of the bladder, meningitis, staggers, colic, and other acute diseases, and also from the effects of irritating drugs. If the difficulty is occasioned by palsy, the water may be drawn off by means of a catheter, but should be treated by a veterinary surgeon, the best means being by hypodermic injections under the skin. If it is due to general weakness of the bladder, two drachms of powdered camphor and one-half ounce of saltpetre may be made into a ball and given. If this do not give relief, try twenty grains of powdered cantharides and one drachm of powdered digitalis made into a ball with soap. For profuse staling, give the following, three times a day, in water: twenty grains of iodine, one drachm iodide of potassium, and four drachms carbonate of soda. For black water, a disease of the general system, but not common, to relieve the bowels, from four to six drachms of powdered aloes and one to two ounces of cream of tartar should be given in something less than a quart of water. If it do not act, repeat the dose, in any case assisting the operation by an injection of a quart of tepid soap suds to which is added three ounces spirits of turpentine. As the severe symptoms are relieved, assist the horse to rise, and use a tonic, say two drachms sulphate of iron and one drachm powdered nux vomica, given as a ball, with linseed meal and syrup. Rest, light nourishing food and good ventilation are necessary in treating this disease.

URINE. A saline fluid secreted from the blood of animals by the kidneys, collected in the urinary bladder, and emitted by the canal of the urethra. Urine differs in different animals, and varies in its characters, according to the kind of food employed. The usual salts contained in it are, sulphates, phosphates, and chlorides, all of which are fertilizing substances. The urine of oxen and horses undergoes decomposition less rapidly than that of carnivorous animals. It contains hippurates, but no lithic acid, that substance which forms red gravel in man. Practically it is of the most valuable of all manures, as the following analysis will show: Human urine contains,

Water	93.30
Urea	3.01
Uric acid	0.10
Lactic acid, lactate of potash, and ammonia	1.71
Mucus	0.03
Sulphate of potash	0.37
Sulphate of soda	0.32
Phosphate of soda	0.29
Phosphate of ammonia	0.16
Chloride of sodium	0 45
Chloride of ammonia	0.15
Phosphate of lime and magnesia	0.11
	100.00

The following table from Sprengel shows the composition of cow's urine, in the first column, when fresh; in the second, when putrefied alone; and in the third column, when putrefied with water. The amount being parts in 100,000.

Components.	When fresh.	Putrefied alone.	Putrefied with water.
Urea	4,000	1,000	600
Albumen	10	....	....
Mucus	190	40	30
Benzoic acid	90	250	120
Lactic acid	516	500	500
Carbonic acid	5256	16	1533
Ammonia	205	487	1622
Potash	664	664	664
Soda	554	554	554
Silica	36	5	8
Alumina	2	....	....
Oxide of iron	4	1	....
Oxide of manganese	1	....	....
Lime	65	2	8
Magnesia	36	22	30
Chlorine	272	272	272
Sulphuric acid	405	388	332
Phosphoric acid	70	26	46
Acetic acid (vinegar)	....	1	20
Sulphuretted hydrogen	....	1	30
Insoluble earthy phosphates and carbonates,	....	180	150
Water	92,624	95,442	93,481
	100,000	100,000	100,000

The next table will show the organic, inorganic, and total of solid matter in urine of seveeral animals and man, and amount voided in twenty-four hours.

Urine of	Water in 1,000 parts.	Solid matter in 1,000 parts.			Voided in 24 hours.
		Organic.	Inorganic	Total.	
Man	930 to 970	22 to 52	8 to 18	30 to 70	3 lbs.
Horse	886 to 940	27 to 79	33 to 45	60 to 124	8
Cow	880 to 930	50 to 70	20 to 47	70 to 120	40
Sheep	930 to 960	28 to 50	12 to 20	40 to 70	....
Pig	926 to 983	9 to 56	9 to 18	18 to 74	....

The urine of the horse is the most highly concentrated, that of the cow the most dilute, being double that of man, weight for weight, and twelve times that of the horse, depending, of course, upon the nature of the food used. It will naturally be seen, therefore, that urine should be applied in a very dilute state, since fresh urine is too concentrated to be applied directly to plants, and it is to the urea, which exists in much greater quantity than in other substances, that its fertilizing qualities are principally due. (See also articles Liquid Manure, Manure, and Top Dressing.)

URN. The small receptacle of mosses in which the sporules are placed. A vessel.

UROCERATA. The name of a tribe of the Terebrantia, or boring hymenopterous insects, in which the tenebra, or borer, of the females is sometimes very long and prominent, and composed of three filamentary processes, sometimes capillary, and coiled in a spiral form in the interior of the abdomen.

USTILAGO. A name given to certain fungi which produce the appearance of burning on the leaves of plants; fire blight. This term was formerly applied to burned ear, a disease of grain.

UTERUS. The womb.

UTRICLE, UTRICULUS. A one-celled, one or four seeded, superior membranous fruit, often bursting by a transverse suture. A little bladder.

UVA URSI. *Arbutus uva ursi.* Bear's berry. A small shrub, the leaves of which are used in medicine.

UVULA. The pendulous portion of the soft palate which hangs over the cavity of the pharynx.

V

VACUUM. A void space. The cavity of any vessel from which air has been extracted by the air-pump is called a vacuum.

VAGINA. A sheath; the passage from the uterus outward.

VAGINA, INFLAMMATION OF. This a rare disease; and usually due to injury to the parts by violence of the male, but occasioned by other violence, difficult labor, or by the presence of cancer or ulcers. There is tenderness, swelling of the parts and the extrusion of watery or purulent matter. In cases of simple inflammation if the discharge is foul, solution of sulphate of zinc, as recommended for inflammation of the yard, may be used, careful but repeated injections being made, so as not to further irritate the parts. In milder cases, slippery elm or linseed tea, with a drachm of sugar of lead to the pint may be used. If ulcerous, or cancerous, proceed as advised in inflammation of the sheath, always seeking the services of a veterinarian if possible.

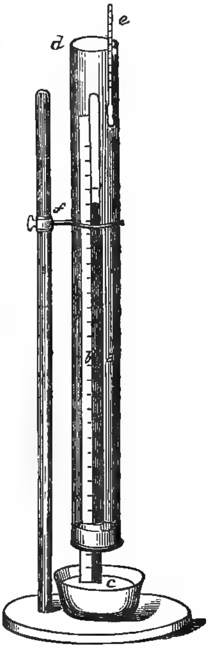
VALERIAN. *Valeriana officinalis.* A perennial herb, the root of which is a nervous stimulant.

VALLESNERIA. A genus of water weeds.

VALVE. In mechanics and zoology, a flap or small door opening only in one direction, and serving to close a tube or passage. There are many kinds of valves, as the door valve, the sliding valve. In botany, the pieces into which dry fruits or anthers burst naturally, are called valves.

VANILLA. The succulent fruit of the *Epidendron vanilla,* an orchideous climbing shrub of Mexico and tropical America. The seeds have aroma, and are used in flavoring.

VAPOR. The late Prof. Henry, Secretary of the Smithsonian Institution, Washington, has contributed much valuable literature on meteorology to what has been known before. The subject of vapor is an important one in agriculture, and hence we extract, from an article by the distinguished scholar, what relates to vapor: The great motive power which gives rise to the various currents of the aerial covering of our globe is the unequal distribution of the heat of the sun; the elevated temperature of the equatorial regions heating the air causes it to ascend and flow over toward the pole, while the cold of the frigid zone produces a condensation of the air, which gives rise to downward currents in that region, and a spreading out there in all directions toward the equator. The simplicity of this movement is first interfered with by the motion of the earth upon its axis, which gives to all the currents flowing towards the equator a curvature to the west, and to all those flowing from the equator a curvature to the east. Another perturbing influence, which has been mentioned, is the unequal heating of the several parts of the different zones of the earth, consisting as they do of alternations of land and water. But the great perturbing cause is the varying quantity of moisture which exists in the atmosphere, and which, by its increase and diminution, gives rise to the varying conditions of the weather, and produces the fitful and almost infinite variety of meteorological changes which occur at different times and in different places. We shall principally devote this article to an exposition of the phenomena of the vapor of the atmosphere, including that of the various aqueous meteors, such as rain, hail, hurricanes, tornadoes, etc. The meteorology of the United States, as well as its geology, is exhibited on a large scale, and affords one of the best fields on the surface of the globe for studying the general movements of the atmosphere. The subject has attracted much attention on this side of the Atlantic, and a number of laborers have devoted themselves to it with ardor and success; but we regret that the discussions, which unavoidably arise among different investigators, have not always been carried on with calmness and moderation with which the pursuit of truth should always be conducted. Indeed, meteorology has ever been an apple of contention, as if the violent commotions of the atmosphere induced a sympathetic effect in the minds of those who have attempted to study them. We have no hypothesis of our own to advocate; and while we attempt to reduce the multiplicity of facts which have been collected in regard to this subject to general principles, we shall aim at nothing but truth, and endeavor to select from the various hypotheses which have been proposed, such as, in our judgment, are well founded on the established laws of force and motion, and which give the most faithful and explicit expression of the phenomena. We shall be ready at any time to modify or change our views as soon as facts are discovered with which they are incompatible, and indeed we shall hold most of them as provisional truths, which may serve to guide our inquiries, and which are to be established, modified, or rejected by the results of subsequent induction. The statement may be repeated, which has been previously made, that while the general principles of meteorology are well understood, the facts relating to it, on account of the variations and multiplicity of condition, are the most complex of those of any branch of physical science. It has been properly said that astronomy is the most perfect of all branches of knowledge, because its elements are the most simple; and we may say, for a like reason, that meteorology is the least advanced, because its phenomena depend upon the concurrence of so many and such a variety of causes. The air at all times contains water in an elastic, invisible state, called vapor. To prove this, it is sufficient to pour into a bright metallic or glass tumbler a quantity of cold water, the outside of which will become covered with dew. If the vessel were pervious to the liquid, we might suppose the water which appears on the outside to come from within, but this can not be the case with a metallic or glass vessel, and the only source to which we can refer the dew is the atmosphere. The stratum of air immediately around the vessel is cooled by contact with its sides, and a portion of its vapor reduced to water. The air thus cooled becomes heavier, sinks down along the side of the tumbler, and gives place to a new portion of which the vapor is also condensed; and in this way the process is continued as long as the temperature of the water is below that of the surrounding air. If the water which trickles down the side of the vessel is chemically examined, it will be found in some cases almost entirely pure, and in others contaminated by animal and other effluvia which are diffused in the atmosphere. If the experiment be made on different days and at different seasons, we shall find a greater or less reduction of the temperature of the liquid within the tumbler is required in order to produce a deposition of the vapor. The greater the number of degrees of this reduction of temperature, the greater will be the evaporation from a given surface of water, and the more intense will be the different effects which depend on the relative dryness of the air. If the experiment be made in summer, and we find but a small reduction of temperature is necessary to produce the deposition of moisture on the outside of the tumbler; and if we attend to the state of our feelings at the same time, we shall experience that peculiar sensation which is referred to what is called the closeness or sultriness of the atmosphere, and caused, by the large amount of vapor with which it is charged. To understand even approximately the effects due to the vapor in the atmosphere, water in an aeriform condition as it exists by itself or separated from the atmosphere; and for this purpose we may employ the ingenious method devised by Dr. Dalton, of Manchester, England, to whose researches in meteorology and other branches of physical science we are more indebted than to those of almost any other individual of the present century. He employed in these researches, a glass tube of about forty inches in length, closed at one end, and filled with dry and warm mercury. The tube thus filled was inverted with its lower end in a basin of the same metal, and thus formed an arrangement similar to that of an ordinary barometer, in which the pressure of the air, as is well known, forces up the mercury and keeps it suspended at an elevation of thirty inches, when the experiment is made at the level of the sea. The space above the mercury is a Torricellian vacuum; that is, a space void of all gross matter, save a very attenuated vapor of mercury, which can also be removed by a reduction of temperature below the fiftieth degree of Fahrenheit's scale, but the correction on this account is so small that it may be neglected. Into this vacuum Dr. Dalton introduced a very small quantity of water, by forcing it from a small syringe into the mercury at the base of the column, whence it rose to the surface and was attended with an immediate depression of the mercurial column, which, when the temperature of the room was at 60°, amounted to nearly half an inch. By this experiment, it was proved that water, at the ordinary temperature, when the pressure of the air is removed, immediately flashes into steam or vapor, and that the atoms of this vapor repel each other, thus producing an elastic force which depresses the column of mercury. In this experiment, the quantity of water introduced was but a few grains, yet it did not all flash into vapor, but a portion of it remained in the form of a thin stratum of liquid on the surface of the mercury. Its weight, however, was insufficient to produce the observed descent of the column, and its effect in this respect could readily be calculated, since its weight was known. The descent of the mercury was therefore due to the repulsion of the atoms of vapor, and the former afforded an accurate measure of the comparative amount of this force. The tube, as we have stated, was forty inches long; and since the column of mercury at first occupied but thirty inches of its length, the extent of the vacuum before the introduction of the water was ten inches, and afterward ten and a half inches. That the depression of the mercury is an exact measure of the elastic force or repulsion of the atoms of the aqueous vapor, will be evident when we consider that if we remove the vapor the column will rise to thirty inches, and will then be exactly in equilibrio with the pressure of the external atmosphere; or, in other words, the two are in exact balance; but if, after the introduction of the vapor, the column is reduced half an inch in height, it is plain that the force which produces this effect must be just equal to the weight of this amount of mercury. Dr. Dalton next diminished the length of this vacuum by plunging the lower end of the tube deeper into the basin of mercury, and thereby causing the upper end of the column to be projected farther into the tube; but this produced no difference in the height of the column, the top of which was still depressed to half an inch below the normal height of thirty inches. From this experiment we infer that the repulsion of the atoms of vapor can not, like that of the atoms of air, be increased by external pressure; for when we attempt to coerce them into a smaller space by external pressure, a portion of them is converted into water, and the atoms which remain in the aeriform condition exert the same amount of presure as before. Dr.



DALTON'S BAROMETER.

Dalton next increased the temperature by surrounding the tube containing the mercurial column with a larger tube filled in succession with water of different temperatures; this produced for each temperature a difference in the depression of the height of the column; and when the water was at the temperature of 100°, the depression, instead of being half an inch, was almost precisely three times as much. The cut represents the apparatus employed by Dr. Dalton, in which *a*, is the barometer tube filled with mercury to the height of *f*, and its lower end plunged into the basin of mercury *c*. The graduated scale for measuring the height of the column is denoted by *b*. The larger tube around the barometer tube to contain the water of different temperatures is denoted by *d*. A thermometer, *e*, is inserted at its upper end by which to ascertain the temperature of the enclosed water and, consequently, that of the vapor within the barometer. With this simple contrivance, Dr. Dalton made a series of experiments to determine the repulsion of the atoms of steam; or, in other words, the elastic force of aqueous vapor, corresponding to the different degrees of Fahrenheit's scale from zero up to the boiling point. To facilitate the operations and to allow for any changes that might take place in the pressure of the atmosphere during the continuance of the experiment, another tube was placed beside the first, in the same basin, and the descent of the mercurial column of the first tube estimated from the top of that in the second, which, to render the measure more gradate, may be effected by means of a small telescope, sliding on an accuated rod, and movable in a horizontal plane. By placing water of a given temperature within the outer tube and then gradually cooling it after each observation, and finally filling the same tube with freezing mixtures, a table similar to the following was constructed. Dalton's experiments, however, have been repeated with additional precautions by other scientists and particularly by M. Regnault, from whose work the table on page 997 has been compiled, giving the elastic force of aqueous vapor, in English inches of mercury, temperature of Fahrenheit's scale's. The first column of the table gives the temperature of the water and vapor in the Torricellian vacuum for every ten degrees; the second, the depression of the mercury or the elastic force of the vapor, corresponding to the several degrees of temperature of the first column. The remaining columns give the depression of the mercury for the intermediate degrees, this arrangement being adopted to save space. For example, if we wish to know the elastic pressure of vapor at the temperature of 70°, by looking opposite to 70°, in the second column, we find 0.733 or nearly seven-tenths and a third inches of mercury. Again, if we wish the amount of repulsive force of the atoms of vapor at the temperature of 86°, we cast our eye along the line of 80°. until it comes under the 6°, which is at the top of the table, and find 1.242 or very nearly an inch and a quarter as the height of a column of mercury which vapor of water will sustain without being condensed into a liquid, at the temperature of 86°. By looking along the table it will be seen that there are equal increments of elastic pressure. Thus, while the elastic force of vapor at 20° is sufficient to depress the mercurial column a little more than one-tenth of an inch, at 40° it supports nearly two and a half times as much, at 60° five times, at 80° ten times, and at 100° nineteen times. The reason of this is not difficult to understand, since it is evident that the elastic pressure of the vapor must be increased by the action of two causes: First, by increasing the temperature, the vapor tends to expand just as air would do under the same circumstances; and second, by the same increase of temperature, a new portion of water is converted into vapor, which, being forced into the same space, increases the density, and consequently, the elasticity of the vapor which existed there before. Dr. Dalton also showed that there is a remarkable difference between vapor which exists over water, and vapor separated from the liquid from which it is produced. In the first case, as we have seen, every increase of temperature causes the formation of a new quantity of vapor, which serves to increase the density and consequently the repulsive energy of the vapor previously existing. Hence, as we have shown before, the expansive power of vapor or steam increases in a geometrical ratio, while the temperature increases in an arithmetrical ratio, that is, an addition of a few degrees of heat produces more than a proportional degree of elastic force. The case, however, is very different with vapor separated from the water from which it is produced; it then obeys the same law as atmospheric air, and increases in elasticity with equal additions of temperature. The atmosphere increases its elastic force by one four hundredth and ninetieth part for every degree of Fahrenheit above the freezing point; the vapor of water follows the same law. The table as given is limited to 100°, and is sufficient for resolving problems relative to the hygrometrical condition of the atmosphere. It is, however, important for the use of the steam engineer that it should be extended to a much higher degree, and accordingly experiments have been made for this purpose by a number of persons, and particularly by M. Regnault at the expense of the French government. From that table we may see that, at the temperature of 212°, the elastic force of vapor balances thirty inches of mercury and is then just equal to the pressure of the atmosphere. This fact gives the explanation of the phenomenon of boiling, since the vapor formed at the temperature of 212° has just sufficient repulsive power to expand beneath the pressure of the atmosphere, and to pass up in volumes through the water, giving it the peculiar agitation known as boiling. It is further evident from the same table that vapor is given off from ice, even at zero or 32° below freezing point; if, therefore, a lump of this substance in a cold day be placed under the receiver of an air pump, even when the apparatus is cooled down to zero, a portion of it will immediately spring into vapor, sufficient to fill the whole capacity of the cylinder, when the air is withdrawn; and if this vapor in its turn be removed by working the pump, another portion of the ice will pass into the state of vapor, and if the pressure of this be removed, another quantity of ice will be evaporated; and if the pumping be continued sufficiently long all the ice will be dissipated in vapor without passing through the intermediate condition of water. Instead of continuing to work the pump, in order to evaporate the ice, we may produce the same effect by placing within the receiver a broad dish containing sulphuric acid, which will absorb the vapor as fast as it is formed. We may, however, convince ourselves immediately of the evaporation of ice by exposing a given weight of it during a cold day in the shade while the temperature is below freezing. It will be found sensibly, though slowly, to diminish in quantity. The same effect, however, is exhibited in the process of drying clothes in cold weather, which though they may be stiffened by the frozen water with which they have been wetted, soon become dry and pliable by the evaporation of the ice. The apparatus of Dr. Dalton enables us to make the following experiment, which has an important bearing on some of the phenomena of meteorology: If, while the column of mercury is at the temperature, for example, of 60°, and a small quantity of water is resting on its upper end, the space above being filled with vapor due to this temperature, we place under the lower end of the tube beneath the surface of the mercury a small crystal of common salt it will rise through the mercury by its specific levity, and be dissolved in part or whole by the stratum of water at the top. Now, as soon as this solution begins to take place, we shall see the column of mercury ascend; a portion of the vapor will be absorbed, and the tension of the remainder be diminished. In this case, the attraction of the salt for the particles of water neutralizes a part of their repulsive force and thus diminishes the weight of mercury the vapor can support. For the same reason, salt water boils at a temperature several degrees higher than 212°, though the vapor produced in this case has only the elastic force of that due to pure water. From the foregoing we conclude that the quantity of vapor from the surface of the ocean is less and has less tension and density, than that from the surface of fresh water lakes, at the same temperature. The table which was furnished by Dr. Dalton, and has since been corrected by more refined experiments, is of great value in various branches of science. The very simplicity of the method employed is an evidence of scientific genius of the highest character, and is well calculated to excite our admiration, as well as to call forth our gratitude, on account of the important truths it reveals. Dr. Dalton, although thoroughly imbued with a love of science for its own sake, and a profound thinker, was eminently a practical man, in the proper sense of the term. He had not only the sagacity to frame significant questions to be propounded to Nature, but also the ingenuity to devise simple means by which the answers to these questions would be given in terms the most precise and accurate. Again, there is another circumstance in regard to vapor which is of essential importance in understanding the part which it plays in producing the diversified changes of the weather, namely, the great amount of heat which it contains at different temperatures. It is well known that the quantity of heat that a body contains is not actually measured by the thermometer or the temperature which it exhibits; for example, if a cubic foot of air at 60° be expanded without receiving or losing heat, its temperature will be much diminished, because the same amount of heat which was before contained in a given space is now distributed through a larger space. If an ounce of steam from boiling water, which indicates a temperature of 212°, be condensed in water at 60°, it will give out to the latter enough heat to elevate six times the quantity of water to the boiling temperature; that is, six times as much water through 152°, or the same amount of water 912°; or, in other words, after having given out more than 900° of heat in the act of being converted from a vapor to a liquid, it still retains a temperature of 212°. The heat which is thus set free, and has not been recognized by the thermometer, is called latent heat. In thus condensing a given quantity of vapor, from water at different temperatures, in a given quantity of cold water, and noting the elevation of temperature of the latter, it has been shown by Dr. Dalton and others that an ounce of vapor at all temperatures contains very nearly the same amount of heat, adding the latent and sensible heat together. This constancy of the amount of heat arises from the fact, that as we increase the thermometric heat a new portion of vapor is forced into the same space, its density increases, and the amount of latent heat is diminished; hence if the attenuated vapor from ice were received in a syringe, and suddenly condensed until its density became equal to that

Degrees Fahrenheit.	0° Fahr.	1° Fahr.	2° Fahr.	3° Fahr.	4° Fahr.	5° Fahr.	6° Fahr.	7° Fahr.	8° Fahr.	9° Fahr.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
0............	0.043	0.045	0.048	0.050	0.052	0.055	0.057	0.060	0.062	0.065
10............	0.068	0.072	0.075	0.078	0.082	0.086	0.090	0.094	0.098	0.103
20............	0.108	0.113	0.118	0.123	0.129	0.135	0.141	0.147	0.153	0.160
30............	0.167	0.174	0.181	0.188	0.196	0.204	0.212	0.220	0.229	0.238
40............	0.248	0.257	0.267	0.277	0.288	0.299	0.311	0.323	0.335	0.348
50............	0.361	0.374	0.388	0.403	0.418	0.433	0.449	0.466	0.482	0.500
60............	0.518	0.537	0.556	0.576	0.596	0.617	0.639	0.662	0.685	0.708
70............	0.733	0.758	0.784	0.811	0.839	0.868	0.897	0.927	0.958	0.990
80............	1.023	1.057	1.092	1.128	1.165	1.203	1.242	1.282	1.323	1.366
90............	1.410	1.455	1.501	1.548	1.597	1.647	1.698	1.751	1.805	1.861
100............	1.918	1.977	2.027	2.099	2.162	2.227	2.293	2.361	2.430	2.501

of boiling water, its temperature would be 212. On account of the great amount of latent heat of vapor, heat must be absorbed from all surrounding bodies during the process of evaporation; and in all cases of the reverse process, that is, of the conversion of vapor into water, an equal amount of heat must be given out. This absorption of heat by vapor at the place of its formation, and the evolution of an equal amount at the place where it is condensed into water, is one of the most efficient means of varying the temperature of different portions of the earth from that which they would naturally acquire under the regular periodical variation due to the changes of declination of the sun. In the evaporation of a cubic foot of water it is known from experiment that an amount of heat is absorbed equal to that evolved from the combustion of twenty pounds of dry pine wood, and consequently every cubic foot of rain water which falls from the clouds leaves in the air above an equal amount of extraneous heat, which tends to abnormally raise the temperature due to the elevation, and to produce powerful upward currents above, and horizontal motions of the air below. We may also recall in this place the fact that water, in passing from the state of ice to that of a liquid, absorbs 140° of heat, which is again evolved in the act of freezing, and that this also is an efficient means by which colder portions of the earth are mollified in temperature. We are also indebted to Dr. Dalton for another important series of experiments, which relate to the mingling of air and vapor. In the experiments before given the vapor was weighed and its temperature and tension determined in a separate state and unmingled with the air. To ascertain the effect which would be produced on the tension of vapor when suffered to be exerted in a space already occupied with air of different densities, Dr. Dalton employed the same method of experimenting previously described. A barometer tube was filled and inverted in a basin of mercury, a quantity of air was then admitted, which, rising into the Torricellian vacuum, pressed by its elasticity on the surface of the mercury and caused it to descend a given number of divisions of the scale, which were accurately noted: a small quantity of water was next admitted, which, rising to the top of the mercurial column, was, after a few moments, in part converted into vapor, while the mercury was observed to be depressed. When the experiment was repeated with different quantities of air above the mercurial column and at different temperatures, produced by varying the heat of the water in the external tube, or, which would amount to the same thing, by varying the temperature of the room, the remarkable fact was discovered that the depression of the mercurial column, due to the introduction of the water, was precisely the same at the same temperature as when the experiment was made with a vacuum; for example, at the temperature of 60°, whatever might be the elasticity of the air within the tube, the introduction of the water always gave an additional depression of half an inch. From this result the important fact is deduced, that the tension or elastic force of vapor in air is the same as that of vapor in a vacuum; from which we might also infer that the quantity of vapor which can exist in a given space already occupied with air is the same as that which can exist in a vacuum at the same temperature. Now, this fact may be directly proved. How? A determinate result may be obtained by the following method, which also gives us an independent means of determining directly the amount of vapor which exists in the atmosphere at a given time, and which may be employed for verifying the results obtained by other means: Let a tight cask, furnished with a stop cock near its lower part, be entirely filled with water, and let the small end of a tube, which has been drawn out in a spirit lamp, be cemented into the vent-hole above, so that no air can enter the cask except through the tube. Let this tube be filled with coarsely powdered dry chloride of calcium—a substance which has a great affinity for moisture—and the upper end put in connection with an open vessel containing air entirely saturated with moisture, which can readily be effected by agitating a quantity of the liquid in the vessel from which the air is drawn; let the stop-cock be now opened, and exactly a cubic foot of water be drawn into a measured vessel, it is evident that precisely a foot of air will enter the top of the cask through the tube and between the interstices of the pieces of chloride of calcium, the moisture will be absorbed and its weight can be accurately ascertained from the increase of weight of the tube and its contents, which had previously been weighed for that purpose. By this simple experiment, as well as by the one we have previously given, we are enabled to conclusively prove that the weight of vapor contained in the air, in a given space, is the same as that which would exist at the same temperature in a vacuum. To render, however, the result of this experiment absolutely perfect, a slight correction must be made on account of the expansion of the air and the vapor due to the increased repulsive energy of the compound over that of the air itself. This will be evident from a due consideration of what follows. If into an extensible vessel, such as an India-rubber bag filled with air, a little water be injected, the bag will be suddenly expanded by the additional repulsive force of the atoms of vapor. Previous to the introduction of the water the bag will be pressed equally on the outside and on the inside; on the former by the weight of the external atmosphere, and on the latter by the repulsive or elastic force of the atoms of the enclosed air; when the water is introduced and a portion of it springs into vapor, the elastic force of the aqueous atoms must be added to that of the atoms of the air, and the interior will then be pressed outward with a force equal to the sum of the two repulsions. For example, if the experiment be made at sixty degrees and the air at its normal weight, the outward pressure within the bag previous to the introduction of the water will be equal to thirty inches of mercury, but after the water is injected it will be thirty inches and a half; hence expansion will take place and the bag will be distended until, by the separation of the interior atoms, the repulsion is so much weakened that the pressure without and within will again be equalized. The amount of the increase in bulk will be given by the following proportion: as the pressure of thirty inches of mercury is to the pressure of thirty and one-half inches, so is the original bulk of the India-rubber bag to its bulk after the introduction of the vapor. From experiments and observations it is evident that in free air the vapor exists as an independent atmosphere, being the same in weight and in tension as it would be in a vacuum of the same extent and the same temperature. That the same amount of vapor can exist in a space filled with air as in a vacuum, at first sight appears paradoxical, but when we consider that a cubic inch of water expanded into steam at 212° occupies nearly 1,700 times the bulk which it does in the form of water, also that air may be compressed into a space many hundred times less than that of its ordinary bulk, it is evident that the extent of the void spaces is incomparably greater than the atoms themselves, and, consequently, it is not difficult to conceive that the atoms of the vapor have abundance of space in which to exist between the atoms of air and the atoms of air between those of vapor. Dr. Dalton announces this important truth by stating that air and vapor and almost all gases are vacuums to each other. This enunciation is a true expression of the state of diffusion which gases and vapors attain after the lapse of a given time, but it does not truly express the phenomena of the act of diffusion. In a perfect vacuum a given space is filled with vapor almost instantaneously, or with a rapidity which has not yet been estimated, but this is not the same in a space already filled with air. In this case, though the vapor ultimately diffuses itself through the air as it would do in a vacuum, yet time is required to produce this effect; the result is as if there were a mechanical or some other obstruction to the free passage of vapor through the different strata of air, and, indeed, it would appear from the following experiments that a definite force similar to that produced by a slight attraction or repulsion, is offered in the resistance of a given thickness of this medium: In the laboratory of the Smithsonian Institution, a glass tube of about three feet in length, closed at its lower end, suspended vertically, and containing about an inch of water, has remained for several years undisturbed in this condition, without the least perceptible diminution in the amount of the liquid. In another experiment, a pane of glass was removed from an external window of a room, and the place of the glass supplied by a board, through the middle of which a hole of about an inch in diameter was made, and in this opening a tube was placed horizontally, one end being in the room and the other in the outer air. To each end of this tube a glass bulb was attached, air-tight, the one within the room containing about an ounce of water, while the tube and the bulb on the outside were occupied with air. The temperature of the air within the room was, on an average, about seventy degrees, while that of the air without was, on an average, nearly thirty-two degrees, and although the experiment was continued for several months during the winter, not one drop of water was distilled over into the outer bulb. When, however, the latter was surrounded by a freezing mixture, a small quantity of vapor did pass over and was condensed into water and also when the vapor as contained in the outer bulb was absorbed by introducing a quantity of strong sulphuric acid into this bulb, the water in the other bulb gradually diminished in weight. From these experiments it would appear that there is more than a mechanical obstruction to the transfusion of vapor through air, and that if the difference of tension of vapor in two vessels only amounts to a certain quantity, no transfusion from one will take place to the other, or, in other words, for each inch or foot of thickness of a stratum of air, a certain amount of unbalanced repulsive energy is required for transfusion. The rapid mingling of vapor with air is due, in a considerable degree, to the currents produced by the mixture itself, and by variations of temperature. It is not upon the actual amount of vapor which the air contains at a given time or place that its humidity depends; but upon its greater or less degree of saturation. That air is said to be dry in which evaporation takes place rapidly from a surface of water or moistened substance. In an atmosphere entirely saturated with vapor, that is, in one which is filled with as much vapor as the space which it occupies can contain, the vapor already in the air by its elastic force presses on the surface of the moist body and neutralizes the repulsive action of the water; if, however, the temperature be raised, the elastic force will be increased and a new portion will be forced into the same space; the further, therefore, the condition of any portion of air is from saturation the more rapid will be the evaporation from the moist bodies which it surrounds. For example, a portion of air at a temperature of 100° would contain vapor of an elastic force, were it entirely saturated, equal to a pressure of two and a half inches of mercury. If the same air, however, only contained vapor of the elastic force of 60°, or, in other words, if the dewpoint was at 60°, the elastic force would be half an inch, and consequently there would be a force unbalanced by the pressure of vapor equal to the pressure of a column of two inches of mercury. The dryness, therefore, of the air is estimated by the difference of the elastic force of the vapor due to the temperature of the air, and of the elastic force due to the tension of the dewpoint. In meteorological works generally, when a portion of the atmosphere contains vapor equal in tension to that of the temperature of the air, it is said to be, as we have before observed, fully saturated, and its humidity is marked 100; but if the elastic force of the air as determined by the dewpoint is only one-fourth of that necessary to produce complete saturation, the relative humidity is marked 25. To find, then, the relative humidity at any time, we seek from the tables the tension of vapor due to the temperature of the air, and again due to that temperature to which it must next be cooled down in order to produce precipitation, or full saturation, which temperature, as we have seen, is that of the dewpoint. We then say, as the tension of the first temperature is to 100, so is the tension of the other temperature to the per centage of saturation. In this way comparative tables of relative humidity for different places are calculated from actual observation.

VARIETIES IN VEGETATION. This is an important subject and one in which every cultivator of the soil is interested. In addition to what has been heretofore given in this work we append a synopsis of facts and conclusions derived from various authentic sources, which will be of value. The origin of varieties is a subject of deep interest, and, perhaps, less understood than almost any other. A species, unlike a true hybrid, will always reproduce itself from its seed. and for an indefinite period. The plants which are raised from its seeds will not, however, be exactly like the parent species, but will differ in some particulars, as form, size, color, quality of fruit, but not in its original type, or material in its organic structure. These particular differences which have been enumerated constitute varieties, forms that are not monstrous, enduring only for a time and then disappearing, but the natural outgrowth of seed, not produced by a direct fiat of the Creator, as the species are supposed to have been, but by an inherent energy, acting by determinate laws, modified by the conditions in which they are placed, as soil, climate, and other extraneous influences which are too latent for us to comprehend. Varieties may also be obtained by cultivation and selection. It is sometimes said that God created the species of man and the varieties. There is no doubt that man, by means of cultivation, is a most powerful agent in the production of varieties. As the mind of man, when under powerful excitement, will make great intellectual efforts, such as it never made before, so a plant under the stimulus of high cultivation, will make an extraordinary development, often in a direction not expected, and produce a new variety which it never would have originated if it had been left alone in a wild state. The process pursued in this mode of producing varieties is to select the best fruit of any species or variety, and sow the seeds in a soil properly prepared for their most vigorous growth; then, again, selecting the best fruit from the new plants and planting the seeds, thus continuing the operation till the desired variety is obtained. Such varieties are sometimes called seedlings, because they are raised from the seeds, without any artificial process of hybridizing or cross-breeding. This process of producing new varieties has been carried on very extensively, and with wonderful results, and it would be very difficult to assign the limits to which the improvement may be carried. Prof. Von Mons, a distinguished pomologist, of Belgium, cultivated the pear very extensively in this way, and with good success. He began by sowing the seed of a healthy seedling pear which approximated nearest to the original species of any which he could find, without taking a wild one, supposing that by this course he could get some varieties different from any which had been seen before. In the fifth generation he obtained some excellent fruit, although he carried the process even to the seventh generation. He did not preserve every one of the multitude of plants which he raised from the seeds, till it matured fruit, but those which were feeble, or did not have the characters that he deemed essential for the production of good fruit, were destroyed; and so accurate had his observation become by long experience that, as he informs us, he could tell by the form of the leaf, the color of the branches, or the spreading of the top, whether the fruit would be good or not. He observed that, while the plant of the first generation was about seven years in coming into bearing, the time was diminished for each succeeding one, so that in the seventh it took only about four years. It would probably not be best for the common experimenter to begin by sowing the seeds of an uncultivated variety, as Prof. Von Mons did, but to select the best, thus appropriating to himself what had been gained by cultivation, although he might not, perhaps, obtain anything so entirely distinct from existing varieties as was done in the case of Prof. Von Mons. We have every reason to suppose that the Persian or European vine (*vitis vinifera*) has been brought to its present state of perfection from a wild grape; for it has been cultivated in Egypt from the remotest antiquity, and Egyptians declare that Osiris first taught them its use. It had been cultivated in Asia 800 years before those pious leaders and shrewd statesmen, Joshua and Caleb, visited the valley of Eshcol and brought away one cluster, so heavy that it was borne between two upon a staff. It grows to an enormous size when under cultivation. Schulz says he supped under a grape-vine in Palestine the stem of which was a foot and a half in diameter, the height thirty feet, and its branches formed a canopy thirty feet in diameter. The clusters, he adds, are so large that they weigh ten or twelve pounds, and the berries may be compared with our large plums. A gentleman from California, of undoubted veracity, informs me that he has seen a foreign vine in that State, planted a century or more ago by the Jesuit missionaries, which has a diameter even greater than this. There are few plants more inclined to vary or sport than the grape. All the European varieties, which vary so much in color and sweetness, have been produced from the same species, and sometimes white varieties and black have grown on the same stalk. The following are some of the varieties derived from the *Vitis labrusca:* The Adirondac Anna, Cassady, Catawba, Concord, Christine, Creveling, Diana, Dracut Amber, Hartford Prolific, Iona, Isabella, Israella, Ives' Seedling, Lydia, Maxatawny, Rebecca, Union Village, etc. From the *Vitis cordifolia,* originated the Clinton, Franklin, and Taylor's Bullet. From the *Vitis æstivalis* we have the Alvey, Devereaux, Herbemont, Norton's Virginia and others. (See article Grape.) Many of our useful as well as ornamental plants vary much by change of habitat and by culture. The cabbage, in its wild state, had scarcely any head. The beet, carrot, parsnip, and turnips had roots no larger than the common thistle, (*Cirsium arvense*). The tubers of the potato were but little larger than the groundnut, (*Aralia trifolia,*) and the tomato bore fruit very much like the potato-ball, but now, by cultivation and selection, it has acquired a size of more than six inches in diameter. The strawberry has become many times larger than in its natural state. Prof. Buckman, of England, in a few years converted, by cultivation and careful selection, the wild parsnip into new and good varieties. M. Vilmorin produced the same change in the wild carrot in a few generations. Winter wheat and spring wheat may be converted into each other. M. Monnier sowed winter wheat in spring, and out of 100 plants four alone produced ripe seeds; these were sown and resown, and in three years plants were reared which ripened all their seed. Conversely, nearly all the plants raised from spring wheat which was sown in autumn, perished from frost; but a few were saved, and produced seeds and in three years this spring variety was converted into a winter variety. Running or twining beans may be reduced to bush beans by selecting the fruit that grows nearest the ground from year to year, and, on the contrary, their stems may be made to grow much longer by selecting pods from the top or end, and constantly planting. Cucumbers may be dwarfed in size, and almost stopped in running, by selecting seeds from those which grow near the root, and planting constantly. A farmer might very easily originate a new variety of wheat, by selecting some head which differed very much in size of kernel or length of spike, and sowing the seeds by themselves, from year to year, on well-prepared land, and weeding out, those heads which are not like the original type, and rejecting the small seeds. The same is true of maize, peas, beans, and, indeed, of all plants that are inclined to sport or vary. Single flowers which have a tendency to sport may be converted into double flowers by long cultivation in rich soil, and sometimes by keeping the seeds for several years, till they become weakened in their power of germination, and then planting them. Every tendency in the plant to vary must be carefully watched. When a valuable plant of any kind has been obtained, it is very desirable to preserve it, and cause it, if possible, to produce true seeds every year, and thus prevent it from reverting to its original or common form. This process is called by gardeners setting, and consists in planting the seeds, for several years, by themselves, and entirely unconnected with any other plants similar to it, and guarding at the same time against bees and other insects which may convey pollen to it. In this way, and by weeding out constantly, the plant becomes set, and will, with proper care, reproduce itself regularly from year to year. It must be remembered, however, that no variety will reproduce itself in every particular of shade of color, or taste, or other properties; and, therefore, when we wish to perpetuate a variety exactly, it must be done in the same manner as in the case of hybrids, by scions, cuttings, suckers, layers, etc. Varieties may also be produced by cross-breeding. We have already shown in what cross-breeding consists, how the operation is performed, and to what class of plants it is applied. It now only remains to explain its effects on the objects employed. All varieties, as has before been remarked, are perfectly fertile between one another, and it may be laid down as a general principle of universal application, except in cases where the relation is very close, that cross-breeding produces strength in the offspring, a result precisely the reverse of true hybridization, which always occasions weakness in some form. It has been said that the exception of close interbreeding, or cross-breeding, is obviously a wise provision of nature to prevent varieties from becoming too fixed in their habits, and differing too much from the original species; and, in the human race, to keep the members of families within the proper and natural limits of the marriage relation. The offspring produced by cross-breeding, as by hybridizing, is of a character nearly intermediate between the parents, the characters of the male usually being the most prominent; but the variety which possesses the greatest strength, and is nearest the type of the original species, finally predominates. It, therefore, has an important influence in obliterating individual differences, and giving uniformity of character to varieties of the same species. By repeatedly cross-breeding the different varieties of the same species, we could ultimately arrive very nearly at the original standard or type of the species. Varieties of plants may be improved by cross-breeding; and even the same variety, when it is grown in different sections of the country for a few generations, and then the seeds are brought together and planted, will be invigorated and improved in size and quality. Cross-breeding has one advantage, and a very important one, over cultivation in the production of varieties, in the fact that they may be produced at once, with a very great degree of certainty, by uniting two known qualities in one individual. In this way we may combine directly, and at our pleasure, the desirable qualities of two known varieties, and produce a cross-breed sometimes far superior to either when taken alone. But, notwithstanding this, we must look to cultivation principally for originating the primary qualities, and to cross-breeding for blending them in beautiful and harmonious proportions. Although as yet by far the greater number of the best varieties of our fruits, and other plants, as the apple, pear, melon, and turnip, were probably obtained by cultivation, yet very many of the choicest were the result of the artificial cross-breeding of these primary varieties. Besides the advantages already named, cross-breeding improves the size and quality of the fruit of plants, their hardiness and prolificacy, and the beauty of their flowers. It has been found to be one of the most effectual means of acclimation, so that plants which could not endure the cold of the more northern climates are made perfectly hardy by this process. By it we may give to the hardy pears of the North the delicate sweetness of those of the South; to the insipid and watery grape the richness of the Black Hamburg; and to the white rose the delicate blush which the crimson imparts. The benefits derived from this art are summed up in the following extract from the London *Horticultural Magazine*: To it we owe some, indeed many, of our most beautiful garden flowers, as well as the most valuable of our fruits and vegetables. Among flowers, the most important qualities which can be impressed on the different races are greater hardiness of constitution, precocity or tardiness of flowering, the communication of odor where it is not possessed, increase in size, alterations in the forms of individual flowers, or greater prolificacy and improved arrangement, as regards their collective production. Modifications and the blending of colors, which are sometimes aimed at, seem to be the most paltry changes of any that are attempted. Among fruit and vegetables, the changes to be effected should be confined more to productiveness and quality than to appearance. Thus, the increase of size, together with improvement or modification of the sensible qualities, are the main objects to be sought, followed by such qualities of general application as hardiness, precocity, tardity, productiveness, or increased inflorescence. It may be well to remark that it can not generally be known with certainty, when a new variety first begins to bear, whether the fruit will be of good quality or not. It usually takes several years for it to develop itself perfectly. If there should be any doubt at any time whether a plant is a hybrid or a cross-breed, it may generally be known by observing the following particulars: If it is intermediate between its parents and does not produce seeds, or produces such as will reproduce it only for a few generations, it is probably a true hybrid; but, on the contrary, if it is intermediate, and its seeds are perfect, and produce vigorous offspring continually, it is a classific hybrid or a cross-breed. The process of cross-breeding plants, although recent in its origin as artifically practiced, is of a very ancient date as carried on in the wide domain of the vegetable kingdom. Nature is continually carrying it on in the field, the orchard, and the garden. The pollen is passing from the flower of one variety to that of another of the same species; thus fertilizing countless numbers, the seeds of which will develop forms and fruits unknown before. Hence a vast number of the new varieties of flowers and plants which are commonly supposed to be the result of some great and powerful effort of nature, may have been produced by this process of nature's cross-breeding. In the foregoing observations we have seen in what hybridizing and cross-breeding consist, the manner in which they are performed, the classes of plants to which they may be applied, and the beneficial results that have accrued to man from the introduction of a multitude of new plants into the vegetable kingdom, and yet it is sometimes more desirable to the practical agriculturist to know how to anticipate and avoid these intermixtures than to produce them. It becomes necessary, therefore, when we are about to cultivate different plants in the vicinity of one another to ascertain how nearly they are allied, or to what class or classes they belong. If they belong to species of different genera we may expect no trouble from any intermixture which they may occasion. The pea (*Pisum sativum*) and the bean (*Phaseolus vulgaris,*) the peach (*Amygdalus Persica*) and the apple (*Pyrus malus,*) the common potato (*Solanum tuberosum*) and the sweet potato (*Convolvulus batatas,*) the beet (*Beta vulgaris*) and the turnip, (*Brassica campestris,*) the parsnip (*Pastinaca sativa*) and the carrot (*Daucus carota,*) will never intermix with each other under any circustances, however much they may seem, in some respects, to be similar; for they are, as may be seen, species of different and remote genera, and nature has declared that they shall never unite. They may be cultivated in the closest proximity, but they can not intermix; and the seeds which each produces will be its own, peculiar and distinct from every other. Therefore, the first inquiry to be made in respect to any plants under consideration is, whether they belong to different genera. If they do, they will very rarely intermix, even with the present botanical classification. We may easily know to what genus or species any plant belongs, by turning to its name in any standard botany now in use. On this principle we are able to give a satisfactory answer to the inquiry whether one plant will turn into another; as chess (*Bromus secalinus*) into wheat, (*Triticum vulgare*) oats *Avena sativa*) into barley (*Hordeum vulgare,*) or the reverse. In the case of the first two plants, it will be observed that they are of different species, and also belong to different genera. It has been laid down as a law of nature that species are distinct, and were created so, and therefore can never change into one another. But these species belong to different genera, and we have seen that, when species are thus remotely allied, they will very rarely even hybridize. The two plants under consideration answer to both of these conditions, and of course one can not change into the other. But further, the experiment has frequently been tried to turn chess into wheat by high cultivation, but has always resulted in failure; the only change which has been effected being an improved variety of chess, without any change in its nature. In cases in which wheat is supposed to have changed into chess, there must have been some deception which escaped the observation of the cultivator. The seeds might have been carried in the manure, which was, perhaps, purchased at some neighboring stable in which chess mixed with the hay had been consumed by the horses or other animals. They may have been lying in the ground for many years, and from a greater depth of plowing than usual have been brought up to the light and heat of the sun, and thus made to germinate, since we know that the longevity of seeds is very great. Some new fertilizer may have been applied which has penetrated deeply enough to stimulate the dormant seeds into growth, and thus cause the chess to appear, on the same principle that applying ashes to fields, where no clover has grown for several years, will cause it to spring up in large quantities. The clover seeds had been lying dormant for years, in the earth and the ashes stimulated them into growth. In cases in which wheat was sown and chess grew in its place, the fact may be explained by supposing that the wheat perished from too much wet, or too great cold, or some other cause; and the chess, being more hardy, survived, and took its place. There must have been some fallacy of this kind; for no one who is familiar with the laws of reproduction can suppose that one of these would change into the other. In species of plants belonging to the same genus, there is frequently great difficulty to be encountered in preventing them from hybridizing. Although it is a general rule, previously laid down, that species of the same genus will not hybridize unless nearly allied, and that the cases in which they do are but exceptions to the general principle, yet, despite this repugnancy to hybridization, there are some which are classified as distinct species that intermix with almost equal facility as varieties of the same species, and it requires the most persistent watchfulness on the part of the agriculturist to prevent their union. As an instance of this kind we may mention the pumpkin (*Cucurbita pepo,*) and the squash (*Cucurbita melopepo,*) which are usually regarded as distinct but closely allied species. The question now arises—how can we know what species will hybridize, and what will not? It can be known only from experiments of our own or others; and it will never be safe to cultivate species of the same genus in the vicinity of one another without a previous knowledge of their relationship or alliance. The question is sometimes asked whether these two plants will change into each other. The answer may be safely given that they will not; but they will intermix, and form a classific hybrid which will resemble both plants, but will still be different from either Since it is a law of hybridization that the hybrid partakes of the nature of both parents, and as a general rule the characteristics of the male parent predominate over the female, it is evident that when the squash is fertilized by the pumpkin the fruit grown from the seed of the fertilized plant will resemble the pumpkin more than the squash; and, on the contrary, when the pumpkin is fertilized by the squash the offspring will resemble the squash more than the pumpkin.

though neither will be changed into the other. If, however, the pumpkin is the stronger plant in its specific character, the offspring may possibly in either case resemble the pumpkin more than the squash. None of the species of the squash and the pumpkin should be cultivated near one another. The muskmelon (*Cucumis melo*) and the watermelon (*Cucumis citrullus*) are liable to hybridize. It is said by some that the muskmelon and the cucumber (*Cucumis sativus*) will hybridize, but M. Sageret, an experienced hybridist, declares that he was unable to effect any union between them. All the species of the *Cucumis*, or melons, cucumbers, and colocynths, should not be cultivated together. The inquiry has frequently been made whether the Bush Bean (*Phaseolus nanus*) will change into the Pole Bean, (*Phaseolus vulgaris*). It will not. But, if it is fertilized by the Pole Bean, a classific hybrid will be produced resembling both, and doubtless will be a climbing bean, but not the same as the male parent, or Pole Bean. The Bush Bean is regarded by many as a variety of the Pole Bean, and therefore the two readily hybridize when cultivated near each other. Care should always be taken to separate them at considerable distance; and so with all the cultivated species of the *Phaseolus*, or beans. M. Sageret says the common cabbage (*Brassica oleracea*) will fertilize all the turnip-bearing species of the *Brassica*, as *Brassica campestris*, *Brassica rapa*, and *Brassica napus;* but none of them will fertilize the cabbage. Thus it may be seen that the cabbage will intermix with the turnip, but the turnip will not intermix with the cabbage. All the turnip-bearing species will, however, hybridize with one another. Therefore, when seeds are to be grown from the cabbage, turnip, colza, or rape, they should not be cultivated together. The intermixture of plants takes place only by means of their flowers, and consequently no cross-breeds can be produced from cultivating the tubers of different varieties together. The different varieties of the common potato will never intermix by their tubers, and they may be planted in the same hill without the least possibility of intermixture. They will, however, intermix through their flowers, like other plants, but no effect will be produced on the tubers by this intermixture; it is only in the seeds grown in the potato ball. The size of the tubers may be considerably increased by removing the flower-buds or the flowers from the stalks; and varieties that have never fruited may frequently be made to blossom by taking away a part of the tubers, that the nourishment may be thrown into the stalks and flowers. A greater profusion of flowers may also be obtained the next year from ornamental shrubs, than otherwise would have been, by breaking off the blossoms of the present year before they go to seed. The inquiry whether varieties of plants will degenerate or run out, as it is sometimes termed, is one that has created much interest at different times, and is really of great practical importance to the agriculturist. There is no doubt that they will degenerate, and the degeneracy may result from various causes. There is a natural tendency, which has been verified by long observation, in all plants to revert to their original species. They seem to be out of their natural sphere when brought into a high state of cultivation, and very much in the condition of the savage who has been taken from his forest home and educated in some seminary of learning. He is constantly uneasy, and when the first opportunity is presented escapes to his native haunts, and joins his old companions in their revels and vices. Therefore, great care should be taken that the largest fruit and the best ears of wheat and corn may be selected in order that the choicest seeds may be procured and sown; otherwise the plants will degenerate in time, and most if not all the excellent qualities which they possessed will be lost. Prof. Lindley says: In all cases where any importance is attached to the result, the plumpest and heaviest seeds should be selected if the greatest vigor is required in the seedling. They may degenerate for want of proper culture. As culture has much to do in developing new varieties, so the neglect of it will do much to destroy them, and there is no doubt that our best fruits, if removed from our orchards and gardens to their habitats in the forests, and reproduced from their seeds for a series of years, would be no better than the original species in a wild state. The delicious Newtown Pippin or the Pearmain would be no more agreeable in flavor than the little European crab-apple (*Pyrus malus*,) from which they probably originated. Prof. A. Gray, in his Botanical Text-book, says: The races of corn, wheat, etc., which now preserve their character unchanged, have become fixed by centuries of domestication. Even these at times manifest an unequivocal disposition to return to their aboriginal stock. Were cultivation to cease, they would all speedily disappear; the greater part, perhaps, would perish outright; the remainder would revert, in a few generations of spontaneous growth, to the form of the primitive stock. The improving hand of culture must be continually upon them, or they will lose all their good qualities and become worthless. The natural cross-breeding of different varieties with those of inferior qualities is a very frequent cause of deterioration. This is often observed in gramineous, leguminous, and curcubitaceous plants, which are raised annually from their seeds. All the varieties of maize are very liable to deteriorate in this way. Those of the *Sorghum saccharatum* intermix so freely that cultivators have found it almost impossible to obtain pure seeds. From the same cause it is extremely difficult to preserve any of the varieties of the melon pure for any considerable time. No one can have any security of obtaining pure seeds unless they are planted many rods from all others, and the perfect flowers from which seeds are to be raised are covered with small tents of gauze of sufficient size to enclose each and protect it from insects. The judicious cross-breeding, however, of individuals of the same variety, when taken from a distance, will, as has before been observed, have a tendency to improve it. The mingling, even, of the sap of different trees, as in grafting, is sometimes not without its deleterious effects on the fruit of the engrafted scion; and the influence becomes more and more apparent the further we get from the purity of the parent stock. It seems allowable, observes Prof. J. Lindley, to infer that the goodness of cultivated fruits is deteriorated by their being uniformly worked upon stocks whose fruit is worthless. The common apple, when grafted upon trees bearing very austere fruit, is injured by the crude and bitter sap of the tree on which it has been grafted. On the contrary, it is improved by being grafted upon a stock superior to its own. A scion, also, taken from a young tree which has never fruited, will be hastened in its growth when grafted on a mature tree, and bear sooner than it would if it had been left to itself. They may degenerate from effect of climate. A vine, for instance, which produces very delicious grapes in Ohio or Missouri may become very inferior in NewHampshire or Maine. Certain fruits can not be perfected except in certain localities where the climate is particularly adapted to their growth and congenial to their nature. There are only a few countries where the grape will grow in perfection. There is no doubt that the climate has in many instances more influence than the soil in causing degeneration of plants. We look to the sunny skies and bland atmosphere of Italy, France, Palestine, or California, for the highest development of the grape and the pear, but for the apple perhaps there is no better region in the world than the middle section of the United States. Plants, then, should be selected that are adapted to the locality in which they are to be cultivated, or otherwise degeneracy must be expected, labor will be thrown away, and no satisfactory results can be obtained. The opinion is generally entertained by agriculturists that varieties which are raised from tubers and from scions or buds become weakened or degenerated by age. This was emphatically denied by Prof. J. Lindley, and as firmly maintained by Mr. T. A. Knight and others. Whatever the truth may be, the fact is obvious that varieties do degenerate by long-continued cultivation; but the change may generally be ascribed to other causes than to age. In the ease of the potato the various elements of the soil that are peculiarly adapted to its growth may have been abstracted by frequent planting on the same ground, so that the plant is actually starved from year to year, and thus weakened in constitution and dwarfed in size. It is often induced, also, from selecting for seed small tubers that are imperfectly matured, and have not secreted starch in sufficient quantity to give adequate nourishment to the new plant before its roots have been sufficiently developed to enable them to draw the necessary nourishment for its support from the soil. Or, when the practice of dividing the tubers has been adopted, they may have been cut into pieces so small that they do not contain enough of the necessary elements to produce a healthy and vigorous plant. In order, then, that there should be no deterioration, tubers should be selected of good size, some of the largest, if they are sound and well formed, and cut into two or three pieces, if that plan is preferred to planting whole, according to their size. In this way the size vigor, and mealy qualities would be kept up, and a good and healthy crop be secured each year. Varieties of wheat, too, often degenerate for the same reason. A person who originates a new variety selects the ear, as we have before shown, which contains the best seeds; and he sows them from year to year, and keeps sowing and selecting them and no others, and soon he gets a variety which is much improved. But as soon as it goes into the hands of the cultivator, all the seeds, the perfect and the imperfect, are sown promiscuously and constantly, and the consequence is degeneration in a few years. Mr. Charles Darwin, in Variations of Animals and Plants, etc., volume 1, p. 379, says that, Colonel Le Couteur, in his persevering and successful attempts to raise new varieties by selection, began by choosing the largest ears, but soon found that the grains in the same ear differed so that he was compelled to select them separately, and each grain generally transmitted its own character. From this statement it is evident that the largest grains should be selected for sowing each year. This might be done at a trifling expense by sifting the grain through a sieve so prepared that the small kernels might pass through, and the large ones be retained in the sieve. Should this plan be pursued yearly there would doubtless be less complaint of the degeneration of this crop. The soil, no doubt, has very much to do with keeping up the size and vigor of the plant both in the case of the potato and the wheat. The necessary elements, such as lime, etc., which conduce to their growth, should be supplied with watchful care, and the labor would be rewarded by most ample and satisfactory results. Too much stress, in every department of agriculture, can not be laid on the importance of providing the proper elements for the food of plants, whatever kind may be cultivated. One person, perhaps, finds his orchard going to premature decay, while his neighbor's is thrifty and produces abundant crops. He supposes that the location of his own is more exposed to the cold winds of winter, or that by some singular fatality injurious insects infest his trees more, but the thought never occurs to him that they are starving for the food which their nature demands, when at the same time his neighbors are well fed. It may be true that neither orchard is enriched by manure from the stable, but one is located in a valley so as to receive a good manuring yearly by the hand of nature, while the other is on an elevation from which all the elements of growth wash away.

VEERING. A ridge made in plowing where two lands meet.

VEGETATION. The complex problems in vegetable life, and in the act of vegetation, have caused it to be made the careful study of some of the most profound thinkers of the present day. In the articles, Germination and Physiology, some branches of these questions are noticed. A plant from the time it begins its growth either from the seed or bud, simply multiplies cell growth until the limit of its vegetative powers are naturally reached, or until growth is stopped by some extraneous cause. The plantlet having reached the surface of the ground, moisture and heat must be supplemented with light, under which the stem and leaves become green and immediately begin to elaborate nutriment from the watery sap drained by the roots from the earth. The roots continue to extend, thus increasing their powers of absorption, the leaves above ground continue to multiply, thus increasing the power of elaboration, and as a rule in just proportion to the root, so will be the proportion of leaf surface of a plant. The seedling has all the organs of the perfect plant, except the blossom buds, and these, as have been shown in another part of this work, are simply modified leaf buds. Thus it simply has to grow and produce in duplicate, what it already possesses. Thus the stem is carried higher and higher, and in plants having more than a simple stem, side branches are produced, as in the oak, each branch, nay each bud representing the ultimate perfect plant, each increasing, and with continued powers of increase, until the mature stage is reached and growth ceases. In the case of annuals, this occurs at the end of the season with the ripening of the seed. With biennials, it occurs at the end of the second year. With triennials the third year, and with perennials, this growth continues indefinitely, particular species of trees wanting 5,000 or even more years to complete their growth. Some plants die down to the ground at the end of the season, the nutriment for the succeeding year's growth being started from year to year, as in the case of herbaceous biennials and perennials, or as in the case of deciduous trees, that store elaborated sap next the bark, and in the buds, but drop their leaves at the end of the season. In the case of evergreens, the leaves remain persistent, for one or more years, sometimes for five or six years, the new growth being supplied from the annual buds, as in the cone bearing trees, or else buds open successively as in the case of some tropical forms of vegetation. Vegetation may therefore be divided into annuals, biennials, and perennials, since as a rule the so-called triennials are simply biennials, that under abnormal conditions survive to the third year. Annuals, then, store up their life germs in the seed; biennials in the roots, the first season, expending this the second season in flowering and fruiting. By stopping the flowering, biennials may be made to continue to the third season, and some annuals may be changed into biennials, as in the case of winter wheat, strictly an annual plant. So biennial plants may bear fruit the first year. The organs of vegetation are three, the root, the stem, and the leaf. The form and appearance which these take are diverse, and yet however wonderful, still each may be traced to one of the three organs. This study is called morphology. The root is the simplest form, consisting of the primary root, and its branches, there are, however, subterranean, and aerial roots. Indian corn gives us an example among annual plants; the Pea-nut throws out aerial roots, which striking into the earth the nuts are formed thereon; the Banyan tree is an example among perennial trees, of aerial roots starting from the branches high in air, growing downward until they reach and pierce the soil, and forming additional props or trunks to the parent tree. So aerial roots are formed on a small scale by various climbing plants, as the Trumpet creeper, Poison ivy, the Virginia creeper, the English ivy, etc. So orchids or air plants, have nothing but aerial roots, and sustain themselves as parasites on other plants. The Mistletoe, Dodder, and various fungus plants, are well known parasitic plants. The stem as to form or kind is distinguished as belonging to herbs, shrubs and trees. It is herbaceous, if it die down in the autumn. It is denominated shrubby if it is woody, lives over the winter, and belongs to those trees denominated shrubs, or it is arborescent when belonging to tall trees of a single stem. It is upright when it grows erect; ascending when it rises in a slanting direction; declining when bent or turned to one side; decumbent when it lays along the ground but with the end turned more or less upward; procumbent when the whole stem trails along the ground; prostrate when it naturally lies flat on the ground; creeping, if postrate and taking root along its lower side where it rests on the ground; climbing when it rises by means of tendrils, as in the grape, or by twisting its leaf-stalk around the support, as in the Maurandia, or by its rootlets, as in the ivy; it is twining when the stem supports it by winding spirally about a support, as in the hop or bean. The Squash is a climbing plant, yet if it have no support it becomes a creeping plant, anchoring itself to the ground by roots thrown out at the joints. The Strawberry is a true running plant. It forms no tendrils, but does throw out runners, forming an independent plant at the end of the runner. The leaf of a plant forms the organ corresponding to respiration and digestion. These forms are almost endless in variety, and yet in a given species, afford a means for distinguishing the species. A complete leaf has a blade, the extended portion above the footstalk; a footstalk, the portion connecting it with the stem; and a pair of stipules, or a pair of little blades at the base of the footstalk next the stem. The quince has this perfect leaf, many leaves have no stipules, many have no footstalk but sit directly on the stem. Some indeed have no blade, but this is rare.

VEGETABLE CHEMISTRY. The chemical examination of all products of the vegetable world, as well as the functions of plants. (See Chemistry, Agricultural.)

VEGETABLE OYSTER. (See Salsify.)

VEGETABLE PHYSIOLOGY. An examination of the growth and functions of plants. (See Generation, Germination, etc.)

VEIL. Calyptra. A membrane connecting the pileus with the stem of some mushrooms.

VEINS. The vessels which convey blood that has circulated through the body back to the heart.

VELVET LEAF. (See Mallow.)

VENA CAVA. The great veins which discharge the venous blood into the right auricle of the heart.

VENTER. In entomology, the lower part of the abdomen.

VENTILATION. The subject of Ventilation is a most important one in connection with agriculture, since it bears not only directly upon the health of the family, the farm animals kept, upon the perfect saving of vegetables and seeds, and also upon the proper curing of cheese, and, in fact, upon all that pertains to a healthy condition inside any covering. Many complicated systems of ventilation have been and are constantly being invented, few of which long survive. In farm houses ventilation is not so abstruse a question as in city mansions. The chimney flues and the air spaces in the walls, together with the windows, will furnish ample means of ventilation. How to do this in the most economical manner, will depend upon the size of the house, and the number of inside rooms. When there are many, pure air may be forced in by a system of pipes leading to a main pipe, at the roof, turned to a right angle near the end, and terminating in an abrupt bowl or cone shaped opening, so provided that it may always turn to face the wind. Another series of pipes connecting with a main one leading out of the roof will convey away the impure air from the rooms. In ordinary farm houses pure air may be provided for by means of ventilators in the windows. The flues of the house, or the pipes leading to them, conveying away the impure air. Barns and stables should be provided with ventilating pipes or trunks not less than four feet square, and provided at the top with a good ventilating apparatus. These pipes will also serve as chutes through which hay and fodder may be passed to the feeding floors below. The stable floors should have a sufficient number of ventilating sashes, or, sashes hung by weights so that a proper amount of fresh air can be supplied at all times, and in such amount as may be necessary. Thus not only will ventilation be supplied, but also that necessary element, plenty of light. The ventilation of cellars, both those of buildings and of barns, and not less important of dairy buildings, where a cool current is necessary in summer, and pure air in winter, may probably be best conserved by the plan known as sub-earth ventilation, advocated and perfected by Mr. Wilkinson, of Illinois. This consists, substantially, in laying pipes or tile six inches or more in diameter from four to six feet under the surface of the ground, and of as great a length as may be desired, but not less than 400 feet, and where opening out at the surface of the ground, being provided with blowers, which will turn with the wind, and so the open side is kept always facing the wind. Thus the air in passing into the open mouth of the subterranean pipes, in its passage is cooled to the same temperature of the earth at the depth at which the pipe is laid, and passing out at the other end into the room to be ventilated, enters and cools the apartment to about fifty-five degrees, or in late summer to about sixty degrees Farenheit. This temperature being uniform, allows the curing of cheese in the most perfect manner, and at the same time the air of the room is kept perfectly sweet and cool.

VENTRICLE. A cavity of the heart, brain, etc.

VENTRICOSE. Any part which appears blown out.

VERATRIA. An active alkaloid principle, from the *Veratrum album*, or white hellebore.

VERBENA. *Vervain.* Some years ago, and until this plant began to be severely attacked with rust, on the cutting bench, it was perhaps the most popular of plants both for the window and for bedding purposes. Its pretty trusses of flowers, in almost endless variety of color, and its profuse blooming, whether in the open ground in summer, or in the window in winter, made it universally sought after. It is adapted both to pot or vase, and will continue to bloom almost the whole winter if kept rather cool at night, and with plenty of sun during the day. Out of doors it will stand any temperature above actual freezing, and if protected during frosty nights will continue to bloom late in the fall. In the room 65° during the day, and not below 45° at night will keep the plants healthy, if care be taken to keep the leaves free of dust and insects. Water only when dry, and then liberally, never allowing water to stand in the saucers, and in mild weather give air in plenty, either by opening the window or setting them on the porch in a still atmosphere. It is usual now to depend upon seedlings. Sow the seed in a hot bed the first of March, prick out into three inch pots when large enough and transfer to the open ground as soon as danger of frost is over, setting the plants one foot apart. They should commence to bloom about the first of June and continue in bloom all the season. There are a number of species indigenous to the United States, North, among them, *Vervain angustifalia; V. Hastata,* or blue vervain; *V. urticifolia,* white vervain; *V. stricta,* hoary vervain; *V. officinalis,* common vervain; *V. bractiosa* and *V. anbletia.* The first, second and third named are found East and West. Officinalis was introduced from Europe. The rest are western species; the last named being a well known prairie flower, and is sometimes cultivated.

VERJUICE. The juice of green grapes or apples, from which a vinegar is made.

VERMIN. Destructive animals or insects.

VERNATION. The manner in which the leaflets of a bud are folded.

VERRUCOSE. Wart-like in appearance.

VERTEBRÆ. The bones of the spine, which is also called the vertebral column.

VERTEBRATES, VERTEBRATA. All animals having a spinal column.

VERTICAL. Upright, pointing to the vertex, or uppermost point overhead.

VERTICELLUS. A whorl. *Verticellate* is a derivative; disposed in a whorl.

VERTIGO. Badly fitting tight collars, especially if the horse be fat and full of blood, overwork in a hot sun, hereditary tendency to brain disorders, and various local disorders, will occasion the horse to stagger and sometimes fall in the harness. If produced by some other cause than a tight collar, the horse should not be used on the road since the difficulty increases with age, and constitutes a permanent unsoundness.

VESICANTS. Substances which produce blistering.

VESICLE. A small bladder.

VESPIDÆ. The family of wasps.

VESTIBULE. A porch or ante-room.

VETCH. *Vicia.* The cultivated Vetch, *V. Sativa,* or tare of Europe, has been tried from time to time in the United States, but its cultivation abandoned, and is now regarded as a useless weed. (See Tare.) The Kidney Vetch, or Sand Clover, *Anthyllis vulneraria,* has also been recommended as a forage plant, but in the United States has proved entirely worthless. The Milk Vetch, *astragalus,* as Indian pea, pop pea, ground plum, and rattle box weed, is abundant in the West and far-west. The peas are used boiled as food by the Indians. It should be destroyed wherever found, since the pods are obnoxious from adhering to the wool of sheep and injuring its quality.

VETCHLING. The genus *Lathyrus,* leguminous plants, frequently of great beauty, as the sweet pea.

VETERINARY SCIENCE. The care of sick animals on the farm requires more than ordinary prudence in its management. The dumb animal can not tell of its aches and pains, can not describe peculiar symptoms, except by brute signs, quite unintelligible to those who have not given particular study and attention to the phenomena presented in various cases. Pain in many instances is plainly enough intimated as to its near locality, by the animal turning its head to the part, or by striking at it with its feet. Yet the operator in veterinary art, must have studied much to be able always to tell the cause of that pain. Happily the days of bleeding and strong physic, the universal rule among a class of horse doctors, is now well past, and the modern veterinary surgeon depends more upon good care and nursing, with such remedies as may be needed to meet particular symptoms as they occur. Under their appropriate names, in the body of this work, are given such remedies and specifics as are proper for the diseases treated of, (those most usually appearing in farm animals) and in all difficult and critical cases the reader is advised to appeal to a veterinary surgeon if such can be had, and if not, then apply to the family physician, for no humane country physician will now-a-days refuse to minister to a dumb brute, for fear of being called a horse doctor. That day is happily passed except among a class who might almost be called unworthy the name of M. D. It really requires more science sometimes to understand the symptoms of a dumb brute than a human subject, and hence the physician who prescribes really shows himself not only humane, but of broad culture as well. As showing how the practice of the healing art on the human subject has been assisted by comparative investigations on the bodies of animals, and also as showing something of the benefits accruing from the study of comparative anatomy and physiology, we may quote from as old and well known an authority as Galen, who said: If medical men have been guilty of gross errors, it is because they have neglected to dissect brutes. Says Mr. Vines, speaking of some who have distinguished themselves as surgeons: They have transplanted to the medical profession the honor of discoveries that were made by trenching on the territory of the veterinary science. In experiments in transfusing the blood of one animal into that of another it was discovered that what were termed the globules of the blood were uniform in all animals of the same species, and yet presented different forms in animals of different tribes. In man, the particles of blood presented flat disks, resembling pieces of money, having a slight depression. In birds, reptiles and fishes the disks were oval, instead of being round, and instead of being depressed in the center, they were elevated on each side. From this experiment it was argued that the fitness of the blood of one animal to the uses of another of a different species depended on the formation of its globules. Experiments have frequently been made to test the truth of this theory, and it has been found to be correct. An eminent physiologist has remarked that, in order to arrive at an explanation of what is obscure in man, we must look to the lowest and simplest forms of creation. For though in man is combined, in a wonderful and unequaled manner, all the functions which separately exhibit themselves in various other animals, he is not the most favorable subject for observing their action; hence we are obliged to refer to a number of other tribes for the assistance we gain in the study of their comparative structures. There is not a single species of animal that does not present us with a set of facts which we should never learn but by observing them in such species, and many of the facts ascertained by the observation of the simplest and most common animals. Speaking of veterinary art, its general history, and the science as it existed twenty years ago, the late Dr. Dadd wrote: The veterinary science, like that practiced on man, was first called into existence by necessity; the many diseases to which domestic animals were subject, and to which they, too frequently, fell victims for want of proper professional knowledge, and the great loss which agriculturists experienced in consequence, led them to seek for a remedy. In the year 1761, the first veterinary school was established at Lyons, under the patronage of government, whose fostering care the infant school for a time received. At the commencement of this embryotic enterprise, the populace looked on with indifference; but many of the liberal and scientific men of that day saw in the enterprise a boundless field for research, a broad road to usefulness and distinction, and many eagerly embarked in it with unflinching perseverance, overcoming every obstacle, with a view of making known those laws regulating the vital forces of domestic animals. The fruits of their labors are bequeathed as a legacy to the profession, and the names of the first cultivators of veterinary science are inscribed on the tablets of their country's history as public benefactors. Four years after the endowment of this, the first school in France, a similar one was established at Alfort. A regular system of veterinary medicine was there taught, under which students acquired an acquaintance with the various forms of disease, and the *modus operandi* of therapeutic agents on domestic animals. The novel enterprise was regarded by other nations of Europe with a watchful eye, and they were not slow in coming to the rescue; schools rapidly sprang up in Holland, Berlin, Copenhagen, Stutgard, and in various other places, which proved equally successful and beneficial as the French schools. We now pass over a period of twenty-seven years, during which time the science had gradually enlisted in its ranks men of influence, talents, and research. And now an individual of French descent, named St. Bel, lands on the shores of England, having letters of introduction from the first men in France to Sir Joseph Banks and other influential individuals, to whom he made known his mission; which was, that of establishing the veterinary science, then unknown, and of course unappreciated, in the British dominions. He was encouraged, with very flattering assurances of success, to commence operations, and shortly after his arrival in London he published proposals for establishing a veterinary school; there seemed, however, to be a sort of indifference manifested among the masses, and consequently very little, beyond making known his object, was effected during the first year. In the following, he published proposals to read lectures on the science, and thus give the English nation an opportunity to judge of the value of the new project; but, alas! he was doomed to disappointment; his second proposal met with no better success than at first. The apparent failure of his primary labors has been attributed, by an eminent writer, to various causes, and it may be well for us to notice them, for the very same causes have been in active operation, diverting American skill and intelligence from embarking in a cause so worthy the attention and support of a free and enlightened nation. It was in consequence of the character of those who presumed, without the necessary qualifications, to practice the art, that the English husbandmen refused to put their shoulders to the wheel, and receive the offered boon. That country had been visited by diseases of a pestilential type, which had made sad havoc among the stock, and had swept them from the green hills and verdant valleys, as by the blast of a tornado. Their horses, too, did not escape the arm of the destroyer; they were constantly suffering and dying from insidious forms of disease, the history and characters of which were almost unknown. This state of things, together with the unfortunate occurrence that there were no legitimate practitioners, had opened a wide field for adventurers and quacks, whose barbarous systems, of medication, probably, was the cause of many deaths. These practitioners, in lieu of better, were taken as standards, and the people had, to a great extent, formed an estimate of the value of this art in exact ratio to the talents of the village farrier, and in proportion to the success that attended his labors. This is precisely the state of affairs in America. St. Bel gives us another reason for his failure, but it amounts to nearly the same thing. He says: The opulence of England offered a wide field for imposters of foreign origin, by whom the nation was daily imposed on, and repeated experience of such impositions naturally excited distrust towards foreigners in general; and because honesty of views was not written on his face, patience and perseverance became his only resources. At this stage of affairs St. Bel was fortunate enough to make the acquaintance of a gentleman who had a decided taste for the art, and who eagerly responded to the views of the professor, and bade him not despair of ultimate success; assuring him that by setting the matter in its right light before the people he would soon obtain all he desired. This assurance inspired St. Bel with new hopes, and he immediately issued a pamphlet of some twenty-eight pages, entitled, Plan for Establishing an Institution to Cultivate and Teach the Veterinary Art. This pamphlet was well received, and several agricultural societies paid the writer handsome compliments, and conferred on him honorary distinction. During the year 1790, several meetings took place between the members of agricultural societies and others favorable to the cause; at length measures were adopted for promoting the object. A resolution to this purport was now passed, which read as follows: That the parties had observed the good effects produced on the public mind by the exertions of the friends to the art, for its improvement, and approved of St. Bel's plan for establishing a public institution for that purpose. The result was, that an institution was soon endowed, which was named The Veterinary College of London, to which St. Bel was appointed professor. But, unfortunately, that distinguished individual had scarcely occupied the chair one year, when a sudden and brief illness terminated his mortal career, and he was consigned to the tomb ere the laurels had scarcely encircled his brow. Being thus cut off at such an early period, yet in the midst of his usefulness, the prospects of the infant institution became greatly affected—only for a short season, however. The college was considered to be in a flourishing condition; the Duke of Northumberland had already contributed a sum equal in our money to twenty-five hundred dollars, and the enterprise numbered among its staunch supporters such men as the Earl of Grosvenor, Mr. Penn, Earl Morton, Drs. John Hunter and Crawford, and subsequently that great surgeon and medical hero, Sir Astley Cooper. Medical men hailed the new enterprise as one not only calculated to ameliorate the condition of suffering domestic animals, but, what was of still greater importance to them and mankind, they perceived in it a fruitful field for the cultivation of comparative anatomy and physiology. With this object in view, Dr. J. Hunter assisted the friends of the new school both by his professional influence and from his private purse. Although the college had been in existence but a brief period, its pupils had gained sufficient knowledge of theory and practice to distinguish themselves; thus fully realizing the anticipations of its founders. Among the first students who sought to qualify themselves as efficient veterinary practitioners, we find recorded the names of Laurence, Blain and Clark. Each of these philanthropists has since left to the world a record of their labors, which, even in this enlightened age, serve as useful guides to the young aspirant for veterinary fame. The professorship made vacant by the death of the father of this science, St. Bel, was conferred on Mr. Coleman, who had previously devoted himself to physiological research; he, too, soon distinguished himself, and the college again assumed its former flourishing condition. A medical committee was now appointed, consisting of some of the most eminent practioners that the country could boast of, by whom the pupils were examined, and when found to have acquired sufficient knowledge of the art, certificates were granted accordingly. We are informed that this medical examining committee were lecturers of human medicine, and with a liberality that reflected great credit on them, permitted the veterinary pupils to attend their lectures on human anatomy free of charge. Thus did a band of really great and good men unite their efforts and interests, for the study of the science of life in all its diversities and forms. By this wise association of the sister sciences, its advocates aimed a death blow at ignorance, quackery, and superstition of the times, and they were successful to some extent; for a new order of practitioners took the field; they soon demolished the old landmarks set up by the ignorant farriers, and created in their stead beacons of light; thus spreading the illuminating rays of science broadcast, and the public, as well as domestic animals, were benefited thereby. The advantages under which the veterinary art can now be studied in England, France, and Germany are not inferior to those of the most favored university; and such astonishing discoveries, through the aid of chemistry and the microscope, are in such rapid succession surprising the medical world, and so splendid are the achievements in the departments of veterinary surgery, that the noble sons of Æsculapius (our brethren of the human school) are watching the labors of their kindred spirits with no ordinary interest. In the United States comparatively few graduates have entered the sphere of veterinary science. Some of our agricultural colleges have chairs of veterinary science, and yet to the American mind seeking an honorable profession the duties pertaining to veterinary practice do not seem to take kindly to it. Hence it is left principally to the graduates of European schools, who have emigrated hither. In our great cities every large stable has its paid veterinarian. In the country, especially in the more sparsely settled districts, it would be impossible for a veterinary surgeon to gain a living. Hence the greater need that every owner of animals should know something of the treatment of them, and hence again the reason why in this work we consider it important to give plain, simple, concise rules for the treatment of such diseases as generally come under the eye of the agriculturist, and which will be found treated of under their appropriate titles. Some of the family scales made at the present day are so nicely adjusted that they will answer for weighing drugs where the nicest accuracy is not needed. For this reason we give a table of apothecaries weights of quantities by untensils. Apothecaries weight is as follows: Sixty grains make one drachm; eight drachm one ounce, and sixteen ounces one pound. Where strict accuracy is not essential: sixty drops is equal to a teaspoonfull, and a teaspoonfull is a drachm; four teaspoonfulls make a tablespoonfull or half an ounce; two tablespoonfulls make an ounce; one wineglassfull, two ounces; one teacupfull four ounces; one tumblerfull, one half-pint, and two make a pint. So also the half pint and pint tin cup may be used as measures. Nevertheless, where much stock is kept it is better that the farmer provide himself not only with the proper scales, but also with a graduated fluid measure. So also it would be better that a few instruments should be kept, as for instance, a blunt pointed bistoury for operating under the skin or in cavities. A thumb lancet, as being better than the old fashioned fleam and safer than the spring lancet, gauging the depth with the thumb. A pair of forceps, for dressing wounds, catching and holding arteries for tying, etc. An aneurismal needle, blunt pointed for introducing small seton tapes, and if necessary for exploring wounds; a silver probe, however, blunt at one end and sharp at the other is better. A frog knife, such as is used by horse shoers, for cleaning and paring the hoofs, etc. A pair of curved scissors for trimming the edges of wounds, and cutting away hair close to the skin. A straight broad scalpel, which is useful in opening abscesses, as well as for castrating animals. These with a seton needle, a few surgical needles, and some white silk, linen thread, or fine catgut for tying wounds will provide amply for any case as ordinarily coming up on the farm, or when it may not be imperatively necessary to call a veterinary surgeon. A small collection of medicines to be kept will be found useful. White or opaque bottles should be used, since the action of light changes some substances. Keep everything well corked, and all corrosive substances in strong glass bottles with ground glass stoppers. So instruct the druggist of whom you buy. From five to ten doses of each will be sufficient. The annexed list of medicines as given by Dr. Law in his Veterinary Adviser will be found valuable for reference being arranged for all farm animals. Those marked by a star (*) will be found useful to have always at hand. The list is as follows:

Acetic Acid, antidote to alkalies, cooling astringent: Horse 1 drachm; ox 2 drachms; ass 1 drachm; sheep 1 scruple; dog 2 to 3 drops.

Tincture of Aconite, sedative, diaphoretic: Horse 20 to 30 drops; ox 30 to 40 drops; ass 15 to 20 drops; sheep 3 to 5 drops; dog 1 to 3 drops.

Alcohol, stimulant, diuretic, narcotic: Horse 1 to 3 ounces; ox 3 to 6 ounces; ass 1 ounce; sheep ½ ounce; dog 2 drachms. Cooling astringent.

Brandy, Whisky, and Gin, stimulant, diuretic, narcotic: Horse 3 to 6 ounces; ox 6 to 12 ounces; ass 2 to 5 ounces; sheep 10 ounces; dog ½ ounce. Locally cooling astringent.

Strong Ale, stimulant, diuretic, narcotic: Horse 1 to 2 pints; ox 2 to 4 pints; ass 1 pint; sheep ½ pint; dog 2 ounces. Locally cooling astringent.

Barbadoes Aloes, purgative: Horse 4 drachms; ass 3 to 4 drachms; dog ½ drachm.

Cape Aloes, purgative: Horse 5 drachms; ass 4 to 5 drachms.

Alum, astringent: Horse 2 to 3 drachms; ox 3 to 4 drachms; ass 2 drachms; sheep ½ to 1 drachm; dog ½ to 1 scruple.

Ammonia, Liquid, diffusible stimulant, antispasmodic, antacid, diuretic: Horse ½ ounce; ox ½ to 1 ounce; ass 2 to 4 drachms; sheep ½ to 1 drachm; dog 10 drops. Locally blister.

Aromatic Ammonia, diffusible stimulant, antispasmodic, antacid, diuretic: Horse 1 to 2 ounces; ox 2 to 4 ounces; ass 1 to 2 ounces; sheep ½ to 1 ounce; dog 1 drachm. Locally blister.

*Carbonate of Ammonia, diffusible stimulant, antispasmodic, antacid, diuretic: Horse 2 to 4 drachms, ox 4 to 6 drachms; ass 2 drachms; sheep ½ to 1 drachm; dog 10 to 15 grains. Locally blister.

Muriate of Ammonia, stimulant, discutient, alterative, diuretic: Horse 2 to 4 drachms; ox 4 to 6 drachms; ass 2 drachms; sheep ½ to 1 drachm; dog 20 grains. Locally cooling discutient.

Acetate of Ammonia. Solution, diaphoretic, diuretic, stimulant: Horse 2 to 3 ounces; ox 3 to 4 ounces; ass 2 ounces; sheep ½ to 1 ounce; dog 2 drachms.

Anise-seed, stomachic, carminative: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 to 4 drachms; dog 1 to 3 scruples.

Antimony, Tartarized (Tartar Emetic), emetic: Swine 5 grains; dog 2 to 4 grains. Sedative, diaphoretic: Horse 2 drachms; ox 2 to 4 drachms: ass 2 drachms; sheep 1 to 2 scruples: swine ½ to 1 grain; dog ¼ to ½ grain. Locally blister.

Areca Nut, vermifuge, tæniafuge: Horse 1 ounce: ox 1 ounce; ass 1 ounce; sheep 3 drachms; dog ½ to 1 drachm.

*Arnica, Tincture, stimulant, diuretic: Horse 1 drachm; ox 1 drachm; ass ½ drachm; sheep 1 scruple; dog 10 drops. Locally cooling, soothing.

Arsenic, alterative, nerve tonic: Horse 5 grains; ox 5 to 8 grains; ass 3 to 5 grains; sheep 1 grain; swine ½ grain; dog 1-12 grain. Locally caustic, parasiticide.

*Assafœtida, diffusible stimulant, carminative, vermifuge and appetizer: Horse 2 drachms; ox 4 drachms: ass 1 to 2 drachms; sheep ½ to 1 drachm; swine ½ drachm; dog 10 to 20 grains.

Azedarach, vermifuge: Horse ½ to 1 ounce; ox 1 ounce; ass 3 to 4 drachms; sheep 1 to 2 drachms: swine 1 drachm; dog 20 grains.

Belladonna, anodyne, antispasmodic, narcotic: Horse 2 ounces; ox 2 ounces; ass 1 to 2 ounces; sheep ½ ounce; dog 5 grains

Belladonna, Extract, anodyne, etc.: Horse 2 drachms; ox 2 to 3 drachms; ass 1 to 2 drachms; sheep ½ drachm; dog 1 to 3 grains.

Atropia (alkaloid of Belladonna), anodyne, etc.: Horse 1 to 2 grains; ox 1 to 2 grains; ass 1 grain; sheep ⅓ grain; dog 1-16 grain.

Balsam of Peru, stimulant, antispasmodic, expectorant: Horse 1 ounce; ox 1 to 1½ ounces; ass ½ to 1 ounce; sheep 2 drachms; dog ½ drachm.

Benzoin, stimulant, antispasmodic, expectorant: Horse 1 ounce; ox 1 to 1½ ounces; ass ½ to 1 ounce; sheep 2 drachms; dog ½ drachm.

Borax, nerve sedative, uterine stimulant: Horse 2 to 6 drachms; ox ½ to 1 ounce; ass 2 to 4 drachms; sheep ½ to 1 drachm; swine ½ drachm; dog 5 to 10 grains. Locally astringent, parasiticide.

Bismuth, Subnitrate, soothes irritation of the stomach and bowels: Horse 2 drachms; ox 2 to 4 drachms; ass 1 to 2 drachms; sheep 20 grains; swine 10 to 20 grains; dog 5 to 10 grains. Locally soothing, healing.

Blackberry Root, astringent: Horse 2 to 4 drachms; ox ½ ounce; ass 2 drachms; sheep 2 scruples; dog ½ scruple.

Blue-stone (Copper Sulphate.)

Boneset, stimulant, tonic, diaphoretic: Horse ½ to 1 ounce; ox 1 ounce; ass ½ ounce; sheep 2 to 3 drachms; swine 2 drachms; dog ½ to 1 drachm.

Bromide of Potassium, nerve sedative: Horse 2 to 4 drachms; ox 4 drachms; ass 2 to 3 drachms; sheep ½ drachm; dog 5 to 10 grains.

Buchu, stimulant, diuretic: Horse 4 drachms; ox ½ to 1 ounce; ass 3 drachms; sheep 1 drachm; dog 10 to 20 grains.

Buckthorn Syrup, purgative: dog ½ to 1 ounce.

Calomel, purgative: Horse 1 drachm; ox 1 to 2 drachms; ass 1 drachm; swine 1 scruple; dog 3 to 4 grains. Alterative: Horse 1 scruple ox 1 to 3 scruples; ass 1 scruple: swine 3 to 4 grains; dog ½ to 1 grain.

Camphor, calmative, antispasmodic: Horse 1 to 2 drachms; ox 2 to 4 drachms; ass 1 drachm; sheep 1 scruple. dog 3 to 10 grains.

Cantharides, stimulant, diuretic: Horse 5 grains; ox 5 to 10 grains; ass 3 to 5 grains; sheep 1 to 2 grains; dog 1-6 to ⅓ grain. Locally blister.

Capsicum, Cayenne Pepper, stimulant, aromatic: Horse 2 to 3 drachms; ox 2 to 4 drachms; ass 1 to 2 drachms; sheep 1 scruple; swine ½ to 1 scruple; dog 2 to 5 grains. Locally irritant.

Caraway Seed, stomachic: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 to 3 drachms; swine 2 drachms; dog 1 scruple.

Cardamoms, stomachic: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 to 3 drachms; swine 2 drachms; dog 1 scruple.

Cascarilla, stimulant, bitter tonic: Horse ½ to 1 ounce; ox 1 ounce; ass 4 to 6 drachms; sheep 1 drachm; dog 10 grains.

Carbolic Acid, sedative, anodyne, astringent, antiseptic, disinfectant: Horse ½ to 1 drachm; ox 1 drachm; ass ½ drachm; sheep 10 drops; dog 5 drops.

Castor-oil, purgative: Horse 1 pint; ox 1 to 1½ pints; ass 1 pint; sheep 3 to 4 ounces; dog ½ to 1 ounce.

Catechu, astringent: Horse 2 to 5 drachms; ox 3 to 8 drachms; ass 2 to 3 drachms; sheep 1 to 2 drachms: dog 10 to 30 grains.

Chamomile, stimulant, tonic: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 drachms; dog ½ drachm.

Cherry Bark, wild, expectorant: Horse ½ ounce; sheep 2 to 3 scruples; swine 2 scruples; dog 1 scruple.

Chloral-Hydrate, sedative, antispasmodic: Horse ½ ounce; ass ¼ to ½ ounce; sheep 1 drachm; dog 20 grains. Soporific: Horse 1 ounce; sheep 2 to 3 drachms; dog ½ drachm.

Chloroform, sedative, antispasmodic, stimulant: Horse 1 to 2 drachms; ass 1 drachm; sheep 1 scruple; dog 5 to 10 drops. Anæsthetic.

Cinchona, Peruvian Bark, bitter tonic. antiseptic, antiperiodic: Horse 1 to 3 ounces; ass 1 ounce; sheep 2 to 4 drachms; dog 1 drachm.

Cinnamon, stomachic: Horse 4 to 6 drachms; ox ½ to 1 ounce; ass 4 to 6 drachms; sheep 1 to 2 drachms; dog 10 to 20 grains.

Cod-liver Oil, tonic: Horse 4 to 6 ounces; ox 6 to 8 ounces; ass 4 to 6 ounces; sheep 1 to 2 ounces; dog ½ ounce.

Colchicum, diuretic, sedative: Horse ½ to 1 drachm; ox 1 to 2 drachms; ass ½ drachm; sheep ½ scruple; dog 2 to 8 grains.

Colocynth, bitter purgative: Dog 2 to 5 grains.

Columbo, bitter tonic: Horse 4 to 6 drachms; ox ½ to 1 ounce; ass 2 to 3 drachms; sheep ½ to 1 drachm; dog 10 grains.

Conium, Extract, sedative: Horse 1 drachm; ox 1 to 2 drachms; ass ½ to 1 drachm; sheep 10 to 15 grains; swine 10 grains; dog 2 to 5 grains.

Copaiva, stimulant. diuretic, expectorant: Horse 2 to 4 drachms; ox 3 to 4 drachms; ass 2 to 3 drachms; sheep ½ to 1 drachm; dog 10 drops.

Copper, Ammoniated, tonic, antispasmodic. astringent: Horse 1 to 2 drachms; ox 1 to 2 drachms; ass 1 drachm; sheep 10 to 20 grains: dog 1 to 5 grains.

Copper, Iodide, tonic, discutient: Horse 1 to 2 drachms.

Copper, Sulphate, tonic, astringent: Horse ½ to 1 drachm; ox 1 to 2 drachms; ass ½ drachm; sheep 10 grains; dog 2 to 4 grains.

Croton Seeds, purgative: Horse 10 to 12; ox 15 to 20; ass 8 to 10; sheep 2 to 3; dog 1 to 2.

Croton Oil, purgative: Horse 15 to 20 drops; ox 20 to 30 drops; ass 12 to 18 drops; sheep 5 to 8 drops; dog 3 to 4 drops.

Cream of Tartar, diuretic: Horse 1 ounce; sheep 4 to 6 drachms; dog 1 drachm. Laxative: Horse 5 ounces; ox 5 to 8 ounces; ass 5 ounces; sheep 1 to 2 ounces; dog ½ ounce.

Dandelion Extract, Taraxacum,diuretic, laxative, bitter: Horse 1 to 1½ ounces; ox 2 ounces; ass 1 ounce; sheep 3 drachms; dog 1 drachm.

Digitalis, sedative, diuretic: Horse 15 to 20 grains; ox ½ to 1 drachm; ass 15 grains; sheep 5 to 15 grains; swine 2 to 10 grains; dog 1 to 3 grains.

Dover's Powder, sedative, diaphoretic: Horse 3 drachms; ox 3 to 4 drachms; ass 2 drachms; sheep 2 scruples; swine 1 scruple; dog 2 to 4 grains.

Ergot, checks bleeding, parturient: Horse ½ to 1 ounce; ox 1 ounce; ass ½ ounce; sheep 1 to 2 drachms; dog ½ drachm.

Ether, diffusible stimulant: Horse 1 to 2 ounces; ox 2 to 3 ounces; ass 1 ounce; sheep ½ ounce; swine 2 to 4 drachms; dog 1 drachm.

Fennel Seed, stomachic; Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 to 4 drachms; dog ½ drachm.

Filix Mas., Extract, Male Shield-Fern, vermifuge, tæniacide: Horse 1 ounce; sheep ½ drachm; dog 10 to 20 drops.

Galls, Oak, astringent: Horse 4 to 6 drachms; ox 1 to 2 ounces; ass 4 drachms; sheep ½ to 1 scruple; swine 1 to 2 scruples; dog 1 to 3 grains.

Gallic and Tannic Acid, tannin, astringent: Horse 1 to 3 scruples; ass 1 to 2 scruples; sheep 5 grains; dog 1 to 3 grains.

Gentian, bitter tonic: Horse 4 drachms; ox ½ to 1 ounce; ass 4 drachms; sheep 1 to 2 drachms; dog 10 to 20 grains.

Ginger, stimulant, stomachic: Horse 1 ounce; ox 2 ounces; ass ½ to 1 ounce; sheep ½ ounce; swine 2 drachms; dog 2 scruples

Glauber Salts (Soda Sulphate).

Henbane, Hyoscyamus, Extract, sedative, antispasmodic: Horse 2 drachms; ox 2 to 4 drachms; ass 1 to 2 drachms; sheep ½ to 1 drachm; swine ½ drachm; dog 5 grains.

Hemp, Indian, Extract, antispasmodic, soporific, narcotic: Horse ½ to 1 drachm; ass ½ drachm; sheep 10 to 15 grains; swine 5 to 10 grains; dog 1 to 2 grains.

Hydrocyanic Acid (Prussic).

Iodine, alterative, discutient: Horse 10 to 20 grains; ox 20 to 30 grains; ass 10 grains; sheep 5 to 10 grains; swine 5 grains; dog 1 to 2 grains.

Iodide of Potassium, alterative, diuretic: Horse ½ to 1 drachm; ox 1 to 2 drachms; ass ½ drachm; sheep 3 scruples; swine 1 to 2 scruples; dog 1 scruple.

Ipecacuanha, emetic, sedative: Swine 1 to 2 drachms; dog 15 to 20 grains. Diaphoretic, expectorant; Swine ½ drachm; dog 3 to 5 grains.

Jalap, purgative: Swine 1 to 2 drachms; dog ½ to 1 drachm.

Iron, Peroxide, tonic: Horse 2 to 4 drachms; ox 4 drachms; ass 2 drachms; sheep 1 drachm; dog 5 to 10 grains. Antidote to arsenic.

Iron, Sulphate, tonic: Horse 2 to 4 drachms; ass 2 drachms; sheep 1 drachm; swine ½ drachm; dog 2 to 5 grains.

Iron, Carbonate, tonic: Horse 2 to 4 drachms; ass 2 drachms; sheep 1 drachm; swine ½ drachm; dog 2 to 5 grains.

Iron, Iodide, tonic, discutient: Horse ½ to 2 drachms; ox 1 to 2 drachms; ass ½ to 1 drachm; sheep 15 to 30 grains; swine 10 to 20 grains; dog 1 to 8 grains

Iron, Tincture of Muriate, astringent, checks bleeding: Horse ½ to 1 oz; ox 1 to 2 ounces; ass ½ ounce; sheep ½ to 1 drachm; swine 10 to 30 drops; dog 5 to 10 drops

Kino, astringent: Horse ½ ounce; ox ½ to 1 ounce; ass 2 to 4 drachms; sheep 1 to 2 drachms; swine ½ to 1 drachm; dog 10 grains.

Kousso, vermifuge: Sheep 2 to 3 ounces; dog 1 ounce.

Laudanum (Opium).

Lead Acetate (Sugar of Lead), astringent, sedative: Horse 1 to 2 scruples; ox 2 to 3 scruples; ass 1 scruple, sheep 10 to 15 grains; dog 2 to 5 grains.

Lime-water, antacid, astringent: Horse 4 to 5 ounces; ox 4 to 8 ounces; ass 4 ounces; sheep 1 ounce; dog 1 drachm.

Lime, Carbonate, Chalk, antacid, astringent: Horse 1 to 2 ounces; ox 2 to 4 ounces; ass 1 ounce; sheep 2 to 4 drachms; dog 8 to 12 grains.

Lime, Chloride, Chlorinated, checks tympany, disinfectant: Horse 2 to 4 drachms; ass 2 drachms; sheep 1 to 2 drachms.

Linseed Oil, laxative: Horse 1 to 2 pints; ox 1 to 2 quarts; ass 1 pint; sheep ½ pint.

Lobelia, sedative, antispasmodic, expectorant: Horse 1 to 2 drachms; ox 1 to 3 drachms: ass 1 drachm; sheep 15 grains; swine 5 to 15 grains; dog 1 to 5 grains.

Magnesia, antacid, laxative. antidote to arsenic: Horse 1 to 2 ounces; ox 2 to 4 ounces; sheep 1 ounce.

Magnesia, Sulphate, Epsom Salts, laxative: ox 1 to 2 pounds sheep 4 to 6 ounces.

Mallow, demulcent: Freely.

Mentha Piperita (Peppermint).

Mercury with Chalk, Hydrargyrum Cum Creta, antacid, laxative: Calf 10 to 15 grains; dog 5 to 10 grains.

Mercurial Pill, Blue Pill, laxative: Dog 5 grains.

Mercury, Subchloride (Calomel).

Muriatic Acid, Hydrochloric Acid, tonic, astringent, caustic, disinfectant: Horse 1 drachm; ox 2 drachms; ass 1 drachm; sheep 20 drops; dog 2 to 5 drops.

Myrrh, stimulant, tonic: Horse 2 to 4 drachms; ox 4 to 6 drachms; ass 2 drachms; sheep 1 to 2 drachms; dog 5 to 20 grains.

Nitre (Potassa Nitrate)

Nitric Acid, tonic. astringent, caustic: Horse 1 drachm; or 2 drachms; ass 1 drachm; sheep 20 drops; dog 2 to 5 drops.

Nux Vomica nerve stimulant, tonic: Horse 10 to 30 grains; ox 20 to 40 grains; ass 10 to 20 grains; sheep 5 to 15 grains; dog ½ to 3 grains.

Oak Bark, astringent: Horse 1 ounce; ox 2 to 4 ounces; ass 1 ounce; sheep 4 drachms; swine 2 to 3 drachms; dog 1 to 2 drachms.

Olive Oil, laxative: Horse 1 to 2 pints; ox 2 to 3 pints; ass 1 pint; sheep 3 to 6 ounces; dog 1 to 3 ounces

Opium, narcotic, sedative, anodyne, antispasmodic: Horse ½ to 2 drachms; ox 2 to 4 drachms; ass ½ to 1 drachm; sheep 10 to 20 grains; dog ½ to 3 grains.

Opium, Tincture, Laudanum, narcotic, sedative, anodyne, antispasmodic: Horse 1 to 2 ounces; ox 2 ounces; ass ½ to 1 ounce; sheep 2 to 3 drachms; dog 15 to 30 drops.

Morphia, Muriate, narcotic, sedative, anodyne, antispasmodic: Horse 3 to 5 grains; ox 5 to 10 grains; ass 3 grains; sheep ½ to 1 grain; dog ¼ to ½ grain.

Peppermint Oil, stomachic, antispasmodic: Horse 20 drops; ox 20 to 30 drops; ass 20 drops; sheep 5 to 10 drops; swine 5 drops; dog 3 to 5 drops.

Peruvian Bark (Cinchona).

Pepper, Black, White, stomachic, stimulant: Horse 2 drachms; ox 3 drachms; ass 2 drachms; sheep 1 to 2 scruples; dog 5 to 10 grains

Pimento, stomachic, stimulant: Horse 2 drachms; ox 3 drachms; ass 2 drachms; sheep 1 to 2 scruples; dog 5 to 10 grains.

Podophyllin, purgative, sedative: Horse 1 to 2 drachms; ox 2 drachms; ass 1 drachm; sheep 10 to 20 grains; swine 6 to 8 grains; dog 1 to 2 grains.

Pomegranate Root Bark, vermifuge: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 2 to 3 drachms; swine 1 to 2 drachms; dog 20 to 30 grains.

Potassa Acetate, antacid, diuretic, diaphoretic: horse 6 to 8 drachms; ox 1 ounce; ass 4 to 6 drachms; sheep 1 to 2 drachms; dog 10 to 20 grains.

Potassa Nitrate, diuretic, febrifuge: Horse 6 to 8 drachms; ox 1 ounce; ass 4 to 6 drachms; sheep 1 to 2 drachms; dog 10 to 20 grains.

Potassa Bicarbonate, antacid, diuretic: Horse 6 to 8 drachms; ox 1 ounce; ass 4 to 6 drachms; sheep 1 to 2 drachms; dog 10 to 20 grains.

Potassa Chlorate, stimulant, diuretic, refrigerant, antiseptic: Horse 1 to 4 drachms; ass 1 to 2 drachms; sheep 20 to 40 grains; dog 5 to 15 grains.

Potassium Iodine (Iodine).

Potassium Bromide, nerve sedative: Horse ½ ounce; ass 2 to 4 drachms; sheep 2 drachms; swine 1 drachm; dog 20 grains.

Potassium Cyanide, sedative, antispasmodic: Horse 1 to 2 grains; ox 2 grains; ass 1 to 2 grains; sheep ½ grain; dog ¼ to ⅛ grain.

Prussic Acid, sedative, antispasmodic: Horse 20 to 30 drops; ox 30 to 40 drops; ass 15 to 20 drops; sheep 5 to 8 drops; swine 5 drops; dog 1 to 3 drops.

Pumpkin Seeds, vermifuge, tæniafuge: dog ½ ounce.

Quinia, Sulphate, bitter tonic: Horse 20 grains; ox 20 to 30 grains; ass 15 to 20 grains; sheep 6 to 10 grains; swine 5 to 10 grains; dogs 2 to 6 grains.

Rhubarb, laxative, tonic: Horse 1 ounce; ox 2 ounces; ass 1 ounce; sheep 1 drachm; dog 20 grains.

Resin, diuretic: Horse 4 to 6 drachms; ox ½ to 1 ounce; ass 4 to 6 drachms; sheep 2 to 4 drachms; swine 2 drachms; dog 20 to 30 grains.

Soap, diuretic antacid, laxative: Horse 1 to 2 ounces; ass 1 ounce; sheep 2 to 6 drachms; swine 2 to 4 drachms; dog 20 to 60 grains.

Soda, Bicarbonate, antacid, diuretic: Horse 4 to 6 drachms; ox 4 to 8 drachms; ass 4 drachms; sheep 1 to 2 drachms; dog 5 to 30 grains.

Soda, Sulphite, Bisulphite, Hyposulphite, antiseptic, disinfectant, alterative, relieves tympany: Horse 1 ounce; ox 2 to 3 ounces; ass 1 ounce; sheep 2 to 6 drachms; swine 2 to 4 drachms; dog 20 to 60 grains.

Soda Sulphate (Glauber Salts), purgative: Horse 1 to 1½ pounds; ox 1 to 2 pounds; ass ½ to 1 pound; sheep 6 ounces.

Sodium, Chloride (common salt), tonic, vermifuge, purgative: Horse 1 to 2 ounces; ox 2 to 4 ounces; ass 1 ounce; sheep 2 to 4 drachms; swine 1 to 3 drachms; dog 10 to 30 grains.

Santonin, Wormseed, Semen Contra, vermifuge: Horse ½ to 1 ounce; ass 4 drachms; sheep 2 to 4 drachms; swine 1 to 3 drachms; dogs 10 to 60 grains.

Squill, diuretic, expectorant: Horse ½ drachm; ox ½ to 1 drachm; ass 20 to 30 grains; sheep 10 to 15 grains; dog 1 to 5 grains.

Silver, Nitrate (Lunar Caustic), nerve tonic: Horse 5 grains; ox 5 to 8 grains; ass 2 to 4 grains; sheep 1 to 2 grains; dog ⅛ to ½ grain.

Spanish Flies (Cantharides).

Spigelia, vermifuge: Horse ½ to 1 ounce; ox 1 to 2 ounces; ass ½ to 1 ounce; sheep 2 to 4 drachms; swine 2 to 3 drachms; dog 1 drachm.

Strychnia, nerve tonic: Horse 1 to 2 grains; ox 1 to 3 grains; ass 1 grain; sheep ⅓ to 1 grain; swine ⅓ grain; dog 1-40 to 1-10 grain.

Sulphur, expectorant, diaphoretic: Horse 3 to 4 ounces; ox 5 to 6 ounces; ass 3 ounces; sheep 2 ounces; swine 1½ to 2 ounces; dog 2 to 8 drachms. Laxative, alterative: Horse 1 ounce; ox 1 to 2 ounces; ass 1 ounce; sheep 6 drachms; swine 4 to 6 drachms; dog ½ to 1 drachm. Parasiticide.

Sweet Spirits of Nitre, Spirit of Nitrous Ether, stimulant, antispasmodic, diuretic, diaphoretic: Horse 1 to 2 ounces; ox 3 to 4 ounces; ass 1 ounce; sheep 3 to 6 drachms; dog ½ to 2 drachms.

Stramonium, narcotic, sedative: Horse 20 to 30 grains; ox ½ to 1 drachm; ass 15 to 30 grains; sheep 5 to 10 grains; swine 4 to 6 grains; dog 2 grains.

Sulphuric Acid, tonic, refrigerant, caustic: Horse 1 drachm; ox 2 to 4 drachms; ass 1 drachm; sheep ½ drachm; swine 20 drops; dog 5 to 10 drops.

Tobacco, sedative, antispasmodic, vermifuge: Horse 4 drachms; ox 4 to 6 drachms; ass 4 drachms; sheep 1 drachm; swine ½ drachm; dog 5 to 6 grains.

Tar, expectorant, antiseptic: Horse ½ to 1 ounce; ox ½ to 2 ounces; sheep ½ ounce.

Turpentine Oil, stimulant, antispasmodic, diuretic: Horse 1 to 2 ounces; ox 1 to 1½ ounces; ass ½ ounce; sheep 4 to 6 drachms; swine, 1 drachm; dog ½ drachm. Vermifuge: Horse 2 ounces; ox 2 to 3 ounces; ass 1 to 2 ounces; sheep 4 drachms; swine 2 to 3 drachms.

Valerian, diffusible stimulant, antispasmodic, vermifuge: Horse 2 ounces; ox 2 to 4 ounces; ass 2 ounces; sheep ½ ounce; swine 2 to 3 drachms; dog 1 to 2 drachms.

Valerianate of Iron, nerve tonic: Dog 4 to 5 grains.

Veratrum, sedative: Horse one scruple; ox ½ to 1 drachm; ass ½ to 1 scruple; sheep 5 to 10 grains; swine 5 to 8 grains; dog 2 grains

Wild Cherry Bark, expectorant: Horse 1 ounce; ox 1½ ounce; ass 1 ounce; sheep 3 drachms; dog 30 grains.

Zinc, Carbonate, astringent, tonic: Horse 2 drachms; ox 2 to 4 drachms; ass 2 drachms; sheep ½ to 1 drachm; swine ½ drachm; dog 10 to 15 grains.

Zinc, Sulphate, astringent, tonic: Horse 1 to 2 drachms; ox 2 to 3 drachms; ass 1 drachm; sheep 15 to 30 grains; swine 10 to 20 grains; dog 2 to 3 grains. Emetic: Swine 15 grains to 1 drachm; dog 8 to 15 grains.

In explanation of the various terms and designations, used in connection with abnormal states of the system, the following explicit glossary is given, which will make everything clear to all readers:

Abnormal—Irregular.
Absorbents—Medicines used for absorbing; also the vessels of the body which suck up.
Acute—Sharp, severe.
Adipose—Fatty.
Adynamic—Debilitated.
Alæ—Wings.
Alteratives—Medicines which change a disease for the better.
Anasarca—Dropsy of cellular membrane.
Anasarcous—Dropsical.
Anæmia—Bloodlessness.
Antiseptics—Medicines opposed to putrefaction.
Antispasmodic—Remedies opposed to spasms or convulsions.
Antiphlogistic—Opposed to inflammation.
Aperients—Medicines which open the bowels gently.
Aqueous—Watery.
Ascites—Dropsy of the belly.
Ataxic—Disordered.
Auscultation—Examination by sounding and listening.
Autopsy—Post-mortem examination
Bifurcation—Division into two branches.
Bolus—A large pill.
Buccal Membrane—The lining of the mouth.
Canthus—Corner of the eye.
Capsule—Shell or case.
Carbonaceous—Containing carbon.
Carminatives—Medicines which relieve pain by expelling wind from the bowels.
Cartilaginous—Composed of cartilage.
Cathartic—Loosening.
Cellular—Cell-like.
Cerebellum—The brain.
Cerebrum—The brain.
Chancrous—Cancerous.
Clinical—Relating to individual practice.
Coma—Stupor.
Comatose—Stupefied.
Conjunctival Membrane—The membrane which lines the eyelids and covers the eyeball.
Cornea—Transparent coat of the eye.
Cranial—Pertaining to the skull.
Cranium—Skull.
Crucial—Shaped like a cross.
Decarbonize—To purify the air.
Diagnosis—The art of telling the nature of diseases.
Diaphoretics—Medicines which promote perspiration.
Diathesis—Predisposition to certain diseases.
Dietetics—Regulation of diet.
Diuretics—Medicines which increase the flow of urine.
Duct—Canal.

Dynamic—Relating to the vital forces.
Emollients—Substances used to reduce inflammations.
Emphysema—Distention by gas or wind of certain portions of the body.
Emunctories—Organs which carry off waste matters.
Encephalon—The brain.
Enema—Injection.
Enzootic—Endemic diseases among animals.
Epizootic—Epidemic among animals.
Equilibrium—Balance.
Equine—Relating to the horse.
Etiology—The doctrine of the causes of diseases.
Excrementitious—Useless.
Excretory—Relating to vessels which throw off useless matter.
Extravasation—Escape of a fluid of the body from its vessel into surrounding parts.
Exudation Oozing through a membrane.
Fauces—The throat.
Fleam—An instrument used in bleeding.
Graminivorous—Feeding on grass.
Hematosine—The red coloring matter of the blood.
Hemorrhage—Bleeding.
Hippiatric—Relating to diseases of the horse.
Histology—General anatomy.
Hydrocephalus—Water in the head.
Hygiene—Preservation of health.
Ichorous—Humory.
Idiopathic—Primary affections.
Idiosyncrasy—Peculiarity of constitution.
Indurated—Hardened.
Inguinal—Belonging to the groin.
Intercostal—Between the ribs.
Inunction—The act of rubbing in.
Lachrymal Glands—Those which secrete tears.
Lancinating—Shooting.
Laxatives—Loosening medicines.
Lesion.—Disorder.
Ligament—The substance which joins bones together.
Mammæ—Breasts.
Masseters—Muscles of the jaws.
Morbid—Diseased.
Morbific—Producing disease.
Navicular—One of the bones of the foot.
Neuro-pathology—The nervous system in disease.
Nodulous—Like a knot.
Nosology—Classification of diseases.
Œdematous—Swollen.
Opaque—Not transparent.
Os calcis—Bone of the heel.
Osseous—Bony.
Ovoid—In the form of an egg.
Palatine—Relating to the palate.
Panzootic—An epidemic affecting animals generally.
Parasite—An animal which lives on another.
Parotid—Largest salivary gland.
Pathology—The study of the body in disease.
Pedicle—Narrow part of a tumor.
Petechial—Resembling flea-bites.
Phthisis—Wasting away.
Pituitary Membrane—Lining of the nostrils.
Pseudo-Membranous—Relating to false membranes.
Pus—Matter.
Pylorus—Entrance into intestines.
Rale—A watery sound heard in sounding the chest in some diseases.
Sanative—Health-giving.
Schneiderian Membrane—The lining of the nostrils.
Sebaceous—Of the nature of suet.
Sedatives—Medicines which produce sleep.
Serous—Watery.
Serum—Watery part of the blood.
Solvent - That which dissolves.
Sporadic—Scattered.
Submaxillary—Beneath the jaw.
Sudamina—Small eruptions.
Supra-renal—Above the kidney.
Thoracic—Relating to the chest.
Thyroid—Shaped like a folding door.
Tonics—Medicines which give tone and strength to the body.
Tubercular—Relating to tumors in the structure of an organ.
Tumefaction—Swelling.
Turbinated Bones—Bones of the nose shaped like a top.
Turgescence—Great amount of humors in any part.
Vascular—Full of blood-vessels.
Ventricle—Cavity.
Virus—Poison.
Vis a Fronte—Force from the front.
Vis a Tergo—Force of propulsion.
Viscous—Sticky.
Voice-box—Larynx.

VEXILLUM. The standard: the upper petal of a papilionaceous or pea-like flower.

VIBRISSA. The pointed bristles which grow from the upper lip of animals, or from the jaws of birds, and are used as feelers.

VILLOSE. Woolly, covered with soft, flexible hairs, closely set.

VILLOUS. Having the appearance of a pile of velvet.

VINE. A class of climbing plants, which support themselves by their tendrils, aerial roots, or leaves to any object which they can grasp; also applied to twining plants, and those which run along the ground, taking root at intervals. (See Vegetation.) In pomology the term vine is applied especially to the grape.

VINEGAR. The juice of any fruit, especially that of the grape and the apple, which, having gone through the vinous fermentation, enters into the acetic fermentation, acquiring a more or less sharp acid taste. All reference to vinegar as a preservative must be understood as being made to a pure cider or wine vinegar. Chemical vinegars, such as are most commonly found in market, having various chemical properties, may either entirely fail to effect a preservation, or wholly consume the substance. For a good vinegar, to three gallons of pure apple cider add one gallon of soft water well sweetened with molasses, and expose to the sun or warm air till the acetic fermentation is nearly complete, then remove to a cool dry apartment. The cask should always be left uncorked. Vinegar can be made from the juices of almost any fruit containing either starch or sugar. In expressing the juice for any fruit wine the pulp retains a large percentage of starch well adapted to making vinegar. A German method of doing this with unripe fruit is as follows: They are to be grated, exactly as potatoes are prepared in the manufacture of starch, and the pulp passed through a moderately fine sieve, or through a coarse and open-meshed cloth. There is, thus, nothing left behind but the pomace proper, or cellulose, all the starchy matter having been passed through the sieve with the juice. This is next to be diluted with water in proportion to the quantity of starchy matter thus obtained; and the whole is then placed in the clean copper kettle, one or two per cent. of concentrated sulphuric acid being added, and heated long enough to transform the starch into grape sugar. The sulphuric acid is to be neutralized by means of carbonate of lime; the gypsum or the sulphate of lime thus produced allowed to settle, and the liquid to become clear, and then poured off. This liquid is to be left for fermentation to take place, either with or without the use of yeast. A liquid having eight or ten per cent. of sugar can easily be made to have four or five per cent. of alcohol after fermentation, which, by its subsequent acidification, will yield vinegar containing five to six per cent. of acetic acid, the usual strength. In the making of commercial vinegar, the basis of the manufacture depends upon alcohol, obtained from starch and sulphuric acid forming starch sugar, from weak alcoholic washes adulterated with sulphuric acid, or from alcohol obtained from the refuse wash of distilleries, or made direct from grain. Thus many years ago, a patent was taken for making vinegar from distillery wash as follows: The substance claimed is the swill grains or the exhausted liquor of distilleries. In all operations conducted in the large way, and especially where there are chemical processes depending on affinity, and that again on slight changes, such as strength of the materials, temperature, and other modifying causes, the chemical changes of one stage of the process are rarely completed before another is commenced; and thus more or less material is necessarily lost in all great manufacturing establishments. Thus in distilleries which to be profitable must be conducted on a large scale, the fermentation of the grain, in order to save the largest amount of alcoholic liquid, is disturbed before the process of fermentation is completed, and consequently a portion of sugar, of starch, and of dextrine, are left in the waste liquor or swill after distilling off the alcohol, which, if allowed to ferment again by a moderate temperature, will soon run into the acetic fermentation and vinegar will be produced. Hitherto the swill has been used only for feeding cows and swine; the inventor however, availing himself of the new German, or quick process of making vinegar, has been enabled by devices for separating the solid matters which would otherwise clog the apparatus and impede the process, to convert the swill into a vinegar to be used in the manufacture of white lead, sugar of lead, Paris green, and in other salts called acetates.

VINEYARD. The cultivation of vineyards has always occupied the attention of man from the earliest ages, and the grape has become one of the most celebrated fruits in history both from its product in wine, and from the value of its fruit in a sanitary point of view and as a dessert fruit. In the article Grape, we have given space to the cultivation of the grape with special reference to the value of the fruit as a market crop. In the article Wine, the manufacture of the juice is treated of. The home vineyard may be managed in the most simple manner. The commercial vineyard must be managed with scientific accuracy, to prevent loss in cultivation, pruning, gathering and marketing. In the home vineyard there can not be much choice of location. It must be near the house, for expeditious use, or the thought of a vineyard must be abandoned. In a commercial vineyard a site must be selected that will present the best conditions of soil, exposure, and facilities for marketing. At the home vineyard, the training and pruning may be pretty much to suit the whim of the cultivator. The trellis for particular reasons, being generally adopted, notwithstanding it has been time and again demonstrated that the simple system of training to poles is not only cheapest but also the best, though it must be confessed that if sufficient care be exercised, great crops may be grown either in the commercial or home vineyard upon trellises. The cut given will show the manner of training. In this article it will not again be necessary to go into the systems of cultivation. There are works extant that would fill a large library upon grape culture, and manuals devoted to each separate branch of the business, and also to the cultivation of special varieties. We shall, therefore, content ourselves, here, with a view, taken from United States statistics, showing the status of grape culture in the several States of the Union, embracing varieties popular as table fruit; wine grapes; varieties principally grown; those giving the heaviest must on the sugar scale; varieties most subject to rot; effect of shelter to prevent mildew; effect of soil in reference to rot in berry; soils chemically considered most favorable to health and perfection of fruit; effect of drainage, etc. To prevent confusion and as a means of separating the titles, they are presented in the form of questions and answers; varieties named being in order according to their estimated value:

What varieties are most popular as table fruit? **Arkansas**: Catawba, Delaware. **Connecticut**: Concord, Delaware. **Delaware**: Concord. **Georgia**: Herbemont, Scuppernong. **Illinois**: Concord, Delaware, Catawba, Iona, Hartford Prolific, Isabella, Diana. **Indiana**: Concord, Catawba, Delaware, Hartford Prolific, Isabella, Diana. **Iowa**: Concord. Delaware, Hartford Prolific, Clinton, Creveling. **Kentucky**: Concord, Ives, Delaware. **Kansas**: Delaware. **Missouri**: Concord, Catawba, Delaware, Hartford Prolific, Isabella, Diana, Iona. **Minnesota**: Delaware. **Michigan**: Concord, Delaware. **Massachusetts**: Concord, Delaware. **New Jersey**: Concord, Isabella, Delaware. **North Carolina**: Scuppernong, Catawba. **New York**: Delaware, Iona, Catawba, Isabella, Concord, Salem, Diana, Adirondac, Hartford Prolific, Rebecca, Maxatawny. **Ohio**: Concord, Catawba, Delaware, Isabella, Iona, Rogers No. 15. **Pennsylvania**: Concord, Isabella, Catawba, Iona, Hartford Prolific, Diana, Israella. **South Carolina**: Scuppernong, Catawba, Isabella, Lenoir. **Tennessee**: Catawba, Isabella, Concord.

TRELLISED GRAPES.

What varieties are in highest repute as wine grapes? **Connecticut**: Delaware, Concord. **Georgia**: Scuppernong. **Illinois**: Concord, Norton's Virginia, Catawba, Clinton, Delaware, Ives, Iona, Hartford Prolific Herbemont. **Indiana**: Catawba, Delaware, Ives, Concord, Norton's Virginia, Isabella, Iona, Clinton. **Iowa**: Concord, Delaware, Clinton, Catawba, Norton's Virginia, Rogers's No. 4. **Kentucky**: Catawba, (in old vineyards) Ives, Delaware. **Kansas**: Delaware. **Missouri**: Norton's Virginia, Concord Catawba, Delaware, Herbemont, Clinton, Ives. **Minnesota**: Concord. **Michigan**: Delaware, Concord. **Massachusetts**: Concord, Delaware. **New Jersey**: Delaware, Clinton. **North Carolina**: Scuppernong. **New York**: Delaware, Iona, Catawba, Isabella, Concord, Clinton, Oporto. **Ohio**: Catawba, Delaware, Concord, Ives, Norton's Virginia, Clinton. **Pennsylvania**: Catawba, Delaware, Isabella, Concord, Clinton, Ives. **South Carolina**: Scuppernong, Clinton. **Wisconsin**: Isabella, Catawba.

What varieties are principally grown? Arkansas: Catawba, Concord. Connecticut: Hartford Prolific, Concord. Delaware: Concord. Georgia: Scuppernong. Illinois: Concord, Catawba, Clinton, Hartford Prolific, Delaware, Norton's Virginia, Isabella, Herbemont, Iona, Diana, Ives. Indiana: Concord, Catawba, Isabella, Delaware, Ives, Norton's Virginia, Clinton, Diana, Hartford Prolific, Iona. Iowa: Concord, Clinton, Norton's Virginia, Catawba, Roger's No. 4, Delaware. Kentucky: (old vineyards,) Catawba; (new vineyards.) Ives, Concord, Delaware, Diana, Norton's Virginia. Kansas: Concord. Missouri: Concord, Norton's Virginia. Catawba, Delaware, Clinton, Herbemont, Isabella. Iona. Minnesota: Concord, Northern Muscadine. Michigan: Concord. Massachusetts: Concord. New Jersey: Concord, Isabella. North Carolina: Scuppernong; New York: Isabella, Delaware, Concord. Catawba, Diana. Iona, Clinton, Salem, Hartford Prolific. Ohio: Catawba, Concord, Isabella, Delaware, Ives. Norton's Virginia, Clinton, Hartford Prolific, Diana. Pennsylvania: Concord, Isabella, Catawba, Iona, Diana, Hartford Prolific, Clinton, Creveling. South Carolina: Scuppernong, Catawba. Tennessee: Catawba. Wisconsin: Concord, Delaware.

What varieties give the heaviest must on the sugar scale? Connecticut: Delaware. Georgia: Pauline, Herbemont, Catawba, Scuppernong. Illinois: Delaware, Norton's Virginia, Catawba, Rulander, Concord, Herbemont, Clinton. Indiana: Catawba, Delaware, Ives, Concord. Iowa: Delaware, Norton's Virginia, Catawba, Concord, Clinton. Kentucky: Norton's Virginia. Kansas: Delaware. Missouri: Norton's Virginia, Delaware, Concord, Catawba. Minnesota: Delaware, Iona. Michigan: Delaware. Massachusetts: Delaware, Clinton, Concord. North Carolina: Scuppernong. New York: Delaware, Iona, Diana, Clinton. Ohio: Delaware, Catawba, Norton's Virginia, Concord. Pennsylvania: Delaware, Iona, Isabella, Catawba. South Carolina: Catawba, Pauline.

What varieties are most subject to leaf diseases, and to what extent are they injured? Arkansas: Isabella, badly; Concord, slightly. Connecticut: All varieties more or less except Ives. Georgia: Pauline, Herbemont, and all the varieties of the *Vitis Labrusca*. Illinois: Catawba, Delaware, Clinton, Isabella, Rebecca, Diana, Iona, Ives, Hartford Prolific, Maxatawny, Israella, Creveling. Indiana: Catawba, Delaware, Isabella, Cuyahoga, Iona, Israella, Concord, Diana. Iowa: Clinton, Catawba, Diana, Isabella, Rogers's Hybrids, Allen's Hybrid, Iona. Kentucky: Rogers's Hybrids, Delaware, Clinton, Tokalon, and all varieties if pruned in summer. Kansas: Delaware, Catawba, about three-tenths. Missouri: Catawba, Delaware, Isabella, Iona, Clinton. Michigan: Isabella, Iona, Israella. Massachusetts: Delaware, Creveling, Israella, Diana, Hamburg; Creveling, four-tenths to five-tenths. New Jersey: Delaware, Creveling, Rebecca, Iona, Diana, Allen's Hybrid, Maxatawny. New York: Delaware, five-tenths; Adirondac, four-tenths; Walter, three-tenths; Allen's Hybrid, three-tenths; Isabella, two-tenths; Concord, one-tenth; Diana, one-tenth; Rebecca, one-tenth; Iona, one-tenth; Israella, one-tenth. Ohio: Catawba, Delaware, Iona, Isabella, four-tenths to five-tenths; Rogers's Nos. 3, 4, 15, three-tenths to five-tenths; Allen's Hybrid, four-tenths; Israella, three-tenths; Clinton, Iona, Diana, one-tenth to three-tenths. Always most injurious to plants that are overloaded with fruit; prevents ripening of wood, and weakens the vitality of the plant. Pennsylvania: All varieties are subject to leaf blight, sometimes to the extent of seven-tenths of the foliage, except Concord Hartford Prolific, and Northern Muscadine. South Carolina: Catawba, Isabella. Tennessee: Isabella, very badly. Wisconsin: Little or no disease.

What varieties are most subject to rot, and to what extent? Arkansas: Clinton, Isabella. Connecticut: Diana. Georgia: Catawba, Isabella, six-tenths. Illinois: Catawba, seven-tenths to entire; Isabella, five-tenths to eight-tenths; Clinton, four-tenths to six-tenths; Creveling, five-tenths to seven-tenths; Diana, five-tenths; Taylor's Bullet, three-tenths; Tokalon, three-tenths; Iona, four-tenths; Rebecca, three-tenths; Concord cracks. Indiana: Catawba, three-tenths to eight-tenths; Isabella, three-tenths to eight-tenths; Diana, three-tenths to five-tenths; Concord, two-tenths. Iowa: Catawba, five-tenths to eight-tenths; Diana, four-tenths; Isabella and Clinton, three-tenths; Concord, one-tenth. Kentucky: Rogers's Hybrids, Iona, Catawba. Kansas: Catawba rots badly in wet seasons. Missouri: Catawba, Isabella, Iona, Tokalon. Michigan: Catawba, Isabella. Massachusetts: Diana; very little in other varieties. New Jersey: Isabella in wet locations only. North Carolina: Catawba. New York: Catawba, three-tenths to four-tenths; Concord, one-tenth to two-tenths; Diana and Delaware on low, alluvial lands are subject to rot to a great extent. Ohio: Catawba, three-tenths to eight-tenths; Isabella, three-tenths to six tenths; Israella, three-tenths; Diana and Iona, three-tenths; Concord, one-tenth to three-tenths. Pennsylvania: Catawba and Isabella, very badly, frequently to the extent of eight-tenths. South Carolina: Catawba, Warren. Tennessee: Isabella and Catawba very badly after bearing two or three crops of fruit. Wisconsin: Allen's Hybrid, three-tenths.

What effect has shelter or protection, of any kind, in preventing leaf diseases? Arkansas: Sheltered trellis effectually prevents leaf diseases. Connecticut: Very little effect. Georgia: Always fair when grown in trees. Illinois: Favorable wherever tried; even slightly-covered trellis insures against mildew; protection will insure fair crops in the most unfavorable seasons. Indiana: Beneficial where tried. Iowa: Good where it has been tried. Kentucky: A beneficial effect to all tender-leaved varieties. Missouri: Where tried has exerted a favorable influence. Massachusetts: Beneficial by increasing the temperature. New York: Favorable where it does not prevent a free circulation of air. Ohio: Vines trained against buildings and on covered trellises are free from leaf diseases, instances are known of successful culture of uncertain varieties under shelter, successive crops for thirteen years having been raised. South Carolina: Most excellent effect; prevents leaf diseases. Tennessee: Vines protected by projecting eaves or copings always do well.

What effect has soil in reference to rot in the berry? Illinois: Low, wet soils almost invariably produce rot in the berry; rich lands also seem to induce rot in the berry. Indiana: Wet and rich soils are the prevailing causes of rot in the berry. Iowa: Undrained clay soils cause rot. Kentucky: Stiff, retentive subsoils, keeping water near the surface, produce rot. Kansas: Very rich soils cause rot in the grape. Missouri: Rot in the berries is very rare, and is seen on rich or heavy clay soils only. Massachusetts: Not liable to rot on dry soils. New Jersey: In wet seasons and on wet soils we have rot in the berries. North Carolina: The rot is frequently disastrous on rich or retentive soils. New York: Only on low grounds and wet subsoils. Ohio: Heavy wet soils are extremely pernicious, and thought to be the primary cause of rot; drained soils, even clays, are almost entirely exempt. Pennsylvania: The rot is most destructive on undrained, heavy clays, but is also induced by over-manuring and enriching the soil. South Carolina: Seldom escape rot in the berries, on heavy, damp soils.

What soils, chemically considered, are most favorable to health and vigor of plant, and perfection of fruit? Arkansas: A reddish clay soil, intermingled with sand, is the most congenial, so far as experience confirms; on pure clays the crop has failed. Connecticut: A good depth of limy, loamy soil is best. Georgia: Soils containing alkaline phosphates, and considerable humus, are most productive, and maintain healthy plants. Illinois: Silicious and calcareous soils are well suited; also gravelly clay soils, if somewhat rolling on the surface; clay subsoils are very good, if not too wet; especially so if they contain some iron and lime Indiana: Grapes do well on clays if properly drained and limed; also very fairly on gravelly and sandy soils when properly worked. Iowa: The vines seem to do equally well either on silicious, calcareous, or gravelly soils, where the last is not too poor or light. Shales are very good. Clayey soils produce the richest fruit, but sandy soils the greatest amount of vine. Kentucky: Soils containing much oxide of iron seem to favor the rot. Kansas: A sandy clay soil is best for grapes. Missouri: The most favorable soils are those of a silicious and calcareous nature, containing magnesian limestone, with potash and phosphates; clay soils are very good, but they must be drained. Michigan: The earliest and sweetest fruit is produced on clay soils, but sandy soils give the largest and best looking fruit. Massachusetts: Where the growing season is short, a dry sandy soil is preferable. North Carolina: A light sandy loam gives best results. New York: Calcareous and aluminous soils abounding in phosphates; shaly soils are always good. Ohio: Calcareous and aluminous soils, well drained; also rotten shales. Pennsylvania: Calcareous soils in combination with iron; shaly and silicious soils are very well adapted. South Carolina: The varieties of *Vitis estivalis* prefer silicious soils; the varieties of *Vitis vulpina*, those of an aluminous character; and the varieties of *Vitus rotundifolia* do equally well in either; as a general rule, light soils are best if supplied with lime and potash. Wisconsin: A loose limestone soil is perhaps the most favorable; sandy clay soils are also good, but very stiff clays are not so profitable.

What effects have been observed from mechanical conditions of soils, such as draining, subsoiling and other cultural operations? Arkansas: Subsoiling and trenching show marked results for good. Connecticut: Draining is indispensable in order to get the grape to grow in originally wet soils. Illinois: Draining, trenching, and good culture are necessary; the soil should be well pulverized and manipulated before planting. Indiana: Draining seems indispensable in most soils; subsoiling and good culture generally are always attended with marked results. Iowa: Deep plowing, in conjunction with draining and subsoiling, prevents rot to a very great extent. Kentucky: Draining and subsoiling pay well. Kansas: We find the best results on drained soils, and shallow after culture.

Missouri. The yield of fruit is largely increased by draining, trenching and subsoiling. Massachusetts: Draining is useful. North Carolina: The products are greatly improved by proper stirring and culture of the soil. New York: Draining and subsoiling are of essential benefit, making the growth more certain, and preventing injury from drought. Ohio: Very dry soils are vastly improved by trenching; draining is indispensable in stiff clays, and subsoiling favorable; good clean culture will always be attended by best crops. Pennsylvania: Under-draining is always attended with good results in tenacious soils. South Carolina: Draining is absolutely necessary in clay soils; subsoiling is useful in aluminous lands, but of no use in silicious soils. Tennessee: Draining and deep culture, especially on poor soils, are of great benefit. Wisconsin: Deep culture is necessary in dry summers.

What effect has elevation upon the health of the vine? Give results of observations, and opinions as to the proper height above valleys. Arkansas: Other things being appropriate, we prefer low situations, because they are sheltered from heavy storms. Connecticut: No difference if the ground is dry in the valleys. Illinois: Elevated rolling lands are decidedly the best, but elevation is not so important when near large bodies of water; near small streams, or in valleys distant from water, an elevation of from one hundred and fifty to two hundred and fifty feet is much preferable; very liable to freeze in low grounds. Indiana: An elevated position is always the best; grapes are healthier, with much less disposition to rot, even in wet seasons. Iowa: An elevation of fifty to two hundred feet above streams has proved best. Kentucky: There is no question but that elevated sites are to be preferred, where the air can circulate freely, and be protected from slight frosts. Kansas: Elevations of fifty to one hundred feet above valleys, with grounds sloping to the south, are the best. Missouri: Elevations of from three hundred to four hundred feet above the water-level have proved the very best, for health and value of products. Minnesota: The best vines are those cultivated on elevations one hundred to two hundred feet above the river. Massachusetts: Side hills (of no great elevation) with southern slopes are most favorable; northern slopes and low frosty hollows must be avoided here. North Carolina: The Scuppernong grape does best in low lands, but other varieties succeed only on elevations; on the mountain sides, where we are exempt from occasional late and early frosts, failure has never been known: in low valleys they are destroyed by blight and rot. New York: Our best vineyards are on considerable elevations, from fifty to four hundred feet above the valley. On these high lands we are not subject to early frosts in autumn, and the vine is healthier generally than in low grounds. Ohio: Elevations are considered good, but opinions differ as to height; some prefer being within range of fogs; fifty to three hundred feet above creeks and small streams exempts from early fall frosts, and vineyards are generally more healthy; where there are large bodies of water, elevation seems of but little consequence. Pennsylvania: Elevations of from two hundred to four hundred feet are safer in early and late frosts, and both the fruit and the vines are superior to the production of low grounds. South Carolina: The best grape region is that above the frost-belt on the mountain slopes; this is clearly indicated by the fact that a diseased grape leaf or berry has never been seen on these elevated lands. Tennessee: We find decidedly the best grapes on elevated positions. Wisconsin: Elevations are subject to destructive wind-storms.

Has any variety of the foreign grape proved remunerative in vineyard culture? The returns uniformly express a negative answer to this question.

What is the effect of summer pruning, and what method of winter pruning is best? Arkansas: Judicious summer pruning assists in developing the fruit; any system of renewal is good for winter pruning. Connecticut: Vines that are allowed to run all summer without pruning invariably yield large crops. Delaware: When summer pruning is judiciously performed, it has a tendency to increase the quantity and quality of the fruit; and also tends to promote maturity of growth. Georgia: We find summer pruning injurious. Illinois: All known methods of pruning are more or less practiced. Summer pruning is considered hurtful, according to its severity. Cases are cited of severe summer pruning causing the loss of half of the crop. Indiana: Summer pruning should be limited; it is injurious if severe. All methods of renewal and spur methods of winter pruning are practiced. Iowa: Summer pruning is injurious, if it involves the removal of much of the foliage. A moderate pinching of the points of fruiting shoots checks growth and improves the fruit. The renewal and other systems of winter pruning are practiced. Kentucky: On the whole, summer pruning is considered injurious, and should be abandoned. Kansas: Summer pruning should be strictly confined to pinching out the points of shoots, and not removing them entirely. Missouri: Summer pruning is practiced to a moderate extent. The winter pruning takes place in November. All modes are practiced. Michigan: Summer pruning is deemed hurtful when carried to any considerable extent. The winter pruning is on the renewal system. Massachusetts: Very little summer pruning. Winter pruning on the spur system. North Carolina: Summer pruning severely injures, and sometimes kills the vine in this locality. New York: Summer pruning is injurious, except so far as to check the growth of rampant shoots, or remove superfluous wood. All systems of winter pruning are practiced, but the renewal mode is preferred. Ohio: Summer pruning is injurious as an unqualified system, but is favorable to the extent of removing superfluous buds, and checking over luxuriant growth. Many systems of winter pruning are practiced, but the renewal system is preferred. The system of horizontal arms with spurs has resulted in comparative failure. Pennsylvania: Moderate summer pinching is favorable to increase in the size of fruit, but is likely to increase the present at the expense of subsequent crops. Winter pruning is varied, both the renewal and the spur system in various modifications being practiced. South Carolina: Summer pruning is not practiced. The renewal system has been adopted in winter pruning. Tennessee: No summer pruning done. Wisconsin: Summer pruning is found to be beneficial when done with judgment. Winter pruning is done in November.

What insects are most injurious to the vine, and what is the extent of the injury; and what remedies have proved efficient? Arkansas: The leaf roller is somewhat troublesome on all varieties, except the Scuppernong and Clinton. Connecticut: The thrips is sometimes very injurious. Delaware: A small curculio, is very destructive. Georgia: No trouble from insects. Illinois: The leaf folder, thrips, borer, and curculio are occasionally found in vineyards. Shaking and hand-picking are the only known remedies for the last named. Indiana: Insects are not troublesome, although rose bugs occasionally devastate the young fruit bunches. Iowa: The leaf roller and thrips are the principal insect enemies. The first named can be destroyed by dusting with hellebore powder. Kansas: The thrips is sometimes seen, but not to any great extent. Missouri: The rose bug, thrips, and some other insects are to be seen, but not to any great extent. Minnesota: No injury from insects. Massachusetts: Rose bugs are troublesome. New Jersey: Rose bugs sometimes destroy the crops. North Carolina: The Scuppernong grape is exempt from all insect enemies; other varieties are sometimes injured. New York: The grape beetle, thrips, rose bug, and caterpillar appear. Whale-oil soap and dusting with lime are good preventives. Ohio: A worm that eats its way from one berry to another does considerable injury. The thrips is most destructive upon thin and smooth-leaved varieties. They have been prevented by washing the vines with a mixture of soft-soap and suphur in the fall, after the decay of the foliage; also by fumigating with tobacco smoke on their first appearance. Lime and sulphur sprinkled on the leaves are also effective. The rose bug, steel-blue beetle, and curculio are occasionally troublesome. Pennsylvania: Various insects make their appearance, but none of them are very injurious, except the thrips in some dry seasons. South Carolina: The thrips is occasionally troublesome. Tennessee: No insects of any moment. Wisconsin: The thrips to a small extent

According to the above reports, the most popular varieties for table use are, first, Concord; second, Delaware; and third, Catawba. Those in highest repute for wine, are first, Delaware; second, Concord; third, Catawba, and Scuppernong in the Southern States. The varieties principally grown are the Concord and Catawba, but the newer varieties are rapidly being disseminated, and their representative merits will be tested in a few years. On the must scale the Delaware shows the greatest uniform amount of sugar, next the Iona; the Catawba and Norton's Virginia are also favorably mentioned in this respect. In regard to mildew and other leaf diseases, no variety appears to be entirely exempt; Concord, Ives, Hartford Prolific, and Northern Muscadine appear to suffer the least, and it is probably owing to this exemption from severe leaf injury that these varieties are so prominent. Rot in the berry is almost as universal as leaf blights, nearly all the varieties being liable under certain conditions. If any exceptions are made they refer to the family of summer grapes, the cultivated varieties of which are the Elsinburgh, Norton's Virginia, Lenoir, Cunningham, Herbemont, etc.; these appear to be noted for their freedom from rot. Old vines are also more generally liable to rot than those in young plantations. Shelter from dews and other atmospheric changes is considered advantageous in modifying leaf diseases. It has long been observed that plants growing under the partial protection of the overhanging eaves of a building, also those allowed to ramify unmolested on the branches of trees, are generally exempt from injury. Covered trellises seem to exert a similar influence. The effects of soil with reference to rot in the berry seems to be very decided. Soils that retain water, as undrained clays, are very likely to rot the fruit of grapes, more especially when the plants are over four or five years old. Very rich bottom lands are also conducive to this disease. Wet seasons are more fatal than dry on any soil, the primary cause appearing to be an excess of water in the soil. The chemical constitution of the soil does not seem to exert any very marked influence on the growth of the vine; clayey soils produce the richest fruit as also the earliest ripe; the latter, however, depending upon the moisture of the season; success evidently depends rather upon its physical quality. The conviction is gradually gaining ground that all grape soils should be artificially drained, unless they actually rest on an extremely porous strata; deep culture, or rather deep preparation of the ground, is also strongly recommended in connection with draining, the two operations being of much benefit only when simultaneously performed; draining being of little value unless the soil is deeply cultivated, and deep culture of but little value unless the land is drained. The effect of elevation upon the health of the vine is considered as favorable; the reports are nearly unanimous on this point. Not only are high lands more favorably disposed to drainage facilities, but the greater immunity from late spring and early fall frosts is of vast importance. Localities contiguous to large bodies of water are pre-eminently favored in this respect, but small streams in sheltered valleys have an injurious rather than a beneficial influence. The returns are entirely unanimous in regard to the failure of the foreign grape in vineyard culture, a fact which should be considered by those who are still experimenting with foreign wine grapes east of the Rocky mountains. The table given below will be found valuable as showing, at a glance, the status of viniculture in the several States of the Union.

States.	Number of counties reported.	Total acreage planted.	Total acreage in bearing.	Grapes produced. (tons).	Grapes sold, (pounds).	Wine manufactured, (gallons).	Average cost per acre.	Average product per acre, (pounds).	Average product of wine per acre, (gallons).	Average product per acre for five years, (gals).
Arkansas	....	....	....	....	....	....	....	....	....	....
Connecticut	1	45	35	20	10,000	15,000	$300 00	6,000	....	250
Delaware	....	....	....	....	....	....	....	....	....	....
Georgia	....	....	....	....	....	....	....	....	....	....
Illinois	37	2 711	1,515	1,415½	615,500	224,412	285 20	5,072	200	312½
Indiana	11	149½	104	81	10,000	6,922	274 00	6,666⅔	250	300
Iowa	7	178	111	26	19,000	2,740	320 00	6,200	....	180
Kentucky	....	....	....	....	....	....	....	....	....	....
Kansas	....	....	....	....	....	....	....	....	....	....
Missouri	19	1,528¼	992	944½	237,000	163,116	341 50	6,900	483⅓	540
Minnesota	1	5	1	2	1,000	80	....	....	....	....
Michigan	2	45	13	12	8,000	1,575	197 00	....	....	....
Massachusetts	2	94	38	15	10,000	2,000	400 00	7,000	....	....
New Jersey	1	50	40	....	....	....	....	....	....	....
North Carolina	2	200	....	....	....	5,000	40 00	....	700	450
New York	9	7,473	4,387	7,338	2,322,000	234,250	247 14	4,571	....	416⅔
Ohio	23	10,000	7,387	4,330½	4,813,000	384,012	274 00	3,475	320	199½
Pennsylvania	6	1,101	612	1,030	1,402,500	34,100	140 00	3,000	....	200
South Carolina	2	500	475	[illegible]	....	1,000	100 00	2 000	150	275
Tennessee	....	....	....	....	....	500	....	....	....	....

VIOLET. *Viola.* The pansy or heartsease, *V. tricolor*, is, or should be cultivated in every garden, since if protected in winter, it will give abundant bloom from May to August, and again in the fall. If placed in a cool moist shady situation it will bloom all summer. Some European varieties of violets are sweet scented, ours are not, but they make up in beauty what they lose in perfume. We have eighteen species. The dog-tooth violet, should not be included. It is an *erythronium*, and belongs to the lilly family. If the seeds of pansy are started early in a hot bed and transplanted, they will bloom early in the season, giving an abundance of flowers.

VIREO. The fly catchers, are among our most useful and innocent birds. The principal species are red-eyed vireo, *V. olviaceous;* the warbling vireo, *V. gilrus;* the white-eyed vireo, *V. noveboracensis;* the solitary vireo, *V. solitarius* and the yellow-throated vireo, *V. flavifrons.* The species are all trim, delicate in plumage, indefatigable in the pursuit of insects, and should be protected so they may feel entirely at home about the house, barns, garden and orchard.

VIRGIN'S-BOWER. *Clematis.* The common Virgin's-bower, *C. Virginiana*, from its habit of climbing to the tops of young trees and covering them with gossamer-like blossoms. The whole species are perennial herbs or vines, a little woody and climbing by the twisting of the leaf stalk. The following species are native North except *C. cylindrica*, which occurs at Norfolk, Va. and South. Northern species are, *C. ochroleuca*, *C. viorna* and *C. Pitcheri.*

VITELLUS. An occasional covering of the embryo in seeds. The white of an egg.

VITREOUS HUMOR. The fluid or humor which fills the posterior chamber of the eye.

VITRIOL. An old name for the sulphates.

VITRIOL, OIL OF. Sulphuric acid.

VIVES. This is a chronic enlargement of the glands of the lower jaw, and extending to the mouth. These becoming tender, at length discharge. This may generally be met by painting the affected parts with tincture of iodine. If not, prepare for application to the skin, over the swelling, an ointment composed of one drachm of biniodide of mercury, well triturated with an ounce of lard. This may be repeated daily until a free secretion from the skin is accomplished.

VIVIPAROUS. Producing living young, and not eggs.

VOLATILE ALKALI. Crude ammonia. (See Nitrogen.)

VOLUTE. In architecture, a scroll.

VOLVA. The wrapper or veil of certain fungi, as the agaricus.

VULTURE. The *vulturidæ* are represented in the United States by three or four species, only two of which are of importance in agriculture—the Crow, (see Crow) and the turkey buzzard, *cathartes aura*. This species is found everywhere South, more rarely north of the Ohio river, and living on dead carcases and putrid flesh as scavengers, are beneficial and tolerated. From being carefully protected in the South, they become quite tame. As compared with the crow, they are not nearly so beneficial, since the crow subsists in the North almost entirely on insects and small animals, only depredating on corn when other food fails. South the vulture is a beneficial bird. North it is not known.

W

WACKE. A hard basaltic rock.

WALKS. Walks, drives and roadways, in the vicinity of the farm or rural dwelling, should be so carefully made that they are good at all times, and should approach as directly to the object sought as possible, and without unnecessary curves, especially short ones. Within the house place, curved lines are admissible and beautiful, and here much elaboration may be spent, and once decided on they must be carefully formed and carefully kept, for nothing looks so slovenly as weedy, untidy, half-formed walks or drives through the grounds or garden. Thus unnecessary walks and roads should always be avoided. In relation to walks and roads on the farm, but specially about the homestead: It is true that the beauty of curved lines sometimes prompts to a deviation from the more available direct course; and, where it can be done without too great sacrifice of utility, it is not objectionable. But no walk should be turned from its obvious direct course without an apparently sufficient reason. A change of level in the ground, a tree or a group of plants, or other similar obstruction, will induce, and seemingly demand, a change of line. There are many locations where the straight line should be preferred as a matter of taste in design. As a connecting link between the strictly horizontal and the perpendicular lines of a building, and the irregular surfaces surrounding it, a perfectly straight walk is in the best taste and adds greatly to the effect of the architecture, while a frequently curving walk detracts from it. So also, a walk along the side of a straight boundary fence should not curve if both lines are visible at the same time. Most persons are aware of the great beauty of straight walks and avenues of trees; and for public parks of lesser order, enclosed by formal outlines, they can always be introduced with great effect, as well as convenience, where curving walks would be the reverse. In this case beauty depends upon harmony rather than contrast, and more than either upon utility. When roads or walks are carried over irregular surfaces, the natural turns and windings necessary to follow an easy or uniform grade, and keep as near the original surface of the ground as possible, will usually develop pleasing curves. A little studied attention in this matter of the course of a road will not only increase the beauty of curves by adding to them the grace of utility, but also deep and expensive cuttings, as well as heavy embankments, will be avoided, and easy grades and economical construction be more certainly secured. When it is necessary to branch a secondary road from the main line, it should leave the latter at as nearly a right angle as convenient, and at the same time be somewhat narrower, so that its appearance may convey the proper idea of its being subordinate, and so avoid confusion and mistake; otherwise the roads leading to the stable, ice house, or garden, may be mistaken for the road to the mansion. Under no circumstances should walks be made conspicuous in views of natural scenery. If it is essentially necessary that a walk should cross a lawn where it would interrupt a continuity of view, and destroy breadth of effect, it should be sunk beneath the line of vision by placing it in a slight excavation, which may be further assisted by throwing up a small mound on the side nearest the point of view. These expedients, as also that of planting thick groups of low-growing shrubs, will be effective and satisfactory if properly executed. In laying out curving roads it is not advisable to closely follow geometrical rules, or to set the curves out to any regular radius. This plan may occasionally prove perfectly satisfactory on a strictly level surface, but it will have quite an opposite effect where the ground is greatly undulating. The curves, to be pleasing, must be attractive—not too sudden or abrupt—and properly blended at their points of junctions. Very much of personal comfort and pleasure in rural residences depends upon good roads. A smooth, firm, dry road is one of the greatest conveniences and enjoyments; while a rough, soft, muddy road is one of the greatest drawbacks and annoyances of country life. Bad roads form the greatest obstacles to progress and permanent improvements in all the neighborhoods that are blasted with their presence; they have a demoralizing effect upon the inhabitants, and are a sure sign either of poverty or mismanagement, or both. Water is the worst enemy to good roads. It is, therefore, a leading principle in road making so to construct them that they may be kept dry. In absence of a timely recognition of this principle, many costly roads have proved to be failures; but where it has had prominent recognition and its value has been properly appreciated, good roads have been made at a trifling expense. After locating the road and marking out its course, the sides should be brought to the proper grade and finished by a layer of sod as a guide to further operations. In crossing a sloping surface it is not necessary to have both sides perfectly level, but the nearer this can be secured, with due regard to getting rid of surface water, the better it will admit of a neat finish and the more easily will it be kept in repair. The road bed is then formed by excavating and removing the soil to a depth of six inches at the sides, curving slightly higher in the center, and made perfectly smooth by rolling, producing a uniform surface upon which the material of the road is to be placed. The best stone for road metal is tough granite. Hard brittle stone is more readily reduced by pressure, but in a well kept road this difference is not important. It is, however, all important that the stones should be broken small. The largest should easily pass through a two-inch ring, and if one-half of them are small enough to pass through a ring of only one inch in diameter, the road will ultimately become all the more compact. The road bed should be filled with this broken stone to a level with the sides, increasing in depth toward the center at the rate of one inch to the yard. Thus, a road sixteen feet in width would have a depth of about nine inches in the center. The utmost care should be applied to regulating the surface, and the smaller stones should be used on top, in order to secure an even, compact, carefully moulded grade, which should be compressed by repeatedly passing a heavy roller over it, wedging every stone, and making a surface almost as smooth and solid as a pavement. A thin layer, not more than one inch in thickness, of fine clayey gravel should then be evenly distributed over the stones, and the roller again applied until the surface becomes homogeneous, firm, and close. The surface of the road will thus be higher than the sodded edgings; water will therefore pass readily from it, and one of the main points of keeping a good road will be secured. This will form a first class road for ordinary carriage drives, or for all purposes required in public parks or private grounds; and, if kept in good surface by frequent rolling, so as to prevent the forming of ruts while it is settling; and, if a facing of gravel is applied when necessary, it will permanently fulfil all requirements of a good road. The quality of gravel deserves notice. Wash gravel, consisting only of sand and rounded pebbles, should never be used. No amount of pressure will render it firm, and it is the most disagreeable material to walk upon. The best gravel is that to be found in banks composed of pebbles mixed with reddish clay; and the stones must be small. No detail in road making is of so much importance as this. If a wagon wheel or the foot of a horse press on one extremity of a stone the other end of it will probably be slightly raised, allowing small particles of sand to fall into the crevice, when the stone is loosened, and will roll on the surface; hence the necessity of using only very finely divided stones on top, so that they will be smaller than the pressing point, and not become disarranged from leverage or compound action. Where stone can not conveniently be obtained, the road bed may be filled with refuse matters of many kinds, such as coal ashes, clinkers from furnaces, and shells. Oyster shells are plentiful in many places near the seaboard, and form an admirable road; but the permanency, as well as efficiency of these materials in a road bed, will depend altogether upon the care of surfacing with proper gravel. Where it is impracticable to procure, or deemed inexpedient to use, any of the foregoing materials, an earth road may be rendered very serviceable by proper attention to the leading principle—that is, to keep it dry. In this case, instead of excavating a road bed, slight excavations should be made at the sides and the material spread over the center; and that surface water may pass to the sides more rapidly and thoroughly, a greater convexity may be given to the curve. In some sections of the country good roads are kept up in this manner, but they are carefully repaired whenever necessary, and all ruts and tracks are filled up as soon as they are formed. The same general principles apply to the formation of walks and foot paths. The depth of material, however, need not exceed a few inches. It is certain that much unnecessary expense is frequently laid out upon mere foot walks. A porous, gravelly, or sandy soil is in itself a good walk if properly shaped. Such walks admit of greater convexity than carriage roads, which is equivalent to a saving of material. Walks should be well filled up. There is no more disagreeable object, or one that conveys so meager an expression, as deep, raw edgings to a walk, looking as if they had been trimmed with a plow. Walks in this condition may be serviceable as water courses, but they are not comfortable foot paths. (See also Roads, and Landscape Gardening.)

WALL EYE. Opacity of the cornea; glaucoma.

WALL-PLATE. A timber lying on a wall on which girders, joists, etc., rest.

WALNUT. *Juglans.* The Walnut is represented by two species, the butternut, *J. cinerea*, and the black walnut, *J. nigra.* The walnut family, *Juglandaceæ* indeed includes *carya*, or the hickories, yet the name walnut is not generally applied except to the two species mentioned. (See Black Walnut and Hickory.)

WARBLER. The warblers, are as a class beneficial to the farmer, living almost wholly on the seeds of weeds and small insects. Our so-called snow birds, or winter sparrows, belong to this class, as also does our summer yellow bird. Some of the warblers remain north during mild winters, and hence are often seen in flocks with snow birds about houses and barnyards, driven thence in search of food in extreme weather. This class generally nest far north, returning late in the autumn. The principal species are the Blue Yellow-backed warbler (*Parula Americana*), the Maryland Yellow throat (*Geothlypis trichas*), Yellow-breasted Chat (*Icteria virides*), Nashville Warbler (*Helminthophaga ruficapilla*), Black-throated Green warbler (*Dendroica virens*), Yellow-rump warbler, or myrtle birds (*D. coronata*), Pine-creeping warbler (*D. pinus*), Chestnut-sided warbler (*D. Pennsylvanica*), Yellow warbler or Yellow bird (*D. æstiva*), Black-pall warbler (*D. striata*), and the Prairie warbler (*D. discolor*)

WARBLES. Under this name, and also Grubs and Sitfast, are designated the presence of hard lumps, proceeding originally from swelling of the glands at the roots of the hair, occurring generally at the neck, withers and back and at the roots of the mane and tail, generally appearing in the spring. They are inflamed follicles, which break and suppurate, and often end in small ulcers difficult to heal, where they are irritated by the harness or otherwise. They sometimes assume a malignant character which may end in mortification, or an inflamed ring around a whitish central path. It is then termed sitfast and is difficult to heal. In the more simple forms of the disease, when the pimples are ulcerating, they should be poulticed to promote suppuration, but with this in any case to alter the secretions the animal's bowels should be prevented from becoming costive, and an ounce of sulphur should be given in the feed once a day. If the sores seem to need a greater stimulation than poulticing will give, the following resolvent may be used as an ointment: One part of biniodide of mercury and seven parts of neatsfoot oil. Rub all well together and apply every day with gentle friction until the skin is excited or somewhat inflamed. If the difficulty ends in sitfast, cut out the hard part or dead skin in the center, and cover the whole with crude petroleum, or, better dress with an ointment of one drachm of carbolic acid and three ounces of lard.

WARREN. A place in which rabbits or other game are preserved, or in which they are naturally found.

WASH. The fermented liquor from which spirit is distilled.

WASHER. In building, a plate of iron set between a wall and timber, and the nut of a screw.

WASP. *Hymenoptera.* Insects having four membraneous wings, biting jaws and a sting in the extremity of the abdomen, bees, hornets, ants, gall flies, ichneumon flies and saw flies belong to the order, Hymenoptera. The class are mostly beneficial, the principal exceptions being the saw flies, (*Tenthredinida,*) the boring or wood wasps, (*Uroceridæ,*) and the gall flies (*Cynipidæ.*) When wasps build their nests, in trees near dwellings, or in the ground where their disturbance may be annoying, they may be destroyed in the first instance by syringing kerosene into their quarters at night and firing it. When found in the ground, pour kerosene over and into the nest and fire it immediately.

WATER. (See Meteorology, Moisture, Rain and Vapor.)

WATER CHESTNUT. *Scirpus tuberosus.* A rush cultivated in China and Italy for its root, which resembles a chestnut. It grows in ponds and ditches.

WATER CRESS. (See Cress.)

WATER PEPPER. (See Smartweed.)

WATERMELON. *Cucurbita citrullus.* Whatever has been said as to the cultivation of squash, muskmelon, etc., will apply to the watermelon. The varieties, generally cultivated, are the Carolina, Ice Cream, Imperial, and Mountain Sweet. The orange melon is small, early, of good flavor, the meat cleaving away from the rind. The Phinney, is one of the best early sorts and Haskell's, improved one of the best of the large late sorts. (See Melon).

WATER PEPPER. (See Smartweed).

WATER OF CRYSTALLIZATION. Water contained in crystals.

WATER PLANTAIN. The genus *Alisma*, consisting of useless water weeds.

WAVELLITE. A mineral of a radiated or stellated character, consisting of a hydrated phosphate of alumina.

WAX. Various plants are wax producing, among the most noted are the wax palm of Brazil, (*Copernicia cerifera*); the wax palm of New Granada, (*Ceroxylon andicola*); of Japan wax, produced from the fruit of (*Rhus succedanea*, and also *R. vernicifera*); Peetha wax, from the fruit of the white gourd of India, (*Benincasa cerifera;*) Fig wax, a secretion of the (*Ficus cerifera*, a native of the island of Sumatra. Wax of the *Cordilleras*, a green resinous waxy matter secreted by the stipules which envelop the unexpanded buds of (*Eloeagia nitilis*) (*Cinchonaceæ*) used as a varnish for various useful and ornamental objects. The candleberry or myrtle wax is yielded by the genus Myrica, widely prevalent in both hemispheres, principally in the temperate regions thereof; in the Azores, China, the Cape of Good Hope, Europe, Japan, Northern India, and North and South America. The North American species are, *Myrica cerifera*, and *M. Carolinensis*, the latter being the most valuable, yielding one pound of wax to four pounds of berries, and when burned diffusing a delightful odor, even some time after extinction.

WAYFARING TREE. The guelder rose. *Virburnum opulus.*

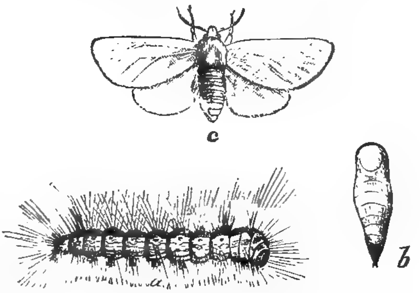
WEALDEN FORMATION. A portion of the upper secondary, consisting of heavy clays and green sand. It is remarkable for the great number of large saurians it contains.

WEASEL. *Putoria.* Usually regarded as verminous, and worthy of death wherever found, from the fact that they will destroy poultry. From the fact that they will destroy or drive away rats, wherever they are protected, the probabilities are that it should be classed among beneficial vermin, since it is easy to protect poultry against their ravages. The lesser weasel (*P. pusillus*) is the common species East and West. It is said to become white in the northern fur regions, but in more temperate regions it retains its brown color in winter. The small, brown weasel (*P.* (*cicognani*) *fuscus*) is another common species and more destructive to poultry than the preceding. The white weasel or American ermine (*P. noveboracensis*) is common east of the Mississippi, in the North, and is fierce, cruel, and sanguinary, boldly attacking animals four or five times its size. Unlike the true ermine, its fur is worthless, and it should be destroyed whenever found.

WEATHER-BOARDING. Boarding nailed either upright or horizontally, and lapping on the outside of the framing.

WEATHER GLASS. A barometer.

WEB WORMS. Web worms are that class of caterpillars which feed on the leaves of trees, and protect themselves by means of webs, within which they feed or else congregate at night. The webs are not only unsightly, as seen on the



FALL WEB WORM.

fruit trees, but they are among the most destructive of leaf-eating insects. They should be destroyed wherever found, and also should be carefully looked for that they may be destroyed while yet young, and before they have done much damage. The cut shows one of the most destructive of these caterpillars, the Fall Web Worm, (*Hyphantria textor*) *a*, larva or caterpillar, *b*, pupa, *c*, perfect insect or moth. The only remedy is by hand picking or thrusting a broom or brush into the webs, and winding them in it with their webs.

WEDGE. One of the simple mechanical powers, the efficiency of which is proportional to the length of the side. Knives are wedges.

WEED. (See Shot of Grease.)

WEEDS. Any plant growing where it is not wanted may truly be classed as a weed. The name, however, is only properly applied to those plants not valuable in agriculture. So long as the slovenly farmer, who grows weeds, can get nearly or quite as much for his illy cleaned grain, the work of extermination would seem hopeless. How serious this evil is the following facts will show, for if we consider the immense number of weed seeds that are mingled among our seeds, we would be at no loss to account for the growth of these pests in our fields. Prof. Buckman discovered, in a pint of clover seed, 12,600; in broad clover, 39,440; and two pints of Dutch clover yielded, severally, 25,560 and 70,460 weed-seeds. Supposing these samples to be sown, here were seeds enough to stock the land with weeds for many years. If we take into account the great fecundity of some weeds, we will not feel the least astonished at the increase of the plants when the seeds are sown, and the plants allowed to arrive at maturity. Prof. Buckman has counted 8,000 seeds in a single plant of black mustard, and in a specimen of charlock 4,000 seeds. The common stinking chamomile produces 46,000, and the burdock 26,000 seeds; and the seeds of a single plant of the common dock produced 1,700 little docks. It is found that a single plant of the common groundsel will produce 6,500 seeds in one summer. The graceful corn cockle sheds 2,600 productive seeds; and the red poppy, which diversifies our corn fields and looks so gay upon our hedges, produces 50,000 minute but vital seeds. The corn sow-thistle launches out into the wind its 20,000 flossy parachutes to take root far away. The common dock lets fall 13,000 solid grains, each destined to shoot down a tap root into the soil. Dandelion produces nearly 3,000 seeds, each furnished with an inimitable apparatus for distant flight. The cow-parsnip, if neglected, will produce 5,000 plants; the meadow scabious, 4,000; the mayweed, 45,000; the daisy, 13,500. Says the *North British Agriculturist*: Alexander II of Scotland denounced that man to be a traitor who poisons the king's lands with weeds, and introduces a host of enemies. Whoever was found to have three heads of common star-wort among his corn, was fined a sheep for each stalk In Denmark the farmers are bound by law to destroy the corn-marigold, and in France a farmer may sue his neighbor who neglects to eradicate the thistles upon his land at the proper season. A law is in operation in Australia to the same effect, and it is proposed to introduce a similar enactment into the Canadian code. Nor have suggestions for such enactments been wanting in England. A clause enforcing the extirpation of weeds in hedges, or along the sides of roads, passed through the House of Commons, but it was for some reason negatived by the Lords. To come to the practical extermination of weeds in the United States, we have found that legislation is of but little avail, it is too difficult to enforce laws relating to the killing of weeds. Each person must exterminate weeds for himself. Fortunately those who do so most carefully are not only the best farmers, but also find their profit in so doing. As to what weeds are, they have been defined, as before stated, as being any plant whatever, out of place. That is wheat or Indian corn if growing anywhere, if not grown for profit, would be, or should be, considered a weed. Yet the more proper appellation of weeds are those plants noxious or not profitable to the cultivator. The late Dr. Darlington has given the most comprehensive and graphic monogram, originally written for the United States government, that we have seen, arranged according to the natural method or according to the plan adopted by Hooker, Torrey, Gray, etc., giving the authentic scientific names of the genera and species so all may be able to understand them, and also the common names so far as they can be traced. Our author has so classified them that the reader will find no difficulty in the reading. The list is given in the author's style and language as follows: In this article the plants are divided into *Phænogamous*, or flowering plants, and *Cryptogamous*, or flowerless plants; also into exogenous plants, or outside growers, as the oak; and endogenous plants, or inside growers, as Indian corn. (p.) denotes a perennial plant; (b.) a biennial; (a.) an annual, and (s.) a woody shrub or small tree.

DIPETALOUS EXOGENS—THE PETAL MOSTLY DISTINCT.

Ranunculus bulbosus. Buttercup, bulbous crowfoot, (p). This foreigner is extensively naturalized in grass plots, meadows, and low ground pastures along our streams, where it is regarded as a nuisance by the farmers. The fleshy bulb is highly acrid, and the plant when once introduced is difficult to subdue. The most effective remedy yet found is to get the plant closely depastured in early spring by stock, especially sheep. Another perennial species, viz: *R. acris*, or tall crowfoot, is naturalized in New England, and is as obnoxious as its congener.

Delphinium consolida. Field Larkspur, (a.) This introduced plant has strayed from the garden in many places, and is an unwelcome intruder in grain fields and other cultivated grounds. This and a kindred species (*D. adjacis*) have become so common in gardens that some attention is requisite to prevent them from trespassing on the farms. Plants which have matured their seeds in the garden should never be carried to the barnyard nor permitted to mingle with farm manures, otherwise the fields will be speedily infested with worthless and pernicious weeds. A slight plowing after the removal of the crops from the fields will favor the germination of the seeds, which will be destroyed by the regular plowing of the field.

Papaver eubium. Field Poppy, (a.) This foreigner has found its way into some districts, and, if unattended to, may become a troublesome weed, as it and the Corn Poppy (*P. rhoeas*) are in Europe. A similar remark is applicable to the Prickly Mexican Poppy (*Argemone Mexicana*) another kindred weed which has been introduced This plant should be extirpated by hand-weeding before the ripening of the seed. In Italy the prickly poppy became so obnoxious as to be called infernal figs.

Camelina sativa. Wild Flax, gold of pleasure, (a.) A naturalized foreigner, and, where neglected, becoming a great nuisance—formerly supposed by the simple and credulous to be a sort of transmuted or degenerate flax. It has been subdued by annual plowing, so managed as to allow the seeds to vegetate, and thus destroy the young plants before the seeds on them are matured.

Capsella bursa-pastoris. Shepherd's purse, (a.) A worthless little intruder from Europe, but the valuable grasses will generally choke out such small weeds.

Raphanus raphanistrum. Wild Radish, jointed charlock, (a.) A naturalized weed, becoming a nuisance in the Northern States. It has already invaded New England and Pennsylvania, and is tending westward. The seeds are contained in a jointed pod, and are thus protected from the severity of frost and concealed from birds until liberated by the process of decay of the pod.

Hypericum perforatum. St. John's Wort, (p.) A foreign weed, formerly supposed to cause cutaneous ulcers in white cows and on horses with white feet and noses; but, the disease disappearing, that notion seems to have become obsolete.

Agrostemma githago. Cockle, rose campion, (b.) A well known foreign weed infesting wheat fields. The black-coated seeds, when abundant and ground with wheat are injurious to the appearance of the flour. The root of this plant should be cut below the surface with a chisel fastened to a long handle and wielded by children. If this is neglected in the early part of the season, the fields should be scarified immediately after the removal of the crops. to favor the germination of the seed, and ultimate destruction by fall ploughing and the frost. The seed obtained from the screening of cereals should not be thrown out upon the manure heap, but fed to fowls, and the refuse left by them should be burned the next day.

Abutilon avicennæ. Indian Mallow, velvet leaf, (a.) This foreigner, hitherto regarded as a worthless and troublesome intruder in Indian corn fields. potato patches, and other cultivated lots. has been recently announced (together with *Hibiscus moschatos* a malvaceous perennial, native of our maratime marshes,) as yielding a fibrous bark suitable for textile purposes, similar to the Jute of commerce. obtained from Asiatic species of corchorus, and employed in the manufacture of gunny bags. The economical value of this material, which is termed American Jute, must be ascertained by experience.

Rhus venenata Poison Sumach, poison elder,(s.) A noxious shrub frequent in moist. low grounds, by which many persons are liable to be badly poisoned. A similar cutaneous affection is often produced by the climbing variety of another species--the *Rhus toxicodendron*, Poison Vine or Oak.

Trifolium arvense. Stone Clover, Welsh clover, rabbit-foot, (a.) This foreign plant is only entitled to notice on account of its worthlessness and prevalence in poor, old fields. Its presence is a pretty sure indication of a thin soil and neglected agriculture, and the obvious remedy is to improve both.

Potentilla Canadensis. Cinquefoil, fivefinger, (p.) The varieties of this are rather harmless, though worthless native weeds, and are merely indications of a neglected soil. There is also a coarse, erect, homely, annual species, *P. norvogica*, which is becoming a frequent weed in the Middle States, and seems to have migrated from the North.

Rubus villosus. Blackberry Bramble, common brier, (p.) Every one knows the common brier; the fruit in its season is a general favorite, and some remarkably fine varieties have been produced under careful culture. The tendency of the plant, however, to spread and take possession of neglected fields, causes it to be regarded as something of a nuisance where it prevails. Another and kindred species, the *R. cuneifolius*, or Sand Blackberry, has found its way into Pennsylvania, apparently from New Jersey, and bids fair to establish itself in the land of Penn. Fence angles and waste places in which the briers have obtained a foothold should be cleaned of all weeds twice yearly, in spring and autumn. This will not only exterminate the briers, but admit air and light to the field borders, otherwise shaded.

Rubus Canadensis. Dewberry, running brier. (p.) Our American dewberry is a fine fruit, and generally preferred to all the blackberries proper, but it is not the dewberry of England, which is the *rubus cæsius* of Linnæus. There is scarcely a farmer's boy in Pennsylvania who is not well acquainted with our plant, from having encountered its prickly, trailing stems with his naked ankles while heedlessly traversing the old fields where it abounds On well managed farms, however, this and all other species of brier, (not excepting our native raspberries) are becoming rare.

Rosa Carolina. This is often an obnoxious plant in wet meadows and low grounds, forming unsightly thickets with other weeds if neglected. Another native species, *R. lucida*, the Dwarf Wild Rose, is quite frequent in neglected grounds. The foreign Sweet Brier, *Bosa Rubiginosa*, is naturalized in many localities and deemed a trespasser.

Sicyos angulatos. One-seeded Star Cucumber. This climbing vine, with leaves resembling those of the cucumber, is a native weed, and a vile nuisance when admitted into gardens and cultivated lots.

Daucus carota. Wild Carrot, (b.) When this wild variety of the common garden carrot becomes thoroughly naturalized, as it is now on many farms in the middle States, it is a troublesome weed, and requires persevering vigilance to get rid of it. It should be diligently eradicated before it ripens its seeds. In case of snow, with a smooth surface crust, the mature umbels break off and are driven by the wind to a great distance. and thus annoy an extensive district. Another umbelliferous nuisance is created by permitting the valuable garden parsnip *Pastinaca sativa*, to disseminate itself and multiply rapidly in adjoining fields, and along fence rows, giving to the farms a very slovenly appearance.

Archemara rigida. Cowbane, wild parsnip, (p.) This native weed occurs frequently in swampy meadows. and is reputed to be an active poison when eaten by horned cattle, which, however, probably seldom happens, unless the pasture is very deficient.

Ægopodium podagraria. Goat Weed, (p.) A foreign weed, troublesome, and difficult to eradicate.

Cicuta maculata Water Hemlock, spotted cowbane, musquash root, (p.) The root of this is poisonous, and proves fatal to children who collect and eat it by mistake for the root of sweet cicely, *osmorhiza longistylis*. It is found indigenous along rivulets and margins of swamps, and should be carefully eradicated.

Conium maculatum. Common or Poison Hemlock. (b.) A poisonous and dangerous weed, introduced from Europe, and occasionally met with about old settlements. It is supposed to be the identical herb with which the ancient Greeks put their philosophers and statesmen to death when they got tired of them.

GAMOPETALOUS EXOGENS—PETALS MORE OR LESS UNITED.

Sambucus Canadensis. Common Elderbush, (s.) This indigenous shrub is very tenacious of life, and inclined to spread extensively along fence-rows and hedges, giving the premises a very slovenly appearance.

Dipsacus sylvestris. Mill Teasel, wild teasel, (b.) This coarse European weed is completely naturalized in some localities, and is not only worthless, but threatens to become a nuisance if not attended to.

Vernonia noveboracensis. Wild Iron Weed, (p.) A coarse native plant, quite common in moist, low grounds, and along fence-rows. The root of this must be cut like the Canada thistle before the flowering season in spring, or the danger will be imminent of its over-running the whole area in a short period by means of its floating seeds

Eupatorium purpureum. Trumpet Weed, joe-pye weed, (p.) Several varieties of this tall, stout weed are indigenous on our moist low grounds.

Aster ericoides. Heath-like Aster, (p.) Numerous species of this large American genus meet the eye of the farmer, in the latter part of summer, in his woodlands, low grounds, borders of thickets, etc., some of which are quite ornamental, but the little bushy one here mentioned is about the only one which invades our pastures to any material extent. In neglected old fields, it often becomes as abundant as it is always a worthless weed.

Erigeron canadense. Horse Weed, butter weed, (a.) This American weed has diffused itself all over our country, and it is said, has reached and pervaded all Europe. The cultivation of hoed crops will clear the fields of this pest. Other varieties of the same genus infest meadows, which, if the evil becomes too burdensome, must be plowed up.

Erigeron strigosum. Flea-bane Daisy, (a.) This very common native weed is apt to be abundant in the first crop of upland meadow. after the usual routine grain crop. After that, especially in good lands, it becomes more rare, being probably choked out, like many other weeds, by the valuable grasses.

Solidago nemoralis. Golden Rod, (p.) Several species of golden rod occur along fence rows, borders of woods and thickets, and intrude upon neglected pasture fields.

Ambrosia trifida. Great Rag Weed, (a.) A coarse, ugly native weed, common in waste places.

Ambrosia artemisiæfolia. Bitter Weed, rag weed, (a.) This indigenous, bushy weed, occurs in most cultivated grounds, and is most abundant among the stubble, after a crop of wheat. But if the land be good, the plant seems to be smothered or choked out the next season by the usual succeeding crop of clover and the grasses. It is always ready, however, to make its appearance whenever the grassy turf is broken up by the plow.

Xanthium strumarium. Clot-weed, cockle-bur, (a.) This vile weed, of obscure origin, has the appearance of a naturalized stranger in our country, and seems, fortunately, not much inclined to spread. The burs are a great annoyance in the fleeces of sheep.

Xanthium spinosum. Thorny Clot-bur, (a.) This execrable foreign weed is fast becoming naturalized in many portions of our country, particularly in the southern States. It may be frequently seen also along the sidewalks and waste places in the suburbs of our northern seaports. It is stated that the authorities of a southern city a few years since enacted an ordinance against the offensive weed, in which enactment it was denounced by the misnomer of Canada thistle. This plant may be destroyed with the hoe in the latter part of summer—in September.

Bidens frondosa. Bur Marigold, (a.) Worthless native weeds in gardens, corn fields, etc., and particularly disagreeable by reason of the barbed awns of the fruit, which adhere in great numbers to clothing.

Bidens bipinnatus. Spanish Needle, (a.) This, like the preceding, if not carefully watched and extirpated, is a great pest in cultivated lots. Another species, *B. Chrysanthemoides*, known as Beggar-ticks, is rather showy, with its head of yellow-rayed florets, and is frequently found along swamps and rivulets in autumn. They are all regarded as nuisances on account of their adhesive fruit.

Maruta cotula. May-weed, fœtid chamomile, (a.) A disagreeable little foreign weed, which is extensively naturalized, and in bad odor among us.

Achillea millefolium. Yarrow, milfoil, nose-bleed, (p.) English agricultural writers speak of it as a plant of some value in their pastures; but it is generally regarded in this country as a mere weed. Certainly it is far inferior to our usual pasture plants, and our cattle are rarely, if ever, observed to eat it.

Leucanthemum vulgare. Ox-eye, daisy, white weed, (p.) This intruder from Europe has obtained almost exclusive possession of many fields in eastern Pennsylvania, and the prospect of getting rid of it appears to be nearly hopeless. Its propagation and diffusion are so rapid and irresistible that one negligent sloven may become the source of a grievous annoyance to a whole neighborhood. The cultivation of hoed crops for a few years will rid a field of this obstruction to useful vegetation. The Corn Marigold, *Chrysanthemum legetum*, a kindred plant, which is said to be such a pest to the agriculture of the Old World, happily does not appear to have found its way as yet to the United States.

Erechthites hieracifolia. Fire Weed, (a.) This coarse native weed is remarkable for its prevalence in newly-cleared grounds, especially in and around the spots where brush-wood has been burnt; hence its common name of fire-weed.

Senecio vulgaris. Common Groundsel, ragwort, (a.) A homely worthless little herb, which Prof. De Candolle remarks migrates almost everywhere with European men. It is naturalized about the seaports of the northern States, and has lately appeared in eastern Pennsylvania.

Centaurea cyanus. Ragged Robin, blue bonnets of the Scotch, (a.) This European plant is often seen in our gardens, and in some places is gradually straggling into cultivated fields. As it is considered a troublesome weed among the grain crops of the Old World, it should be watched here, so as to prevent the blue bonnets from coming over the border.

Cirsium lanceolatum. Common Thistle, (b.) This foreigner, which delights in a rich soil, is abundantly naturalized in Pennsylvania and in the northern States generally. It is a very objectionable weed on our farms, requiring constant vigilance and attention to exclude or keep it in subjection. If permitted to mature its fruit, the expanded pappus may be seen by thousands floating its akenes through the air, and disseminating the obnoxious intruder far and wide. The common thistle, having no creeping roots, is not so obstinate in resisting extirpation as some other varieties. It is easier destroyed if the roots are cut with sufficient care before its flowering season.

Cirsium horridulum. Yellow Thistle, (b.) This rugged, repulsive species looks like a stranger here, being hitherto chiefly restricted to the sandy seacoast of New Jersey. It is certainly desirable that it should continue to be a stranger to every agricultural district.

Cirsium arvense. Canada Thistle, (p.) This is perhaps the most pernicious and detestable weed that has as yet invaded the farms of our country. Though miscalled Canada thistle, it is believed to be indigenous to Europe, and has probably acquired that name by reaching us via Canada. The rhizoma or subterranean stem (which is perennial and very tenacious of life) lies rather below the usual depth of furrows, and hence is not destroyed by common plowing. The rhizoma ramifies and extends itself horizontally in all directions, sending up branches to the surface, where radical leaves are developed the first year, and aerial stems the second year. The plant, that is, the aerial portion, appears to die at the end of the second summer like a biennial, but it only dies down to the rhizoma or subterranean stem. The numerous branches sent up from perennial rhizoma soon furnish prickly radical leaves, which cover the ground so as to prevent cattle from feeding where those leaves are. Nothing short of destroying the perennial portion of the plant will rid the ground of this pest; and this has been accomplished by a few years of continued culture, (or annual cropping of other plants which require frequent plowing or dressing with the hoe,) so as to prevent the development of radical leaves, and thus deprive the rhizoma of all connection or communication with the atmosphere. We have a few other thistles which are all worthless weeds; but not being so obnoxious as the preceding, it is not deemed necessary to notice them further here.

Lappa major. Burdock, (b.) Everybody knows this coarse, homely foreign weed; one of the earliest and surest evidences of slovenly negligence about a farm yard.

Cichorium intybus. Wild Succory, chiccory, (p.) This foreigner is becoming extensively naturalized. Some European agriculturists recommend it as a valuable forage plant, and cattle seem fond of it; though it is believed to impart a bad taste to the milk of cows which feed upon it. In Europe the roasted root is used as a substitute for coffee. In this country the plant is generally regarded as an objectionable weed.

Taraxacum dens-leonis. Dandelion, (p.) An introduced plant, and now so extensively naturalized in our grass-plots, fields, and meadows that although not very obnoxious as a weed, it will be found a difficult task to extirpate it. The leaves and flower buds are frequently used, wilted, as a salad, and boiled as greens, and the root has been much employed recently in domestic economy, and is esteemed a pleasant and salutary substitute for the coffee berry.

Lobelia inflata. Eye-bright, Indian tobacco, (b.) A native weed possessing acrid properties, and sometimes employed as an emetic, and as an expectorant in asthma

Andromeda mariana. Stagger-bush, (s.) This native shrub is very abundant in the sandy districts of New Jersey, where it is reputed to be injurious to sheep when the leaves are eaten by them, producing a disease called the staggers. The evidence on this point is not quite conclusive, but if established would cause the bush to be deservedly ranked among the pernicious plants

Plantago major. Common plantain, way-bread, (p.) This foreign plant is remarkable for accompanying civilized man, growing along his foot-paths and flourishing around his settlements. It is alleged that our aborigines call it the white man's foot, from that circumstance. Another foreign species, the *P. lanceolata*, known as English plantain, rib-wort, ripple-grass, and buckhorn plantain, is becoming particularly abundant in our upland meadows or clover grounds. The farmer should keep its seeds from mingling with those of the red clover, and thus injuring the sale of clover seed in the market

Tecoma radicans. Trumpet-flower, (p.) This showy native climber is often cultivated and admired in the northeastern States, but in the West, along the Ohio river and its tributaries, it is regarded as an intolerable nuisance.

Verbascum thapsus. Common Mullein, (b.) An introduced, homely weed in our pastures and cultivated grounds. There is no surer evidence of a slovenly and negligent farmer than fields overrun with mulleins. As the plant produces a vast number of seeds it can only be kept in due subjection by eradication before the fruit is mature. There is another species called moth mullein, *V. blattaria*, more slender, and equally worthless, becoming frequent in our pastures.

Linaria vulgaris. Toad-flax, Ranstead weed. (p.) A rather showy, but fœtid weed, said to have been introduced into Pennsylvania by a Mr. Ranstead, from Wales, as a garden flower. It inclines to form large, dense patches in our pastures by means of its creeping roots, which take almost exclusive possession of the soil.

Nepeta cataria. Cat mint, cat-nip, (p.) This is common about old settlements. Another perennial species, *N. Glechoma*, (Benth..) called ground-joy, and gill, is also common in moist, shaded places about farm houses.

Lamium amplexicaule. Dead nettles, hen-bit, (a.) A worthless little weed, abundant in and about gardens in the Middle States, requiring some attention to keep it in due subjection..

Leonurus cardiaca. Motherwort, (p.) A homely, obnoxious weed, found in waste places about houses and farm-yards.

Teucrium Canadense. Wood-sage, germander, (p.) This native plant, which is frequently seen in low, shaded grounds along streams, where it is harmless, has recently got into the fields of some of the best farms of eastern Pennsylvania, where it is now regarded as an obstinately persistent nuisance.

Echium vulgare. Blue-weed, vipers bugloss, blue devils, (s.) A showy, but vile weed, extensively naturalized in some portions of our country, especially in Maryland and in the Shenandoah Valley, Va. Wherever it makes its appearance the farmers should act promptly on the Ovidian maxim, *Principiis obsta*, etc.: Meet and resist the beginning of evil.

Echinospermum lappula. Stick-seed, beggar's lice, (a.) The slovenly farmer is apt to get practically and vexatiously acquainted with this obnoxious native weed in consequence of its racemes of bur-like fruit entangling the manes of his horses and the fleeces of his sheep.

Convolvulus arvensis. Bind-weed, (p.) This foreign plant has been introduced into some portions of our country, and will give the farmers much trouble if they do not carefully guard against it.

Cuscuta epilinum. Dodder, flax-vine, (a.) This remarkable parasitic plant, somewhat resembling copper-wire in appearance, was introduced with our flax crop, and was formerly a great pest in that crop, by winding round and entangling branches of stalks so as to spoil them; but the vine has become rare, and has nearly died out since the culture of flax has declined among us.

Solanum nigrum. Night-shade, (a.) Frequent in shaded, waste places about dwellings. It is reputed to be deleterious in its properties, and ought, therefore, to be excluded from the vicinity of all farm-houses, where its berries may tempt children to pluck and eat.

Solanum Carolinense. Horse Nettle, (p.) An exceedingly pernicious weed, and the roots are so penetrating and so tenacious of life that it is difficult to get rid of. It was probably introduced from the South by Humphrey Marshall into his botanic garden at Marshallton, Pa, whence it has gradually extended itself round the neighborhood, and forcibly illustrates the necessity of caution in admitting mere botanical curiosities into good agricultural districts.

Datura stramonium. Thorn Apple, Jamestown (or Jimson) weed, (a.) Two varieties of this coarse, fœtid, narcotic plant (which is probably of Asiatic origin) are common among us as an obnoxious weed, and they should be carefully excluded from the vicinity of all farm-houses.

Enslenia albida. Whitish Enslenia, (p.) This twining plant, allied to the Asclepias or Milk-weed family, and happily as yet unknown to the farmers of the Eastern States, is reported by Prof. Short, a distinguished botanist of Kentucky, to be an intolerable nuisance on the farms along the river banks in Ohio, Illinois, etc.

APETALOUS EXOGENS—COROLLA USUALLY WANTING.

Phytolacca decandra. Poke-weed, pigeonberry, (p.) This stout native is everywhere frequent in rich soil. The *turions*, or tender radical shoots, in the spring of the year afford a popular substitute for those of asparagus; nevertheless, the plant is regarded and treated as a weed by all neat farmers.

Chenopodium album. Lamb's Quarter, goose-foot, (a.) This coarse and rather homely weed has become common and quite troublesome in gardens.

Amaranthus hybridus. Pig-weed, (a.) A repulsive looking weed, an annoyance in gardens and cultivated lots in the latter part of summer. If permitted to mature its seed it soon becomes very abundant.

Amaranthus albus White Amaranth, (a.) Another coarse weed in the farm-yards of the Middle States. Although supposed by some to be a native of Pennsylvania, it has a foreign habit and appearance, and probably came from tropical America.

Amarantus spinosus. Thorny Amaranth, (a.) This odious, bushy weed, supposed to be a native of tropical America is common in unfrequented streets and outskirts of our seaport towns, and is a vile nuisance wherever it appears. It can not be too sedulously guarded against. Hoeing on its first appearance is often effectual for its destruction.

Polygonum Pennsylvanicum. Knot-weed, (a.) A common worthless weed on road sides and in waste places about neglected farm-houses.

Polygonum pucicaria. Lady's Thumb, spotted knot-weed, (a.) Resembles the preceding, and rather smaller, but equally worthless wherever introduced.

Polygonum hydropiper. Water Pepper, smart-weed, (a.) A naturalized weed as worthless as most of the species are, though this is even more obnoxious than the preceding, being a highly acrid plant, and sometimes causing obstinate ulcerative inflammation when incautiously applied to the skin.

Polygonum sagittatum. Arrow-leaved Tear-thumb, (a.) Mowers and haymakers are apt to be familiar with this annoying native weed in the second crop of swampy meadows. Another kindred species; viz: *Parifolium*, or Halbert-leaved Tear-thumb, is an accompanying and equally obnoxious weed. Ditching and draining are the remedies for the evil. Several other *Polygonums* occur, equally worthless, but rather less offensive

Rumex crispus. Sour Dock, curled dock, (p.) An unsightly and objectionable foreign weed, too extensively known.

Rumex obtusifolius. Bitter Dock, broad-leaved dock, (p.) This foreign species is now more objectionable than the preceding, but it is not quite so prevalent. There is also a little foreign species, well known for its acidity, the *R. acetosella*, Field or Sheep Sorrel, (p.,) often so abundant as to be a nuisance on the farm. Improving the land, especially by adequate dressing of lime, is believed to be the best mode of expelling this and many other obnoxious weeds.

Euphorbia hypericifolia. Eye-bright, spurge, (a.) This is a common weed in dry pasture fields, especially in thinnish sandy soils, and has been suspected (how justly has not been determined) as the cause of the disagreeable salivation or slobbering with which horses are sometimes affected in the latter part of summer. There is another flatty, prostrate, bunching little species, *E. maculata*, often abundant in Indian cornfields and other cultivated grounds.

Urtica dioica. Nettle, stinging nettle, (p.) An exotic rather frequent in waste places about farm houses, well known to those who have come in contact with them.

ENDOGENOUS PLANTS—INSIDE GROWERS.

Symplocarpus fœtidus. Swamp Cabbage, skunk weed, (p.) A worthless native weed in wet and swampy meadows, readily known by its skunklike odor when wounded.

Saggittaria variabilis. Arrow-head, (p.) A common native plant of no value, found in sluggish ditches and swampy meadows. The roots, or base of stem, often produce large oval tubers in autumn, which tempt hogs to root for them, and thus disfigure the grounds on which they occur.

Anacharis Canadensis. Water-reed. (p.) This slender aquatic is supposed to be indigenous in our sluggish streams, where it often abounds, and may possibly become troublesome in our canals. It has been introduced into England, where its presence impedes the navigation of the canals to a serious extent.

Smilax rotundifolia. Green Brier, rough bindweed, (p.) This is common in thickets, and a variety of it, *S. Caduca*,. (L.,) often abounds in poor, neglected old fields.

Ornithogalum umbellatum. Ten O'clock, (b.) This exotic from the gardens in many places multiplies its bulbs so rapidly as to alarm the farmer, if neglected. The bulbs are exceedingly tenacious of life, and when once in possession of the soil, it is an almost task hopeless to get rid of them.

Allium vineale. Field Garlic, crow garlic, (p.) Tradition says this species was introduced by the first Welsh immigrants to Pennsylvania for the purpose of affording an early pasture, particularly for sheep. It was formerly so abundant in some districts as to be quite an annoyance, by imparting a disgusting flavor to milk and butter, and injuring the manufacture of wheat flour. By good farming and a judicious rotation of crops the evil has been much abated.

Juncus effusis. Common or Soft Rush, (p.) There are numerous species of this worthless native weed, but this is the best known, and perhaps the most objectionable, as it has a constant tendency to form unsightly bunches, or *tussocks*, in moist low grounds. Mr. Elliott an eminent botanist, says that in South Carolina this Rush occupies and almost covers rice fields as soon as they are thrown out of cultivation.

Cyperus phymatodes. Grass of Florida, (p.) This species is fortunately somewhat rare, as yet, in the northern and middle States, but it is a great pest to the agriculture of the South.

Cyperus hydra. Coco grass, nut grass of South Carolina, (p.) This is regarded by the southern planters as the most intolerable pest of their agriculture. Mr. Elliott says: It shoots from the base of its stem a threadlike fiber, which descends perpendicularly eight to eighteen inches, and then produces a small tuber. From this horizontal fibers extend in every direction, producing new tubers at intervals of six or eight inches; and these immediately shoot up stems to the surface of the earth, and throw out lateral fibers to form a new progeny. This process is interminable, and it is curious to see what a chain of network of plants and tubers can, with some care, be dug up in a loose soil. The only process yet discovered by which this grass can be extirpated is to plow or hoe the spots in which it grows every day throughout the whole season. In their perpetual efforts to throw their leaves to the light the roots become exhausted and perish; or, if a few appear the next spring, they can easily be dug up.

Carex tentaculata. Many-beaked Sedge, (p.) A very common species, in swampy low ground, of the large and unprofitable genus of sedges.

Carex stricta. Tussock Sedge, (p.) This is one of the most common, and most difficult to manage, of all our sedges. Its roots are apt to form large dense tufts or tusocks, in swamps. The careful farmers sometimes get rid of those tussocks by digging them out, and, when dry, collecting them in large heaps, burning them, and using the ashes as a manure. Of this remarkable and very numerous genus, (Carex,) Dr. F. Boott, an accomplished botanist of London, has now in hand one of the noblest and most elaborately illustrated monographs ever issued from the press.

Panicum sanguinale. Crab grass, finger grass, (a.) In the middle States this troublesome grass abounds in gardens in the latter part of summer, and is frequent also in Indian corn fields, but they may be kept in tolerable subjection by the early and faithful use of the instrument known as the cultivator. The crab-grass is regarded as a serious pest in the plantations along the lower Mississippi.

Panicum capillare. Hair-like Panicum, Old Witch grass, (a.) This worthless species flourishes best in a light sandy soil, but is usually more or less abundant in corn-fields. In autumn the dry culms break off and the light-spreading panicles are rolled over the fields by the winds, until they accumulate in great quantities along fence and hedge rows.

Panicum crus-galli. Cock-foot Panicum, barnyard grass, (a.) This coarse homely grass is said to be an inhabitant of all quarters of the globe. It is usually found in the latter part of summer, rather abundant along drains of barnyards and other waste places.

Setaria glauca. Bristly Fox-tail grass, (a.) All our weed like species of this genus are believed to be naturalized strangers here. This one usually makes its appearance in abundance among the stubble, after a wheat crop, and is frequent in pastures, orchards, etc., when not kept down by a more valuable growth. The *S. viridis*, called green fox-tail or bottle grass, is about equally worthless, but not quite so prevalent.

Setaria virticellata, (a.) The adhesive bristles of this species, frequenting gardens and neglected lots, are calculated to make it something of a nuisance if permitted to become abundant.

Cenchrus tribuloides. Bur grass, hedge-hog grass, (a.) This pestilential nuisance is quite abundant in the sandy districts of New Jersey and along the great northern lakes.

Cynodon dactylon. Dog's-tooth grass, Bermuda grass, (p.) Of this grass, which has found its way from Europe into Virginia and other southern States, Mr. Elliott remarks: The cultivation of it on the poor and extensive sand-hills of our middle country, (viz., in South Carolina,) would probably convert them into sheep-walks of great value; but it grows in every soil, and no grass in close, rich land, is more formidable to the cultivator. It must, therefore, be introduced with caution.

Bromus secalinus. Cheat, chess, broom grass, (a.) This is a well known intruder among our crops of wheat and rye, and often appears in the same fields for a year or two after the crops, but is soon choked out by the perennial grasses. This plant is an annual, and easy to overcome by care in sowing clean wheat, by keeping fence corners and field borders clear, and in establishing a proper rotation in cropping. The vulgar error that this grass is merely transmuted wheat, came to us with the earliest immigrants, and, notwithstanding the boasted march of mind, it yet prevails among a certain class of farmers to a considerable extent.

Triticum repens. Couch grass. Quitch grass, (p.) This species of *triticum*, which is quite distinct in habit from cultivated wheat, has found its way into some districts of our country, and is a pernicious intruder, when fully introduced, by reason of the exceeding tenacity of life in its rhizomas, or creeping subterranean stems.

Andropogon nutans. Wood grass, Indian grass, (p.) This and two or three other species of native Indian grasses are common in our sterile grounds, and are no better than mere weeds.

CRYPTOGAMOUS, OR FLOWERLESS PLANTS.

Pteris aquilina. Brake, bracken of the Scotch, (p.) This large fern is often abundant in moist woodlands and borders of thickets, and in our wild forests it affords a favorite shelter, or hiding-place, for deer and other game, but it is little better than a weed on the farm. Having thus disposed of the most prominent weeds in our agriculture, it remains merely to mention, very briefly, three or four of the injurious cryptogams, among the lower order of the fungi, viz:

Merulius lachrymans. Dry rot. This fungus, with some others which infest timber in places where a damp air is confined, as in houses and ships, is very injurious. It is said to be remedied by a wash of diluted sulphuric acid.

Ascophora mucedo. Mold, bread mold. This minute fungus usually abounds on moist decaying substances, and is well known to housewives as growing plentifully on bread and pastry which have begun to spoil; yet it is probable, that many of them have never suspected it of being as genuine a plant as any weed that grows on the farm.

Uredo segetum. Blight, smut, brand. This is usually found within the glumes and fruit of wheat, barley, and other grasses, speedily filling the whole with a profuse black dust.

Puccinia graminis. Mildew, rust. This often operates injuriously on wheat crops in warm, close, foggy weather, near harvest time; especially where the crop is a little backward and mingled with grass or herbage.

WEEVIL. A name applied to various insects including many of the curculios, also to the pea weevil, and also to those attacking the bean. The Grain weevil, which attacks grain and the Rice weevil are similar. During the centennial exhibition the samples from some portions of Europe, especially from Spain, were literally honey combed with the European weevil and this pest was widely disseminated thereby. Various weevils and their habits, and remedies from their attacks have been collected from various sources as follows: The Northern granary and the Southern rice weevil differ but little in form to the ordinary observer, the latter being merely smaller, and having light brown spots on the wing cases. Curtis states a curious fact, that the granary weevil in England is destitute of the organs of flight; whilst the rice weevil has a pair of serviceable wings. Both of them are very injurious to grain and corn, and the rice weevil is very destructive to the Southern rice. The egg of the Northern granary weevil is deposited on the grain; the larvæ burrow inside and feed upon its inner substance; the perfect weevil makes its escape from a small hole bored through the outer skin. Curtis says, it is calculated that 6,045 individuals may be reared from one pair of European weevils in one summer. Dr. Harris says, that these insects are effectually destroyed by kiln-drying the wheat; the grain that is kept cool, well ventilated, and frequently moved, is said to be free from their attack; also by winnowing and shifting rice in the spring, the beetles can be separated, and should be immediately gathered and destroyed. Curtis states that placing the grain in close cellars is the worst of all proceedings, as the weevils delight in darkness and being undisturbed. He recommends frequently stirring or turning over the heaps of wheat; he also says that the scent of spirits of turpentine, or the fumes of sulphur, did not appear to incommode the insects. In an experiment tried, the odor of a few drops of chloroform killed both larva and weevil in some closely corked bottles of samples of wheat in the agricultural department; the same bottles being opened a year afterwards, retained the scent. Benzine would, perhaps, have the same effect, and be much cheaper, but, most probably, would also impart a nauseous taste and smell to the grain. Wheat kept in bottles, thus treated with chloroform for a week, germinated when planted. Curtis says that the larvæ as well as the weevils are destroyed at 190° Fahr. but it also scorches the grain; and that a room heated to 130° by hot water pipes has been constructed in Madeira, which answers every purpose and wheat subjected to this high temperature vegetated in the ground. He also says that fleeces of wool laid on the grain heaps attract and kill the insects. A larger weevil called the hunter-weevil, has been much complained of in certain localities, as eating the leaves of corn. A very similar insect is found near the Pedee river, in South Carolina, the larva of which feeds in the stalk of corn, thereby entirely destroying the plant. This is merely mentioned to warn farmers, in case they should find individual plants among their corn withering, and in a yellow, sickly state, that perhaps the larva of a hunter-weevil, or one very nearly allied to it, may be the cause of all the damage. The only remedy at present recommended is hand-picking and burning the infested plants. Another curculio (*Epicærus fallax*) is very injurious in the neighborhood of Washington, in the weevil or perfect state, to the leaves of young cabbages, clover, and various other plants. It appears, however, says our authority, to be local, no complaints were received except from Iowa, where it injures the foliage of the cherry and apple trees, and gooseberry bushes also. No remedies, however, have been recommended, as its habits have not been much investigated. The larvæ of the white-pine weevil injure pine trees by boring into the leading shoot, thus destroying the growth and symmetry of the tree. Harris recommends the injured leading shoot to be cut off in August, or as soon as it is perceived to be dead, and to burn it, together with its inhabitants. The larvæ of the pitch-eating weevil, and others, devour the substance under the bark of pine trees, and perhaps the method used for decoying the pine eating beetles in Europe may be practiced here with advantage. This consists in sticking some newly cut branches of pine trees in the ground in an open space during the season when the insects are about to lay their eggs; in a few hours these branches will be covered with the beetles, which may be shaken in a cloth and burned. The weevils inhabiting nuts, acorns, chincapins, and chestnuts, are distinguished by their very long projecting and slender bills or trunks. The egg is deposited in the young fruit, and the grubs are found in the interior. They afterwards enter the earth and change to pupæ and perfect weevils. No remedy has yet been found. The pea weevil destroys the interior substance or future seed-leaves of the pea, seeds of locust and other leguminous plants. The egg is deposited singly in punctures made by the female, on the pod. The larvæ, when hatched, penetrate through the pod and bury themselves in the pea opposite the puncture where they eat the interior of the pea. The pupa is formed in the pea itself, and in spring the perfect insect comes out of a round hole eaten through the skin. Many of these-worm eaten peas will germinate, as the germ is seldom injured by the larva. Latreille and others recommend putting the seed peas in hot water a minute or two just before planting, by which means the weevils will be killed and the sprouting of the peas be quickened. Curtis states that an immersion of four minutes in boiling water will kill almost all the peas. The water should not be above 170 to 180° Fahr. Late sown peas escape their attacks, and if sown as late as the middle of June, are seldom infested with this weevil. If the peas are kept over the year, they are free from this pest, the beetle having deserted them. Mr. Curtis states that kiln-drying at a heat of 133° to 144° will kill the insects without altering the quality of the peas, but such seed will no longer vegetate. The New York weevil is a very large curculio of a gray color, marked with whitish lines and black dots. It destroys the buds and gnaws the young twigs of the pear, plum, cherry, maple, oak, etc. As they are not very numerous yet, and appear to be local, no remedy has been proposed. Hand-picking and shaking them off the trees in a similar manner to the plum weevil might answer, if they should increase so as to become very injurious. (See articles Curculio, Thrips, etc.)

WEIGHTS. (See Measures.)

WELSH CATTLE. Naturally we should look to Wales, in England, for types of the ancient race of English cattle, since its climate being comparatively mild, and its people not having been entirely conquered by either the Saxon or Roman invasions, we confidently expect to here find cattle preserving, in miniature, indeed, from the mountainous nature of the country, but yet clearly the old forms and characteristics of the original cattle of Great Britain. Consequently Welsh cattle do resemble the Devons, and Herefords, and also the Sussex cattle of 100 years ago, all these breeds being originally imbued with the prepotent blood of the old Devons. The Pembroke, the Glamorgans, and the Anglesey cattle are the principal breeds. Of these breeds Youatt says: Great Britain does not afford a more useful animal than the Pembroke cow or ox. It is black; the great majority are entirely so; a few have white faces, or a little white about the tail, or the udders; and the horns are white. The latter turn up in a way characteristic of the breed, and indeed the general form of the cattle undeniably betrays their early origin. They have a peculiarly lively look and good eye. The hair is rough, but short, and the hide is not thick. The bones, although not small, are far from large; and the Pembroke cattle are very fair milkers, with a propensity to fatten. The meat is generally beautifully marbled. They thrive in every situation. The Glamorgan cattle are thus described: The Glamorganshire farmers took great pride in their cattle, and evinced much judgment in their breeding and selection. There was one principle from which they never deviated—they admitted no mixture of foreign blood, and they produced the Glamorgan ox, so much admired for activity and strength, and aptitude to fatten; and the cow, if she did not vie with the best milkers, yielded a good remunerating profit for the dairyman. They were of a dark brown color, with white bellies, and a streak of white along the back from the shoulder to the tail. They had clean heads, tapering from the neck and shoulders; long white horns, turning upward; and a lively countenance. Their dewlaps were small, the hair short, and the coat silky. If there was any fault, it was that the rump, or setting on of the tail, was too high above the level of the back to accord with the modern notions of symmetry. Their aptitude to fatten rendered them exceedingly profitable when taken from the plow at six or seven years old, and they were brought to great perfection on the rich English pastures—frequently weighing more than twenty scores per quarter. The beef was beautifully veined and marbled, the inside of the animal was well lined with tallow, and the Glamorgans commanded the highest price both in the metropolitan and provincial market. During the French revolutionary war, the excessive price of corn attracted the attention of the Glamorganshire farmers to the increased cultivation of it, and a great proportion of the best pastures were turned over by the plow. The natural consequence of inattention and starvation was, that the breed greatly degenerated in its disposition to fatten, and, certainly, with many exceptions, but yet, in their general character, the Glamorganshire cattle became and are flat-sided, sharp in hip joints and shoulders, high in the rump, too long in the legs, with thick skins, and a delicate constitution. Therefore, it must be acknowledged at present, and perhaps it must long continue to be the fact, that the Glamorgans, generally, are far from being what they once were.

They continue, however, to maintain their character for stoutness and activity, and are still profitably employed in husbandry work. The beef is still good, marbled, and good tasted; and in proportion as the value of the ox to the grazier has decreased, the value of the cow has become enhanced for the dairy. He who is accustomed to cattle will understand the meaning of this; and the kind of incompatibility between an aptitude to fatten in a little time, and on spare keep, and the property of yielding a more than average quantity of milk. This is the breed which is established in the populous districts of Glamorgan. The Glamorgan cattle bear a close resemblance to the Herefords in figure, although inferior to them in size; they feed, when in confinement kindly—the flesh and fat are laid equally over them—the beef is beautifully marbled, and they yield a more than average quantity of milk. They are fattened to perfection at five years old, but not often at an earlier age: and will become sufficiently bulky on the good pastures of the vale without any artificial food. The Anglesey cattle are small and black, with moderate bone, deep chest, rather too heavy shoulders, enormous dewlap, round barrel, high and spreading haunches, the face flat, the horns long, and characteristic of the breed with which we will still venture to class them, almost invariably turning upward. The hair is apparently coarse, but the hide is mellow: they are hardy, easy to rear, and well-disposed to fatten when transplanted to better pasture than their native isle affords. The Anglesey cattle are principally destined for grazing. Great numbers of them are purchased in the midland counties, and prepared for metropolitan consumption; and not a few find their way directly to the vicinity of London, in order to be finished for the market. In point of size, they hold an intermediate rank between the English breeds of all kinds and the smaller varieties of Scotch cattle; and so they do in the facility with which they are brought into condition.

WELCH CLOVER. (See Rabbit-foot.)

WELDING. The union of two pieces of metal at a white heat by hammering; iron, steel and platinum are the only metals susceptible of welding. The surfaces are cleaned by borax in welding steel.

WHEAT. *Triticum vulgare.* Wheat has in all ages of the world been the chief reliance among nations for bread. Those countries exporting bread grains even to-day relying upon it as a great money crop. This is due to two reasons, it carries well, and its large and uniform price enables it to be sent longer distances than any other bread grain except rice, the latter only serving as food to the partially civilized nations of warm climates. In plants used as food by man, we find the following interesting and condensed history of wheat, which we reproduce: Wheat (*Triticum vulgare*), which is the most important and widely distributed of all breadstuffs, according to the Grecian fable, was originally native on the plains of Enna and in Sicily, but it is much more probable that, like barley, it was received from Central Asia, where Olivier seems to have found it growing wild on the banks of the Euphrates. In any event, it belongs to the longest cultivated cerealia. Even Theophrastes was acquainted with it; probably the grained summer variety, from which the winter wheat seems to have been subsequently developed. In a similar manner, Scripture points to its cultivation in Palestine. Even in China it was known 3,000 years before Christ as a cultivated plant. As Isis was supposed to have introduced wheat into Egypt, and Demeter into Greece, so the Emperor Chin-nong is said to have introduced it into China. The great variety of the ancient names used for indicating this plant points to the wide circle of distribution which it originally possessed. At the present day, wheat is cultivated in all parts of the earth, having been taken to America by the Spaniards, at the beginning of the sixteenth century. Besides the common wheat, several other species of wheat are to be considered as cultivated plants, although they have attained a much more restricted distribution. Among these may be mentioned the *Triticum turgidum,* which was cultivated even by the ancient Egyptians, and was known to the Romans in Pliny's time. As it has not even yet reached India, its native land is to be looked for rather to the south and west of the Mediterranean than in Central Asia. The many-eared or Egyptian wheat (*Triticum compositum,*) is only a variety. It is cultivated chiefly in southern Europe and in England. Two species of wheat, *Triticum durum,* and *Triticum Polonicum,* or Polish wheat, areonly cultivated to advantage in the warmer regions of Europe. The Spelt (*Triticum spelta*), at present cultivated only in Europe, here and there, was met with even by Alexander the Great as a cultivated plant in his campaign in Pontus. Its origin in Mesopotamia and Hamadan, in Persia, is doubtful; especially as its cultivation in these countries can not be carried back to any very remote antiquity, and it likewise seems to have been known in Egypt, even though at the present day it is not found there. The German name *Spalt* points to its early cultivation in Germany. We come finally to the little-cultivated, one-grained wheat, (*Triticum monococcum*), this is the *Kussémeth* of the Scriptures. From it the Syrians and Arabians made their bread. Its cultivation has not extended either to India, Egypt or Greece. Both the Crimea and the region of Eastern Caucasus have been indicated as the native country of the one-eared wheat. The *Emmercorn,* or German wheat, (*Triticum amyleum*), has had an equally ancient cultivation. It is cultivated more frequently in the southern than in the middle portions of Europe. Wheat occupies a broader belt than rye, and is cultivated as the principal crop in middle and southern France, England, (where it constitutes the chief object of culture among the cerealia), a part of Germany, Hungary, the lands of the southern Danube, the Crimea, and in the lands of the Caucasus, as well as Central Asia, wherever the soil is cultivated; along its northern border it is associated in culture with rye, in the southern with rice and maize (Indian corn). The latter is chiefly the case in the North American States, and in the region of the Mediterranean. Wheat is even cultivated in the southern hemishere, at the Cape, Buenos Ayres, and Chili, wherever the climatological conditions will allow. Coming to the United States we find that wheat was first sown in the United States at Cuttyhunk, Buzzard's bay, in 1602, by Goswold, the first explorer of the coast. It was first sown in Virginia in 1611, in the Dutch colony of New

Netherlands, prior to 1626, since in that year samples were sent back to the mother country. The first record of wheat in the Plymouth colony, is that in 1629 wheat and other seed grains were sent for to the mother country. In all new countries capable of producing wheat it quickly becomes the staple crop, but quickly exhausting the soil under such indifferent cultivation as is usually given, it is soon replaced by other crops. Within the last thirty years, the Genesee valley in New York, East, and Virginia in the South, were the two greatest wheat raising sections of the United States. The report of the Commissioners of Agriculture in 1876 gives most interesting figures in relation to this hegira, the three tables of which are significant. The statement is as follows: Another point of inquiry has been the changes in kind and volume of production, caused by westward emigration, settlements of virgin tracts of territory, depreciation of rate of yield by irrational modes of culture, and the varying measure of foreign demand for food products. The movement of population westward across the continent has been one of the wonders of modern times. Not only is the volume of wheat of to-day more than threefold greater than in 1849, but the increase of that portion of it grown beyond the Mississippi is greater than the entire crop of that year. Five per cent. only was then produced west of the Mississippi; and in 1876, a year of comparative failure in the Northwest, it was forty per cent. Dividing the country into three sections, the first including the Atlantic coast States, with Pennsylvania, and the Virginias to the Ohio river, and the second and third sections separated by the Mississippi river, we find more than half of the wheat grown in the first in 1849, the percentages of each section changing rapidly, as follows:

Section.	1849.	1859.	1869.	1876.
Atlantic coast	51.4	30.7	20	19.6
Central belt	43.3	54.6	49	40.8
Trans-Mississippi belt	5.3	14.7	31	39.6

SECTION.	1849.	1859.	1869.	1876.
Atlantic coast	51,657,020	53,294,137	57,476,371	56,489,500
Central belt	43,522,646	94,458,609	140,877.070	118,122.000
Trans-Mississippi belt	5,306,278	25,352,178	89,392,185	114,745,000
Total	100,485,944	173,104,924	287,745,626	289,356,500

The first section has now a little more than one-third of its former proportion; even the second, which was swept with so heavy a wave of immigration in the first decennial period, exhibits a declining percentage, while the third has eight times its former prominence, even in a year of low production of spring wheat, and promises to make the proportion nine to one in 1877, or forty-five per cent. A few years more will find a preponderating weight of wheat production beyond the Father of Waters. Comparing relative quantities rather than proportions of the crop, we find that the Atlantic coast has held its own, and little more; the central belt produces three times as much; the trans-Mississippi belt, more than twenty times as much. The figures in the first table below will explain themselves. That the wheat crop, with a smaller volume and a more active foreign demand, should make so rapid extension is less strange than the nearly equal rate of acceleration of the immense volume of our great natural crop, maize. With less than an increase of 100 per cent. in population, this crop has more than doubled. The quantity produced has actually decreased in the East, it has doubled in the Central States, and is seven times as large beyond the Mississippi. The proportions of the whole crop produced by the three sections are (nearly) as follows:

Section.	1849.	1859.	1869.	1875.
Atlantic coast	30	24	20	14
Central belt	58	55	53	51
Trans-Mississippi belt	12	21	27	35

The East has declined continuously and hopelessly; the center has held a determined struggle, yielding only inch by inch; the West has trod the track of destiny with accelerated step. In 1880 this Western preponderance had already been reached, the center of wheat production being a line running north and south, and touching the Mississippi river at St. Louis. In relation to varieties and to cross fertilization, selection and cultivation, in producing superior qualities, and also in the adaptation of certain soils in growing superior seed wheat, the following facts must suffice: From the well-defined species accepted by botanists, and which may be described in general terms, as the hard wheats, the soft wheats and the Polish wheats, all the innumerable varieties known to agriculturalists have descended. The hard wheats are the product of warm climates, such as Italy, Sicily and Barbary. The soft wheats are grown in the northern parts of Europe, as in England, Belgium, Denmark and Sweden. The Polish wheats grow in the country from which they derive their name, and are also hard wheats. The hard wheats contain much more gluten than the other varieties. This valuable ingredient is a tough, viscid substance, very nutritious, and which, as it abounds in nitrogen, readily promotes fermentation in the dough, and is essential to good light bread. The quantity of nitrogen varies with the soil and climate from five per cent. in some soft wheats to thirty per cent. in the hardest and most transparent. It is the higher proportion of gluten that exists in Italian wheats that fits them for use in the preparation of macaroni and the rich pastes that form so large a portion of the food of the people of that land. The softer wheats contain a larger proportion of starch. The latter are usually grown in England, and require to be well dried and hardened before they can be readily ground into flour. Many of these varieties of wheat have resulted from influences derived from the soil. Some soils are remarkable, far and wide, for producing good seed, and it is equally well known that this seed degenerates in other soils, so that the original is resorted to for fresh supplies of seed. This is so well known in England that the produce of a certain parish in Cambridgeshire is sold for seed at a price considerably above the average. It is not, however, the experience of all that the finest wheat makes the best seed, but in the choice of seed the nature of the soil upon which it is to be sown must be considered as well as that upon which it grew. It has been asserted that all the various noted seed wheats, when analyzed by the chemist, are found to contain the different elements of which they are composed in nearly the same proportion, especially the starch and gluten. For bread, that which contains the most gluten, is preferred; but to produce a perfect vegetation there should be no excess of this substance, and no deficiency, and the seed should have arrived at perfect maturity. Moreover, it has also been stated, and with great apparent probability of its truth, that if we wish to grow any peculiar sort of wheat, and find by our preparation of the soil or its original composition that we produce a wheat in which the gluten and starch are in different proportions from that of the original seed, we may conclude that this is owing to more or less nitrogenous matter in the soil—that is, more animal manure—or proportionally more vegetable humus; and by increasing the one or the other, we may bring our wheat to have all the properties of the original seed. By selecting seed from those ears which appeared superior to the others in a field of ripe wheat, sowing them in a garden or in a part of the field, the variety which may have been produced by some fortuitous impregnation, or by some peculiarity of the soil of the spot where it grew, may be perpetuated. By carefully adapting the seed to the soil, and by a careful and garden-like cultivation, and adding those manures which are found to be best adapted to favor its perfect vegetation, crops of wheat have been raised which at one time would have been thought miraculous, and in Great Britain, where only is its culture regarded as its importance demands, and the highest skill, the result of enlightened inquiry into the requirements of this invaluable grain, been persistently applied, the average product has been greatly increased on all soils. To original defect in the soil or inadequate fertilization, we may reasonably ascribe the deterioration observed to follow cultivation of varieties of wheat which at first appeared well adapted to the locality and the climate. The demand for new seed wheat to repair the loss arising from continued decline in the product from year to year, should induce cultivators to seek for a cause for this deterioration, either in the condition of the soil and its constituents, or in an unwise culture and indifference to the selection of the best product for continuing the crop. We have many recorded instances of the very valuable results of care in selecting the largest and heaviest grains for seed. In some instances the crop has been quadrupled in quantity and quality by the use of the choicest seed selected from that with which the rest of the field was sown. When importing seed wheat and any other seed of new or superior varieties of plants, attention should always be directed to the peculiarities of the soil and climate under which they originated, and those under which it is proposed to grow them. English varieties of spring wheat are sown in February or early in March, have the benefit of early spring growth, and of a milder and moister summer than a spring sown wheat can have in the northern United States. The failure that has attended attempts to introduce English varieties of wheat is no new thing, such having been the almost universal result for many years past. The distinction between winter and spring wheat is one which arises entirely from the season in which they have usually been sown, for they can readily be converted into each other by sowing earlier or later, and gradually accelerating or retarding their growths. If a winter variety is caused to germinate slightly, and then checked by exposure to a low temperature, or freezing, until it can be sown in spring, it may be converted into a spring wheat. The difference in color between red and white wheats is owing chiefly to the influence of the soil, white wheats gradually becoming darker and ultimately red in some stiff, wet soils, and red wheats losing their color and becoming first yellow and then white in rich, light and mellow soils. The grain changes color sooner than the chaff and straw, hence we have red wheats with white chaff, and white wheats with red chaff. The blue-stem, long cultivated in Virginia, was formerly a red, but at length became a beautiful white wheat. If it be true that each variety of grain is adapted to a specific climate in which it grows perfectly, and where it does not degenerate when supplied with proper and sufficient nourishment, may not the consideration of the origin of each variety we propose to sow be of more importance than has yet been accorded to it in the selection of minor varieties, the product of our country? The varieties of wheat that have originated, apparently by accident, (for there are no accidents in nature), or from peculiar culture, do not enjoy all the surroundings necessary for perfect continuous product. Causes yet unexplained are ever at work modifying the germ of the new growth, and the care of man is needed to preserve unimpaired, or to render perfect the already improved varieties That cross-fecundation and hybridization are possible has been fully proved by the results of experiments made by Maund and Raynbird, whose Hybrid Cerélia received the prize medals at the industrial exhibition in London as long ago as 1851; and that success has attended judicious efforts to improve upon the ordinary wheat by continued careful selection of seed, is evident from the product of the Giant wheat and Pedigree wheat, grown by F. F. Hallett, of Brighton, England. By selecting from year to year not only the best heads of wheat, but the best kernels of the finest ears, and using them for seed, this gentleman has produced a variety possessing great fecundity of grain, extraordinary strength of stem, and a uniformity in the size of the ear. Some of the heads of these new varieties measured seven inches in length, and were proportionately thick. In some instances one kernel has produced seventy-two heads, containing six thousand four hundred and eighty grains, and a maximum product was obtained of sixty and sixty-two, and in one instance seventy-two bushels per acre. The highest results on the farm of Mr. Hallett were six quarters or fifty-six bushels per acre, which appears to have been produced, not upon a chosen garden spot, but upon several acres. The large numbers named need not excite surprise or doubt of their probability, since Schuyler county, Ill., has produced wheat heads six and a half inches long, and Talbot county, Md., has exhibited a field of nearly thirty acres which in 1860 yielded very nearly fifty-five bushels of wheat, of sixty pounds each, to the acre, and nine of which produced sixty-four and a half bushels upon each acre. This last was a smooth-headed wheat brought from North Carolina a few years before. William Hotchkiss, of Niagara county, N. Y., exhibited at the industrial exhibition in London in 1851, the product of six acres in 1849-'50 which averaged sixty-three and a half bushels to the acre, weighing sixty-three pounds to the bushel. This extraordinary yield was, however. exceeded in the summer of 1853 by Thomas Powell, of the same county, whose field of seven measured acres averaged within a small fraction of seventy bushels to the acre—namely, four hundred and eighty-nine bushels of wheat. Mr. Hallett describes the system by which he produced his Pedigree wheat as follows: The best plant is called the selection of the year (say 1861) in which it is thus obtained, and consists of numerous ears containing many hundreds, and even thousands, of grains, which are planted separately, those of each ear being kept quite distinct, as, although the best grain of any plant is nearly always found to lie in its best ear, it may be otherwise, and the successive parent ears must be preserved. At the following harvest (1862) the best plant forms the selection for 1863, and its produce is continued on the experimental ground, while that of the remaining plants furnishes the annual seed for the farm in the autumn of 1862, and the crops are in 1863 offered to the public. Thus the selection sold is that of 1861, or in any year that of two years before. the latest selection, that of the year immediately preceding, is not sold, being solely employed as the home seed. It is indeen true of late years, farmers have learned that not only must the land be in proper condition, and the season right, but that none but clean, well-ripened seed must be sown and that the soil must be carefully and honestly prepared. What is required for winter wheat is a winter in which it will not be heaved by freezing and thawing and succeeding weather to keep it growing, with dry and rather cool weather for harvesting. Spring wheat requires similar weather except as to the winter. The three seasons preceding 1880 were of this character. Hence the wonderful crops of wheat, whole Western States producing the best averages of England in her best years. The following table of the several States mentioned shows as follows. The proportionate area represented compared with the entire winter wheat area in each State. The proportion sown and drilled respectively. The estimated relative increase of product by drilling over that obtained by sowing, collected for the year 1874. The proportion of spring wheat sown is about forty per cent. of the whole crop. It is grown mainly in Wisconsin, Minnesota, and Iowa, almost to the exclusion of fall-sown wheat in those States. Michigan, though as far north as either, produces almost exclusively winter wheat, owing to the modifying influences of the surrounding waters, and perhaps in some degree to the soil, much of which has good natural drainage. One-third of the crop of Illinois (in the northern counties) is spring wheat. A small portion of that of Kansas is sown in the spring, and nearly all of that of Nebraska. California is anomalous in wheat as in everything else. Wheat can be sown all through the summer to sprout when rains fall, or it may be put in all through the rainy season till spring. In point of fact, the planting season has actually a range of several months. The little grown in the New

STATES.	Area represented.		Proportion sown.	Proportion drilled.	Increase of product by drilling.	Seed per acre.	
	No of counties.	Percentage.	Percentage.			Bushels in broadcasting.	Bushels in drilling.
New York	21	63	50	50	13	1.80	1.60
New Jersey	10	22	45	55	6	1.95	1.60
Pennsylvania	33	62	30	70	12	1.74	1.49
Delaware	2	43	26	74	10	1.75	1.50
Maryland	8	66	24	76	7	1.70	1.43
Virginia	29	35	62	38	12	1.44	1.21
North Carolina	18	26	97	3	....	1.07	.83
South Carolina	4	....	99	1	....	1.00	.70
Georgia	16	14	90	1	....	1.00	.90
Alabama	8	....	99	1	....	1.00	....
Mississippi	5	....	99	1	....	1.25	....
Texas	9	21	98	2	....	1.18	.90
Arkansas	2	....	100	....	....	1.10	....
Tennessee	27	37	96	4	10	1.20	1.10
West Virginia	17	57	58	42	12	1.53	1.33
Kentucky	23	22	92	8	10	1.36	1.11
Ohio	38	51	39	62	16	1.57	1.33
Michigan	22	52	49	51	9	1.62	1.40
Illinois	32	39	24	76	19	1.52	1.24
Indiana	41	44	49	51	15	1.48	1.21
Missouri	47	45	62	38	21	1.52	1.21
Kansas	23	36	55	45	16	1.49	1.23
Nebraska	2	4	51	49	17	1.56	1.25
California	9	....	98	2	....	1.33	....
Oregon	7	21	81	19	5	1.50	1.21

England States is nearly all spring wheat. In the Middle and Southern States, and in the Western States not named above, fall sowing is almost the exclusive practice. A little is sown in the spring in New York and Pennsylvania. We have shown how the cultivation of wheat has steadily progressed westward, seeking the new and virgin soils. The time is coming however when this must cease. Then wheat will be grown in all the range of climate adapted to it, and form part of a regular rotation. When this is done, wheat may again be profitably grown wherever it has once succeeded, as it is now profitably grown, by that class of farmers who make it one of a series of crops, and who never exhausting their soil by running to one special crop for the present money it brings, from having cared to know that once the fertility of the soil is lost, it will cost more to again bring it back than it would to have kept it, as originally, fertile.

WHEAT BIRD. White-Throated Sparrow, *Zonotrichia albicollis.* A beautitul song sparrow of the Eastern States, arriving early in the season, but breeding in the extreme northern sections of the United States and Canada. It is innocent of harm and not destructive to crops as its name would suggest.

WHEAT GRASSES. Grasses of the same genus as wheat (*Triticum*), of which the couch grass (*T. repens*) is best known. They are not indigenous in the United States, and, although very nutritious, are not objects of special cultivation.

WHEAT MIDGE. (See Midge.)

WHEEL-SHAPED COROLLA. A rotate corolla; it is monopetalous, with a spreading border and very short tube.

WHELP. The young of the dog.

WHEY. The refuse of milk, in making cheese, being separated from the curd, after coagulation. It is fed to calves of three weeks and upward by mixing a pint of buckwheat or rye flour to sixteen quarts of whey. It also has some value, if given to milch cows to drink, but is principally used to feed swine in connection with more solid food. It contains 4.54 parts of milk sugar, 0.35 butter, 0.47 caseine, 0.38 albumen, 0.45 lactic acid, 0.69 ash, and 93.12 water in 100 parts. (See Dairying.)

WHIPPING OUT GRAIN. Striking the ears against a stone or the edge of a board till the grain is separated from the straw.

WHIPPLE TREE. A swinging bar to which the traces of the horse are fastened.

WHIP-POOR-WILL. (See Night-hawk.)

WHIRLBONE. The knee pan. In the horse, the articulation of the thigh bone in the pelvis; the acetabulum.

WHIRLWIND. A revolving wind, blowing to a center. The tornado is a violent whirlwind.

WHISKY. A strong spirit distilled from the fermented mash of corn, barley, wheat or other grains.

WHISTLING. Wind broken, highblowing, roaring, and whistling are all the effect of chronic difficulty in the respiratory passages, or of some disease of the windpipe. In roaring there is generally a sharp cough. Medicines are really of but little use, except to alleviate the distress for a time. One drachm, each, of powdered opium, powdered nitre, and powdered camphor, made into a ball and given once or twice a day, before feeding, for several days, is probably as good as any, or the animal may be treated as recommended for heaves.

WHITE ARSENIC. Common arsenic, arsenious acid. It has been recommended for dusting grain after brining, but should never be used; for other substances, as blue vitriol, answer much better, and are not so dangerous.

WHITE CEDAR. (See Cedar.)

WHITE CLOVER. (See Clover.)

WHITE CROPS. Grain crops; the *Cerealia.* They are exhausting, from the quantity of seeds they form, and are foul crops, from allowing weeds to grow among them. White crops (an English term) require to be followed by clean crops, as Indian corn, etc.

WHITE LEAD. Carbonate of lead. It is the basis of all colors used in painting.

WHITE PRECIPITATE. A violent mercurial poison, used in ointments for destroying vermin.

WHITE ROOT. *Asclepias tuberosa.* Colic or pleurisy root; butter-fly weed. It is used in domestic practice as a cathartic, diaphoretic, and expectorant.

WHITE SCOUR. Diarrhœa.

WHITE SPOT. (See Eye Spot.)

WHITE THORN. The hawthorn.

WHITE TOP. *Agrostis alba.* A grass very similar to red top.

WHITE VITRIOL. Sulphate of zinc. A powerful emetic, and is used in lotions.

WHITE WASH. Ordinary lime wash is made by putting half a peck or a peck of lumps of quick-lime into a tight barrel, and pouring on hot water to slake it; when slaked add water to make it of the consistency of thin cream and it is ready for use. It is one of the best of materials for covering ordinary walls since it is beautifully white and conducive to health. For painting rough out-buildings, fences, etc., put half a bushel of quick-lime in a barrel and add boiling water until it is covered nearly six inches deep, cover the barrel to keep the steam in, and when the violent ebullition is over, add water enough to bring it to the consistency of cream; allowing four pounds of rice flour to each half bushel of lime; or, the rice flour may be mixed with the water for slaking, mixing the flour carefully in cold water before putting it in the hot water. Stir constantly in the hot water until thoroughly set, and then pour it all over the lime as directed. Another excellent wash, and one which will harden on wood work, is to slake the lime as before directed, then add water to bring it to the proper consistency, and add two pounds of sulphate of zinc and one pound of common salt. Add water to bring it to a fit state for spreading with the brush. For cream color, add three pounds, or as much as may be necessary, of yellow ochre. Four pounds umber, one pound Indian red, and one pound lampblack, or in these proportions, will give a fawn color. Four pounds of raw umber, and two pounds of lampblack, or in these proportions, will give a gray or stone color. An excellent wash for rough work is made in the following proportions: Three pecks of water lime, one peck silver sand, or any clean, sharp, fine sand, and half a peck of salt. This coat stands well on old or rough boards, etc.

WHITE WEED. The larger perennial May weed (*Chrysanthemum*), occurring in wheat fields and meadows.

WHITE WOOD. The tulip-tree.

WHITING. Prepared chalk, for cleaning brasses and silver.

WHITLOW. A painful inflammation near the bone, tending to suppuration.

WHITLOW GRASS. The genus *Draba;* cruciferous plants, some of which are ornamental.

WHORL. In botany, an arrangement of leaves or other organs around the stem, and apparently on the same level, as the leaves of madder

WHORTLEBERRY. *Gaylussacia.* Also called Huckleberry. Both the huckleberry, the blueberry, the dewberry and the cranberry belong to the huckleberry—a subfamily, of the order *Ericaceæ.* The huckleberries differ from the blueberry, in having a spicy, rather sweet taste, the berry containing ten large seeds or rather small stones. It is also strictly deciduous. The blueberry, *vaccinium,* is ranked as an evergreen, and in the case of the cranberry, *V. oxycoccus,* and *macrocarpon,* they are strictly evergreen. The principal species of huckleberry are the black or common, *Gaylussacia resinosa.* The pale, blue tangle, *G. frondosa* and the dwarf *G. dumosa.* (See also Cranberry and Huckleberry.)

WILD INDIGO. *Baptisia tinctoria.* A perennial leguminous plant, with wedge-ovate leaves, and yellow terminal racemes, flowering in July, it grows three feet high, is common in the woods throughout the States, and affords a good amount of indigo dye.

WILDING. Young trees produced from seeds naturally distributed.

WILD MUSTARD. (See Mustard.)

WILD PEAR. The June berry,

WILD RICE. *Zizania aquatica.* (See Rice.)

WATER OATS. (See Rice.)

WILLOW. *Salix.* The willow family, *Salicaceæ,* is an important one to agriculture, especially western agriculture, since it contains the willows proper, and the poplar tribe, *populus,* in which are included the cottonwoods. The poplars have been noticed under cottonwood. The willows necessary to be noticed, here are: The White Willow, *Salix alba,* a most valuable tree for wind breaks, when quick growth, and a tolerable firewood are desired. It is upright in its growth, attaining an ultimate height of sixty to eighty feet, grows rapidly from cuttings, and as readily puts forth new wood when topped at any desired height. The wood is much sought for, its charcoal being used in the manufacture of powder. The Black Willow is the common willow of the west, a rugged tree of no particular value. Its wood is, however, used in the making of bowls and other wooden ware. The Yellow Willow, *S. vitellina,* is held to be simply a variety of the yellow willow, and is sometimes planted as a shade tree, but is not well adapted to the purpose. The Osier or Basket Willow, *S. viminalis,* is the well known shrub from which the rods are prepared for basket making. Its cultivation has been undertaken a number of times in the United States, but each time abandoned, trom the fact that American labor could not compete with the cheap labor of women and children, in Europe, in peeling and preparing the shoots. The Bottle or Bedford Willow is also somewhat used for basket work.

WIND DROPSY. (See Blown).

WIND COLIC. (See Blown).

WIND FLOWER. *Anemone Virginiana.*

WIND GALLS. Small tumors near the fetlocks of horses, produced by strains and overdriving. They contain a serous fluid. The animal should have rest; astringent lotions may be used, and a bandage applied very tight. (See Spavin.)

WINDMILL. In mechanics, a mill which receives its motion from the wind. The building containing the machinery is usually circular.

WINDOW GARDENING. The culture of flowers, odorous plants, and those kept for the beauty of their foliage, in dwellings, is probably as old as the era of comfortable dwellings themselves. It is so old in fact that its beginning has never been chronicled. The love of flowers is as inherent in our natures as the love of life, and the desire to possess within the dwelling such objects as strike the eye, would naturally suggest the transplantation of curious or striking plants. Window gardening or the cultivation of plants in rooms, is almost exclusively confined to the middle and poorer classes, or at least to those classes whose wealth will not allow their cultivation in greenhouses and conservatories. It is a constant and striking proof of that innate love of the beautiful, found in the more sensitive natures as well of the savage as the most enlightened of mankind, It is a taste which the rich and the poor may alike enjoy; for the humblest window in an obscure alley of the crowded city may have its crock of plants or its single blooming flower, if no more, giving as unalloyed satisfaction as the most costly plants in the great conservatories of the most wealthy. One of the chief drawbacks to window gardening is that the range of plants for this culture is limited. No skill would enable the cultivator to keep certain classes of plants healthy in rooms. In crowded cities the list would be still less in number, since the confined air of such rooms are the very worst situation in which plants can be placed. Therefore, if healthy plants and an abundance of bloom are expected, variety must be sacrificed. Among the succulent species best adapted to a confined space and close atmosphere are many of the aloes, cactuses, etc. The orange and myrtle are well known among that class, having firm leaves, and a smooth, compact skin. Those plants having the leaves small and of a delicate texture, are illy adapted to house culture, and some tribes as the heaths, and probably the whole race of pinnate leaved, and papilionaceous flowered plants, of which lupins, clover, etc., are types, are entirely unfit for house cultivation. Pinnate-leaved plants have that class of foliage where a single petiole has several alternate leaves attached to each side of it. Water, heat, air and light are the four essentials to plant growth, a proper soil being supplied. The first three and the last all may command. The first three promote growth. Light renders the growth perfect, and over this we can not have perfect control, even in the most favored situations, indifferently so in houses in the country; in the city it is the most difficult factor to control in the cultivation of plants in houses. To reach favorable results light must come directly from the sun, and plants should be so placed, that there be as little refraction and decomposition, always present when it passes obliquely through glass or any other medium other than the air. Without good light it is impossible to grow healthy plants, and while it acts beneficially upon the upper surfaces of leaves, it seems to be injurious to the under surfaces, for however a plant may be placed, it will turn the upper surface of the leaves to the light. Plants in rooms turn not only their leaves but also their branches to the light, and this is in proportion to the light of the windows and the shadow of the room; therefore plants do nicely in a south window, and when light is also admitted to the room from an east and a west window. If this south exposure be a bay window that may be closed from the room, and where heat and moisture may be conserved, you have the best possible conditions, under the circumstances. Now-a-days portable stands are so cheap that almost any one may by their use grow at least some plants, and when the plants require washing or cleaning they are easily removed for the purpose. If saucers are used, they should be filled with coarse gravel upon which to set the pots. Thus any water they contain will be evaporated into the air and about the foliage and thus assist in keeping up a due and equable moisture in the apartment. Plants respire constantly by their leaves. In rooms these soon become choked with dust, and if not cleaned the plant becomes sickly and dies. When grown out of doors they are daily washed by dew, exercised by the wind, and thoroughly cleansed by every shower. Plants with large solid leaves may be sponged, while smaller and rough-leaved plants may be cleansed by inverting the pot on the hand and rinsing in a vessel of water. Loose dirt may be got rid of with a pair of bellows, and thus by giving the plants exercise, will essentially increase their vigor. Whenever possible plants should be taken out of doors, or some other suitable place, for washing, then it may be done with a garden syringe, or a fine rose watering pot held high above them, that they may get advantage of the force of the drops. House plants, especially roses and geraniums, are often subject to the attacks of lice, *Aphides.* They are easily removed by washing in rather weak tobacco water and often in clear water, or a cone of paper may be placed over the plant and a little tobacco smoke blown under. So also they may be destroyed by camphorated water. Mildew sometimes attacks plants. This fungi is the result of a bad condition of the plants. Sulphur or camphor are the proper remedies, and a due circulation of air the preventive. Scale insects—cocus—also attack the orange, camellia, and similar plants. They may be removed by a sponge and water. The idea entertained by some that plants in rooms are injurious to the health of those living in them is altogether unfounded. In fact theoretically the reverse should be the case. Plants exhale oxygen from their under surfaces, during the light. When large numbers of plants, especially those whose flowers are highly perfumed, or those with odorous leaves, are kept in close rooms, they may sometimes occasion faintness, but with the few that are usually kept the perfume will only be sufficient to give the delightful sensation we all so much admire. Plants in rooms, to the extent they are generally grown by persons of taste, are not only not injurious to the health, but will afford relaxation from ordinary routine duties, amusement to the mind, and pleasant exercise to those whose time is not fully occupied. The examination of the several parts, both botanically and physiologically, will afford a pleasant and instructive study that, once engaged in, will thereafter not be discontinued.

WINDROW. A line or row of grass, or other material exposed to dry. The untilled borders of the field.

WINE. In the article Gallizing we have treated of the manufacture of fruit wines, and of increasing the strength of wines by the addition of sugar. It is well known that the juice of any fruit containing acid, starch or sugar, may be converted into a kind of wine, by the addition of such constituents as they may lack. Hence any fruit juice, or the juice of the leaf-stalks of vegetables, as rhubarb, may be made into an innocent and pleasant juice. A well known authority says that starch readily passes into the saccharine fermentation, and sugar into the vinous; thus wheat, corn, rye, barley, etc., put in warm water, a certain portion of the starch within is changed into sugar, and if the fermentation is permitted to proceed till it passes on into the vinous or alcoholic, the sugar is changed into alcohol. The fluid now contains a portion of alcohol which is removed by distillation. As alcohol boils at a much less temperature than water, if the mixed fluid be gradually heated up to the alcoholic boiling point, the alcohol, being converted into vapor, will pass over into the receptacle, while the water will remain unaffected. In ripe apples, peaches, currants, blackberries, grapes, and similar fruits, there is a small per cent. of sugar with little or no starch. The juice is, therefore, so to say, already past the saccharine fermentation and ready for the vinous. Left to the action of the atmosphere, all these juices in a few days ferment, i. e., change whatever sugar there may be into alcohol, the amount of which will depend entirely upon the amount of sugar before fermentation. Such a juice is, in general terms, a cider; if its percentage of alcohol is increased by adding sugar before the fermentation, it is a wine. The process of checking the fermentation is similar in both, only that in the case of wine great caution is to be exercised not to cork too soon, as the energy of the fermentation, being much greater than that of cider, the safety of the corking may be exposed by too early closing. Mashing the fruit, but not so as to bruise the seeds, the juice on being pressed out is mixed with an equal amount of water, and from two to five pounds of sugar to a gallon of the mixture. Grapes usually require about three and a quarter pounds; currants four pounds; blackberry and raspberry, three and a half pounds; peach and cherry, the same as grape; orange wine, the juice of a dozen oranges and three pounds of sugar to a gallon of pure water; the sugar in all cases should be the best white, lump, or crystallized. After the fermentation has nearly ceased it must be stoutly corked, and four or five months later bottled tightly. Sealed well it keeps for years without change. From the invaluable medicinal qualities of grape, currant, and blackberry wines, the certainty of their purity, connected with the fact that nearly every wine of commerce is drugged and utterly unfit for the sick chamber, their manufacture for home use is daily becoming more extensive. No port, sherry, or madeira, as commonly found in our market, is at all comparable to these wines in medicinal excellence or grateful qualities. A practical writer on wine making, in a repor to the Department of Agriculture at Washington, some time since, wrote an exhaustive article on wine making, from which we collate such matter as will be of interest generally to those who have fruit which they wish to convert into wine. The writer says: To make a first class white wine, only white grapes are used; they are mashed in the apparatus, being fixed on the top of the fermenting vat, but not allowing the husks to fall into the vat, which, after being mashed, are put on the press, and when the whole mass is thus prepared, they are pressed out, and the juice, or must, put in the vat. As there are no husks in the vat, the false bottom is not required. The head, or cover, is now put on, and the temperature of the must ascertained by the thermometer. If it is lower than 50°, some must is taken out and heated, to warm up the whole mass till it comes up to 60°, which is the point it should be brought to when fermentation takes a proper course. This temperature must be maintained as evenly as possible, and therefore a proper room, as already described, with a stove or fireplace in it, will be the most serviceable. After the temperature of the must is regulated, the bung with the safety-valve and tube are fixed on, and a small vessel with water is placed under the other end of the tube, or cylinder, so that it will reach into the water about three inches. The whole work of mashing, pressing, regulating the temperature, and closing up the vat, must be performed with the greatest possible speed, as the juice begins to ferment as soon as it is extracted from the berries, and by coming in contact with the atmosphere, the most essential part of the wine, its chief strength, the alcohol, escapes. In proportion as the grape contains sugar, the fermentation of the must will proceed; hence the fermentation of the must from highly improved grapes of best qualities, containing much sugar, and a vintage favored with a hot, dry summer, will take twice as much time as poor and watery juice. By fermentation, the sugar of the grape-juice is converted into alcohol, which amalgamated with the other contents of the grape juice, forms the wine, at once fiery, aromatic, and pleasant in every respect. The dissolution of the greater part of the sugar, and the union with the acids, gluten, tannin, etc., will have been performed when the must begins to get a clear color, an aromatic vinous taste, and quiet; it is then time to draw it from the fermenting vat into the casks, in which it will slowly finish its fermenting process. Rich must will ferment in from five to eight days in the vat, while that of inferior quality gets through in two or three days. It is very important to have large casks in which to keep the wine, as thus its properties and character are much better preserved. When the casks have been filled, a similar tube is fixed, as on the fermenting vat, with one end in the bung-hole and the other in a small vessel of water. Schiller wine signifies a particular color of the wine, varying from one hue to another, and to be called neither white, yellow, nor red. Grapes of all colors are used in making this wine; they are mashed by putting the mill on the top of the vat, and the husks put in it, and fermented together with the must. When they are all mashed, or one vat is filled, the false or fermenting bottom is set in, to keep the husks under the must, and the head and other fixtures put on. The fermenting of schiller wine takes a longer time and is more stormy than white or claret wines; but this is stronger, more fiery, and aromatic, than either. The same temperature is required as for other kinds. Much care, however, must be taken to watch its culminating point, when the carbonic acid gas escapes furiously, the water begins to roar in the little tub, and the safety valve works like a hammer, that nothing may interfere with the action and function of those agents, on which depends, in this critical period, the safety of the whole contents of the vat. The agitation may be observed still better in the glass tube connected with the vat; but after a short time, only a few hours, the must will calm, the fermentation proceed more quietly, and, in two or three days, begin to get clear and vinous, which is the time for drawing the young wine into the casks, there to complete its fermentation. The husks are pressed and the juice obtained added to the rest. As soon as one cask is filled, the tube is fixed into the bung-hole, and a small vessel of water put under the other end, to keep the air from contact with the young wine. The ventilation of the cellar is so regulated as to get an even temperature of about 50°. The blue and Traminer-colored varieties are used for making red wine or claret; after the whole vintage, white, Traminer, and blue, or black, is made into claret. The color of the juice has to be examined, if it be not of the desired dark-red, some coloring matter must be used. There are several harmless substitutes, such as well-ripened elder berries, the berries of the hawthorn, etc. Whatever kind of berries may be used, they should, in all cases, be perfectly ripe; still better if they have been picked some time before they are wanted, and dried in the sun. The quantity of these must be ascertained by taking a sample of the must and adding berry juice till the desired color is obtained; but, as the red or claret wines become lighter by age, the color should at first be a few shades darker. Claret wine takes more time to finish its fermenting process than any other. It is perfected when the color becomes clear, and the taste changed from sweet to strong vinous. According to the state of the weather and the season, which influence the quality of the grape, the fermentation will proceed, but the ordinary period requisite to complete it is from eight to ten days. When finally fit to draw into the casks, the management is the same as with other varieties; the husks are put under the press, and the extracted juice into the casks and mixed with the juice first drawn. The sediment or less, from either variety, is saved in a cask for further use. The husks, which still contain a considerable amount of wine-making properties, after the juice has been extracted from them by the press, are broken up fine, put into the fermenting vat, and water, in equal proportion to its bulk, is added—to each ten gallons of water one gallon of lees—to strengthen and facilitate its fermentation. A light but pleasant wine is obtained in this way, which is fit to drink the next summer, and will be found, in hot weather, a very agreeable cooling drink. All the seeds should be saved, carefully and thoroughly dried, and hung up in bags and in an airy, dry place. The young wine, after it has been brought into the cellar, will go through another second course of fermentation, and will be more or less agitated, for a certain time. The casks have to be filled occasionally, and kept full to the bung;

the dissolution of the sugar and of the different constituents of the wine will proceed slowly, and finally cease altogether; the undissolved matter settles on the bottom of the cask, and is called lees. When the wine gets to such a state, quiet and clean, it is time to draw it off into another cask. The casks, before using them, must be well cleaned and sulphured, which is done by dissolving sulphur in an iron pan over a fire, cutting strips of cotton cloth or linen two inches wide and nine long, and soaking them in the sulphur, then a piece of wire about a foot long is fastened to the bung, and the other end bent to a hook, on which is hung an ignited strip of the sulphured cotton, and introduced into the cask, the bung driven in, the cask rolled to and fro, and finally the sulphuric acid gas, which has not penetrated into the wood, let out by loosening the bung. A syphon, reaching about two-thirds to the bottom of the cask, is used for drawing. If the empty cask can be placed near enough, so that the other end of the syphon reaches to its bung-hole, it is so much better, as there is less escape of the gaseous and flavoring ingredients of the wine. The rest of the wine which the syphon does not draw is drawn off by a faucet, about six inches above the bottom. When a cask is thus filled to the bung-hole, the bung is driven in tight. In order to preserve the fine, clear condition of the wine, all jerking and other rough treatment of the casks must be avoided. The lees from the emptied casks are collected into a cask by itself. White wines will have attained the proper condition for drawing in a couple of months, wine of inferior quality still sooner, and should be drawn immediately after showing a clear, bright color, as the sediment injures its taste and character. Schiller wine, according to its quality and intended use, may remain some time on the lees, especially if it is designed for preserving to an old age; but in most instances it will improve by drawing as soon as it is clear. Claret wine, however, should remain from five to six months in the first cask and lees. When fermentation is no longer perceptible, the cask is filled, the bung driven in, and it is left undisturbed till the drawing is finished. The exact period is a matter of fashion, according to the taste and habit predominating in the country where it is sold. By letting it stand on the lees for several months it obtains more of those peculiar principles, astringency, etc., preferred in good claret. No wine should be drawn, and no good wine-cooper will open a cask in cloudy or sultry weather, as the wine, coming in contact with such an atmosphere, gets turbid and excited; therefore cool and bright days must be chosen for that purpose. All articles used in the drawing, no matter how clean they may be kept, should be previously rinsed with wine. There are many instances when the wine loses its character, either by turning flat, or getting excited and turbid, when it will be necessary to attend at once to its restoration by applying proper remedies, and prevent it from total destruction. By acting according to the principles set down here, such cases can occur only by accident; but, to avoid the calamity, constant care is required. The causes may be different, but generally it will be found that neglect, merely, or perhaps ignorance of proper management, created the trouble. When wine becomes flat, it wants stimulating. This may be done by various means. The liquid from two pounds of raisins, cut fine, and soaked a few days in a gallon of good rectified alcohol, then pressed and strained, is mixed with a couple of gallons of the flat wine, heated to near boiling, and all put into the cask again. After it has been well stirred, the bung is replaced and left undisturbed for at least two months, when it may be drawn into another cask, previously well sulphured. Every thirty gallons will require a gallon of alcohol and two pounds of raisins. Another good remedy is, from each thirty gallons of flat wine two gallons are taken out, two pounds of well-dried grape seed added, and brought over fire; while it is heating the seeds are stirred and rubbed with a beater, and after a while the liquid is strained and put hot into the cask again, which is bunged up immediately. Practical knowledge and experience are necessary to manage such wines; but the cause of the trouble may easily be prevented by adhering to the general principles of wine-making. If the cask produced the flatness, the wine must be drawn first into another, before anything is done with it. When the wine becomes excited, turbid, and ferments again, which may occur often in poor cellars, if the weather should change from cold to warm, or if the casks have been opened in close, sultry, and cloudy weather, the difficulty will be found most likely in the cellar. Wine can not be expected to keep and mature well in a poor cellar, which, perhaps, is also used for other purposes. Sulphur is a good remedy. An empty, clean cask is provided, two gallons of the infected wine put in, a strip of sulphured cotton ignited, the bung driven in, and the cask rolled. After a while, two gallons more of wine are put in, sulphured, and rolled again, according to the quantity to be cured; eight or ten gallons may be impregnated with sulphur, or even more; and finally restored to its stand, and well stirred, with the bung out. After the wine has been drawn once, there is still more or less undissolved matter in it, which will soon settle to the bottom of the cask and therefore render necessary another drawing. This must be done, generally, three or four times before the wine gets clear, well-fined, and fit for the market. The proper time for drawing will be at intervals of from three to five months; but experience and judgment alone can point out the exact period. If it is desired to sell the wine before it has attained its finish, it must be fined. This is done by taking out of the cask from four to five gallons, and adding to each thirty gallons the whites of ten eggs; these are beaten to foam with the wine, finally put into the cask, well stirred, and the cask bunged up. Or powdered gum arabic may be used, in the proportion of one ounce to fifty gallons of wine, well stirred with the whole contents. Both articles are perfectly harmless to the character of the wine, and entirely answer the purpose. In the course of from four to six days the wine will be in the desired condition to draw and bottle for market. It will keep best and improve more in the casks; but there are several instances when, after it has been drawn, and the casks filled, portions remain, for which no casks small enough can be provided; it is better to draw such portions at once into bottles. Simple as the bottling seems to be, yet there are many things to be observed, in order to keep the wine well and prevent it from becoming flat and turbid. The first and chief requirements are clean, sweet bottles, and new, fresh corks; it must be a rule, strictly adhered to, that as soon as a bottle is emptied it is to be rinsed out well with water and placed in the open air, on a shelf or frame erected for the purpose; before using, it is rinsed out once more, and then filled within two inches of the mouth. The cork, which should fit exactly, is dipped into wine, and driven well in. The bottles should always be placed in a horizontal position, so that the corks can not get dry and admit air, which is generally the reason why the wine gets flat. They keep best if put in dry sand, one above the other. As further protection, the corks may be waxed. The husks, lees, and seeds may be differently used; a pleasant wine can be made of them, in the way already described, but a real good marketable wine is obtained by adding sugar in proportion to the vinous principles, found out by proper instruments, by which all wines have to be brought up to a certain standard point, most favorable to their development. But, as a description of this modern art of wine making would require more room than has been allowed, it may only be mentioned that a vintage can be increased from 100 to 200 per cent. without the least detriment to its quality. If the husks are not wanted for this purpose, a good vinegar may be obtained from them. As soon as they come from the press they are broken up fine, and put into a vinegar vat, twice their bulk of rainwater added, with two gallons of lees and a quart of beer-yeast to each barrel. The vat is set in a warm room, but not in a fermenting room, cellar, or anywhere near wine, and allowed to stand till the vinegar is formed, which is then drawn into barrels, the husks being brought to the compost heap, or directly to the vineyard. The lees contain considerable undissolved sugar and other vinous substances, which, by distilling, make a highly flavored brandy. The quantity may be increased without affecting its good quality by adding to each barrel of lees half a barrel of well rectified alcohol; that from potatoes is the best. Let it stand a couple of weeks, turning the cask once or twice a day, and finally it will be fit for the still. The remainder in the still, too weak for brandy, makes a good vinegar. Lees are likewise a good stimulant for flat, insipid wine, and a portion should always be kept on hand to be thus applied. Grape seeds are very valuable for fining and strengthening the wine; they may be used either in the manner mentioned, or a few handfuls thrown into the cask just as they are. They must be well dried, and kept hung up in an airy place. In consequence of many failures in the ripening of the grape, and diseases spreading rapidly over the continent, more or less destroying the crops of whole districts, grape culturists and chemists began to look for remedies and substitutes for those principles in which the vintages are deficient. Much has been said against this method, and much suggested to neutralize predominating acids without resort to sugar and water, but all experiments have thus far failed, either the wine would get flat at once, or be unfit for use on account of its harshness. More than fifty years ago, Chaptal, Cadet de Vaux, and other eminent chemists, suggested that poor wines might be improved by adding sugar; later, Claudot-Dumont urged his countrymen to abstain from the bad practice of sweating and mixing their poor wines, and recommended sugar as the best agent to improve them. But neither of these chemists were able to point out in what proportion sugar should be used to obtain the desired result. This problem has finally been solved by Drs. Gall and Petiol, and approved by such men as Thénard, Döbeneiner, Von Babo, Bronner, and others. Drs. Gall and Petiol both discovered, after many analytical experiments and researches, that the surplus acids in the grape juice can be turned to good account, by bringing its other ingredients (sugar and water) to a proper proportion. Every kind of grape juice is nothing but clear water, in which are dissolved from six to thirty per cent. of sugar, two to four per cent. of free acids, and from three to five per cent. of other matter, or the essence of wine-making principles. Sugar converts itself into alcohol by fermenting, and two per cent. of sugar will produce, in the average, one per cent. of alcohol; the free acids, if they are in proportion to the other principles, give the wine its agreeable vinous character, its flavor, etc.; the last properties contain the principles necessary for fermenting, fining, and keeping. Dr. Gall has further proved the fact that these different acids in the grape do not require particular notice; it is sufficient to find out the whole sum, and then treat them alike. In order to ascertain what percentage of sugar and acids the must, or grape juice, contains, two different instruments are required, a must scale and an acidimeter; for the first purpose Oechsle's must scale is generally used, and Otto's acidimeter for the second; on both the following calculations are based, illustrative of the method, as given, of making wine. Experiments continued for eight years have proved that, in favorable seasons, grape-juice contains, in the average, in 1,000 pounds:

Material.	Pounds.
Sugar	240
Free acids	6
Water	754
	1,000

These proportions may be set down as normal; therefore, to obtain good wine from a vintage of inferior quality, these proportions must be secured by adding sugar and water. It will be seen that the contents of the acids are the indicating point as to what quantities of sugar and water would be required to bring the wine to such a normal state; further, as has been the case generally, the less sugar the more acids. The per cent. of acid in the grape-juice is the basis on which a calculation must be founded. All practical grape-growers and wine-makers in Germany and France admit that a wine containing the proportion of sugar, acids, and water above described, is in every respect preferable to heavier or lighter wines. It has lately been called a normal wine, and will serve here as well as a standard. When a must contains, instead of twenty-four per cent., only fifteen per cent., or instead of two hundred and forty pounds, only one hundred and fifty pounds of sugar, but, instead of only six per cent. of pounds, nine per cent. of acids in one thousand pounds, the question arises, how much sugar and water will have to be added, to bring such a must to the proportion of a normal wine? To solve it, we calculate thus: if, in six pounds of acid, in a normal wine, two hundred and forty pounds of sugar appear, how much sugar is wanted for nine pounds of acids? Answer: three hundred and sixty pounds. And again: If, in six pounds of acids, in a normal wine, seven hundred and fifty-four pounds of water appear, how much water is required for nine pounds of acids? Answer: one thousand one hundred and thirty-one pounds. As, therefore, the must, which we intend to improve by neutralizing its acids, should contain 360 pounds of sugar, nine pounds of acids, and 1,131 pounds of water, but contains already 150 pounds of sugar, nine pounds of acids, and 841 pounds of water, there remains to be added 210 pounds of sugar, 0 pounds of acids, and 290 pounds of water. By ameliorating a quantity of 1,000 pounds must by 210 pounds sugar and 290 pounds water, we obtain 1,500 pounds of must, consisting of the same properties as the normal must, which makes a first class wine. The increase of the quantity is five hundred pounds, or two hundred and fifteen quarts, which, after deducting the outlay for sugar, two hundred and ten pounds, at twelve and a half cents per pound, amounts to twenty-six dollars and twenty-five cents, and, allowing fifty cents per quart, leaves a clear profit of eighty-one dollars and twenty-five cents. Another illustration, which probably comes near the qualities of northern wild native grapes may be thus calculated: Such grape-juice, or must, contains twelve per cent., or one hundred and twenty pounds of sugar, and fifteen per cent., or pounds of acids. One thousand pounds of such must will consist, then, of one hundred and twenty pounds of sugar, fifteen pounds of acids, and eight hundred and sixty-five pounds of water. In order to neutralize these acids, and make them proportionate, corresponding with wine of a good character and normal state, it will require to fifteen pounds of acids, 600 pounds of sugar and 1,885 pounds of water; as the must contains fifteen pounds of acids, 120 pounds of sugar, and 865 pounds of water, have to be added 0 pounds of acids, 480 pounds of sugar, and 1,020 pounds of water. Such improved must will, therefore, consist of fifteen pounds of acids, 600 pounds of sugar, 1,885 pounds of water, or in all 2,500 pounds. Deducting one thousand pounds of must, which furnished the wine-making principles, acids, etc., gives a surplus of fifteen hundred pounds, or six hundred and forty-five quarts of must in a normal state. Value of six hundred and forty-five quarts, at fifty cents per quart, three hundred and twenty-two dollars and fifty cents. Cost of four hundred and eighty pounds of sugar, at twelve and a half cents per pound, sixty dollars. Net profit, two hundred and sixty two dollars and fifty cents. It will be seen that such wine is produced at the small expense of nine and a quarter cents per quart, omitting the one thousand pounds, or four hundred and thirty quarts, which furnished the wine-making principles. But a true estimate of the cost of such a wine from the wild native grapes when they have to be bought must be calculated thus:

3,000 pounds of grapes, at 3½ cents per pound.....	$105.00
480 pounds of sugar, at 12½ cents per pound.....	60.00
Total cost..............	$165.00

And as one hundred and sixty-five dollars make two thousand five hundred pounds of must, or one thousand seventy-five quarts, the actual expense is fifteen and one-third cents per quart; allowing interest on capital invested for apparatus, casks, shrinkage, and labor, the whole expense will not average twenty cents per quart. An immense field of profitable employment presents itself to industrious men. In a favorable season a man will gather five bushels of wild grapes in a day, from which he obtains at least eighty quarts of natural wine, while if ameliorated according to Drs. Gall and Petiol, he will get 120 quarts of good normal wine. It is further proved that such wines made according to these principles mature at least in half the time required by natural wine, and keep better; consequently permitting a quicker return of invested capital, a better article for speculation, safe transport to distant markets, etc. Thus, too, a good wine can be made of an inferior vintage, grown in an unfavorable season, and the quantity of a rich vintage increased to 200 per cent., without the least detriment to its quality. It is very important that this method should be introduced into our country; it will not only encourage people to more activity in this lucrative branch of industry, but will furnish us with a wholesome and pleasant beverage; insuring as a pure, cheap article, a large consumption and a ready sale. Grapes properly cultivated in vineyards or gardens, and in favorable climates and localities, will generally contain sufficient sugar and no surplus of acids; so it may appear that there is no need to practice this method. But Dr. Gall and others found by analyzing the husks or pomace, after the juice had been extracted by means of powerful presses, that these not only still contained a considerable amount of juice, but also a great amount of extracts or wine-making principles, in many cases sufficient for three times the bulk of the juice previously obtained. This fact suggested the question: as there are so many of these valuable properties left, and only sugar and water exhausted, why can not these principles be substituted till the others are completely used up? It was found that it could be easily done. The secret of making wine from water was thus solved, and an all-important principle for wine-making established. By further experiments these speculations not only proved to be correct, but it was in most cases impossible to judge which was natural wine, or which the product of this new method; indeed, the preference is generally given to the latter. While natural wine is so very different, according to circumstances which prevailed in its growth, such Gallized wine is always in perfect harmony, because its contents are not the results of chance, but the close following of processes of nature. The practice of this method is quite simple; for instance, let the vintage be of an average good quality, the must containing twenty-four per cent. of sugar and six per cent. of acid, and the quantity 1,000 pounds. The grapes are mashed in the usual way, but not pressed; the juice, if it be white wine, drawn off into casks to ferment; if claret or red wine, it is fermented on the husks, as described in a former paragraph, and then drawn off into casks. Before this is done, however, 240 pounds of sugar are dissolved in 754 pounds of water, and as soon as the grape-juice is drawn off, this solution is put on the husks in the fermenting vat. It is absolutely necessary to have sugar-water prepared and ready for an infusion before the wine is drawn from the fermenting vat, and put immediately on the pomace as soon as the wine is off, to prevent their coming in contact with the air, getting dry, moldy, and spoiled. It is practicable to draw off this infusion once and put it on the husks again in order that their fatty substances may be better dissolved; but this operation has to be performed without delay, as fermentation commences immediately, and must not be interrupted. The water used for that purpose should be soft rain or cistern water. A large iron or copper kettle is put over a fire and heated, in which the sugar is thoroughly dissolved and then the whole brought to a temperature of 70° and poured over the husks in the vat. The mode of fermenting, temperature, and the entire operation, is the same as before described. To obtain a certain color, it may be necessary to let this second wine remain longer on the husks and in the vat. The proper period for drawing will be best found out by often examining samples till the desired result is obtained. When this is the case, the young wine is drawn off and filled into casks. Again, 240 pounds of sugar are dissolved in 754 pounds of water put on the husks and managed as before stated. Should this second wine, after it has fermented and been drawn off from the lees, contain less than five per cent. of acid, it will be necessary to add two ounces of tartaric acid to each 100 pounds, or twenty ounces to 1,000 pounds of wine; the tartar is pulverized and dissolved in two quarts of heated wine, which is then put into the casks and well stirred. After this third wine (second infusion) has fermented and been drawn off, the husks are taken out and put under the press, and the extracted juice added to the rest in the casks. This wine is treated like other wines, only left some time longer on the lees before drawing and fining. There is, from 1,000 pounds, or 430 quarts of must, an increase of 2,000 pounds, or 860 quarts of wine, which, after charging for 480 pounds of sugar, at twelve and a half cents per pound, will equal sixty dollars, or not quite seven cents per quart. The must-scale and acidimeter have to be used often while such wine is in its fermenting process, and before it is drawn off from the vat, in order to examine and find out the capacity of the husks, whether they contain sufficient properties for another infusion, or only for a part. If the result of the examination of the young wine shows an undiminished amount of acids, the husks will bear another infusion of sugar-water to the same amount as before; or if there is found a deficiency of one and a half or two per cent., the quantity of sugar and water must be regulated accordingly. For instance, after the first infusion has fermented, the pomace shows a decrease of two per cent. of acids, or wine extracts, but there is still four per cent. remaining, which, if fermented with a proportionate quantity of sugar-water, will make as good a wine as any. Therefore, to determine of what proportion the second infusion should consist, we calculate thus: If six per cent. of acids require 240 pounds of sugar, how much is wanted for four per cent.? Answer: 160 pounds. Now, if six per cent. of acid required 754 pounds of water, how much is wanted for four per cent.? Answer: 502⅔ pounds. There is consequently wanted for the second infusion 160 pounds of sugar and 502⅔ pounds of water. It will sometimes be found that, after two infusions have been fermented, and 200 per cent. obtained, the pomace still contains several per cent. of wine extract; therefore, a third infusion of sugar-water may be applied, and a still larger quantity of wine obtained. The calculation in regard to the amount of sugar and water to be used is the same. In either case, should a stronger vinous taste be desired, tartaric acid is added by degrees till the object is attained. To facilitate these manipulations, it is necessary to construct tables, in which the proportion of weight and measure to each other are calculated. It will be found more convenient in practice to measure the must and water, instead of weighing, and as must will differ in its specific weight, according to its acids and saccharine properties, it is necessary to have a table, on which can be ascertained, according to the indication of the scales, the exact amount of each. On the table, for instance, which has been calculated and constructed to Oechsle's must-scale, when ninety-five per cent. is indicated, it will be found that the must contains 21.8 per cent. of sugar. The acids and extracts which the must contains increase its specific weight, and prevent the scale from sinking and showing the amount of sugar correctly, being deducted, and the exact amount of sugar found on it. For the acidimeter, a table is constructed, on which is found the calculation how the per cents. of acid compare with those of sugar, and how much water is required for certain per cents. of acids and sugar in weight and measure. These tables, as they are compiled in conformity with the scales, are generally supplied with the instruments, and with directions for use. As the sugar contains more or less water, even when it appears perfectly dry, it is necessary, after a certain quantity has been dissolved for such ameliorating purposes, to use the must-scale, find out how it compares with the intended purpose, and regulate the balance by either adding more sugar or water till the desired point on the scale is correct. It is a matter of course that only sugar of the best quality should be used; grape sugar is the best; but as this can not be had cheap and in large quantities, white loaf sugar must be used. Still there is no doubt that enough of the former will be manufactured as soon as a demand is manifested. Since the introduction of this method of wine-making into Germany, several grape-sugar factories have been established, and are all doing well, as the demand for this article increases from year to year. Grape sugar can be produced from forty to fifty per cent. cheaper than white loaf sugar; it is therefore, a great desideratum that this method should be adopted. It has been suggested to keep each part of the wine by itself: as the natural wine, the first, second, and third, that a fair chance of judgment may be had; but afterward, when the result has given satisfaction, and all doubts are removed, it will be found that no reason exists why they should not be mixed at once, as the care and management will be considerably facilitated, without interfering in the least with its quality. (See articles Cider and Gallizing for further information.)

WINE STONE. Crude tartar, argal or argol.

WINGS. *Alæ.* In botany, the side petals of pea-like flowers, the membranous expansions of the seeds of the ash, ailanthus, parsnip, and other seeds.

WINTER AND SUMMER PRUNING. The principal object to be kept in view in pruning is to calculate so we may keep the top in proper shape, and so equalize all that each portion of the tree may have a due proportion of light and air, so far as practicable; and, that the tree may form its head from a single stem regularly, and from a given height, keeping the branches regular, and of as equal size as possible, each having as due a proportion of sap as may be. In this the operator must have due regard to the variety, so that the natural habit of the tree may be preserved so far as possible. Therefore no rule can be laid down that will apply to all; for, some are pendulous, others upright, and others again are spreading. The operator must study the natural habit of each, and use his judgment accordingly. In the West, however, all orchard trees should have their trunks shaded so far as possible, and their tops should be kept as dense as possible, affording at the same time due amount of light in every part. Why? We know that all varieties of orchard fruit, whatever their natural locality, require free circulation of air, and a due proportion of sun-light; for, fruits grown in deep shade are never fine in color or flavor; and; this, in proportion to such exclusion. When the top is so dense as to exclude a proper circulation of air, and are deprived of proper light, the leaves are pale, watery, and consequently incapable of their proper functions as elaborators of sap, etc. But trees require a moist atmosphere, and hence, in the West, they may not be so severely pruned as on the sea-coast, or near other large bodies of water. If, however, they be deprived of proper light and air, the weaker portions gradually sicken, and at length die and become harbors for insects, and the decay may gradually extend to other parts of the tree. Therefore all branches or shoots showing signs of disease or decay should be immediately removed. This accomplished, and the head kept sufficiently open so that the branches and foliage do not interfere, and yet kept sufficiently dense so the trunk and ground beneath may be well shaded, is about all that is required in ordinary orchard pruning in the West. In pruning, the natural habit of the tree must be preserved so far as possible. The three principal forms of growth are: First, conical shaped, second, round topped, and third, spreading. Types of these, with a strong upward tendency, are, Sweet June, and Paradise Winter Sweet; those with round heads, Fameuse, and Golden Russett, and those with spreading tops, Tallman Sweet, and Bellflower. To these may be added Primate, Rhode Island Greening, and Stannard, as crooked and irregular growers. It is evident that these will all require different systems of pruning. This should always be done with a view to preserve their natural inclination, so far as possible. The first two simply require to be kept in shape, and thinned only sufficiently to duly admit light and air. The two latter, to be shortened in only sufficiently to induce thicker growth, and induce, so far as may be, symmetry; always keeping the top thoroughly well clothed with leaves. No pruning is better than mutilation. And yet the usual rule is to send the hired man into the orchard some time in winter, with an axe and saw; and after, have him cart out the limbs on a hay rack to the brush heap. Is it any wonder, then, that the mutilated skeletons remaining, clothe themselves with water sprouts and refuse to bear fruit, or that they sicken, decay, and soon die? Is it any wonder that such pruning tends to intensify the idea that it is cheaper to buy fruit than to raise it? In conclusion, the following may be adopted as the ten commandments in fruit planting for the ordinary farmer, who does not profess to be a finished horticulturist: 1. Plant only such varieties as are generally known to be hardy. 2. Select only well formed, healthy trees. 3. Prepare for the orchard on a well drained spot, and bring the soil into good tilth. 4. Plant your trees carefully and pack the earth well around the roots. 5. Force them to remain upright by staking, or otherwise, until they get thoroughly established. 6. Induce twig growth on the stems, while young, to strengthen them, and cut back the young tops to induce a close, firm head. 7. Shade the stems until the top gets sufficient size to do so themselves. 8. Form the heads as low and as dense as possible, having due regard to convenience, and light and air; you have no business with a horse and plow next the trunks. 9. Keep the ground in good heart, and well stirred, up to the middle of July. 10. Keep the pruning knife and saw out of your orchard, except to reduce superabundant and straggling growth, and take this out whenever seen. Thus every farmer may grow sufficient fruit for home use, cheaper than he can buy it.

WINTER BERRY. *Prinos* (*Ilex*) *verticillata.* False alder, a shrub of four to eight feet, with permanent red berries, adapted to shrubberies.

WINTER CRESS. *Barbarea præcox.* An indigenous, perennial, cruciferous plant, growing near spring branches, similar to water-cress, but more pungent in flavor. *B. vulgaris*, also indigenous, is the water-radish, or rocket.

WINTER GREEN. The genus *Chimaphila*; pretty Alpine plants. They are perennial, with long roots, and grow in the shade of woods. The *C. umbellata*—pipsissewa—is used in domestic medicine as a tonic and as an astringent.

WIRE GRASS. (See Blue Grass.)

WIRE WORM. (See Elater.)

WISTARIA. The wistarias are so called hardy climbers, and are really so in the north, up to the latitude of Lake Erie, and even farther north in protected situations, where they may have the protection of a wall or the house. They require a light rich soil, and are among the most rapid and elegant of climbing plants, but are better if taken down late in the autumn and covered, as recommended for grape vines. There are two principal species, and a number of varieties. *Wistaria brachybotrys* is the Japan variety, with light blue and fragrant flowers. *W. Chinensis* is one of the most elegant and rapid growing of any, often reaching fifteen or twenty feet in a season. It has long, pendant clusters of pale blue flowers, in May or June, and again in autumn. The cut shows a shoot, leaves and bloom one quarter of the natural size. There is a white variety, (*alba*,) which is very fine. The double purple wistaria, introduced from Japan, has double flowers, and is deeper in color than the single Chinese wistaria which it otherwise resembles. Another desirable variety is the

Shrubby or cluster flowered wistaria, *W. frutescens*, less vigorous than the Chinese, the flowers pale blue and borne in short clusters; the variety *alba*, or white American wistaria has clear white flowers, and like its blue relative, they are borne in short bunches. This is a free bloomer. *W. magnifica*, has the flowers in dense-drooping racemes, of the size and general character of the Chinese, pale lilac in color, and is vigorous and a free bloomer.

WITHE. A flexible twig or bough that may be twisted and used as a cord.

WITHERITE. Mineral carbonate of baryta.

WITHERS. The high portion of an animal's back over the shoulders. Horses with high withers are said to have the fore hand well up; they go high above the ground and are quick and safe. In draft horses the breadth or weight of the fore hand is desirable. The word is sometimes applied to the womb of the cow. Casting the withers is inversion and protrusion of the womb. It should be returned by the hand and arm, and maintained in its place by a roll of linen introduced into the vagina in a wet state. The animal must be kept quiet and free from fever. (See Womb, Inversion of.)

WOLF'S BANE. Monk's hood.

WOLLASTONITE. A species of prismatic augite.

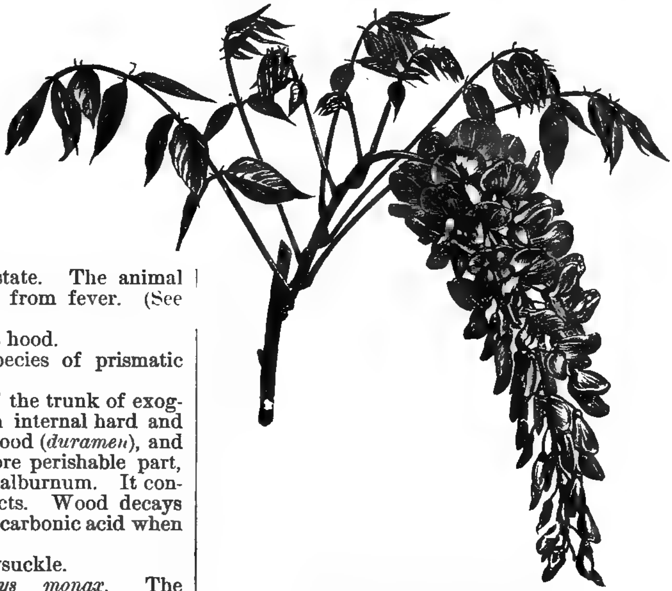
WOOD. The substance of the trunk of exogenous trees; it consists of an internal hard and colored portion, the heart-wood (*duramen*), and an external, softer, and more perishable part, the new wood, sap wood, or alburnum. It consists of woody fiber and ducts. Wood decays slowly, and yields water and carbonic acid when in contact with air.

WOODBINE. The honeysuckle.

WOODCHUCK. *Arctomys monax.* The ground hog, as the animal is familiarly called, is known all over the North, and is found West as far as the Rocky mountains. Its natural haunts are woodlands, the banks of streams, the edges of groves, and rocky bluffs. Though, as a country is cleared up, it often takes to the meadows or permanent pastures, where clover is found, of which it is fond. It likes green corn, peas, and various garden vegetables, and also eats insects and larvæ to some degree. Its burrows deface pastures, and although not so destructive as the rabbit, from its greater scarcity, it should be destroyed whenever found. Its fur is not valuable, but its tough skin, when tanned, makes the best of whip lashes and pouches.

WOODCOCK. *Grallatores.* The whole order of waders, comprising bitterns, cranes, herons, plovers, rails, sandpipers, snipes, and woodcock, are beneficial to the farmers, and should be preserved, since their food consists entirely of insects. The food of the woodcock (*Scolophax minor*) is earth worms and also such larvæ as it can draw out of the ground with its long bill. It is nocturnal and is seldom seen during the day, except it be roused from its covert. Their haunts during the day are woods and thickets, which they leave at night for the fields and moist places in search of food

WOODPECKER. *Picus.* The red-headed woodpecker (*P. erythrocephalus*) is the most common of the family North. It may be regarded as a beneficial bird, since its habit of boring into trees is solely to take the borers and other insects which infest them. The Hairy Woodpecker (*P. villosus*) is a southern species, but is also a summer resident of the valley of the Mississippi up to the northern borders of the great lakes. Its food is insects and grain of various kinds. The Canada Woodpecker (*P. Canadensis*) somewhat resembles this species, but is found further north. The Golden Woodpecker, (*P. auratus*) known also as Yellow Hammer, High Holder, and Flicker. Their food is insects of various kinds and various fruits and berries. They can hardly be classed as beneficial to the horticulturist, but may be so to the mere farmer.



CHINESE WISTARIA—HALF NATURAL SIZE.

WOOD PEWEE. (See Pewee.)

WOOD SORREL. The genus *Oxalis*, the leaves of which are sour, and contain oxalate of potash. They grow in rich, shady places. Many species bear beautiful flowers.

WOOD WASPS. The saw flies.

WOOD WAXEN. *Genista tinctoria.* Dyer's broom, a perennial leguminous plant, with yellow flowers, growing one foot high, leaves lanceolate, smooth, stem round, upright, without spines. It is exotic, but grows readily in the Northern and Eastern States. The plant in flower yields a yellow dye, which is fixed by solution of tin or acetate of alumina. It may be readily raised from seed, in drills a foot apart, and the plants kept clean by the cultivator.

WOODY FIBER. Very slender, tapering, cellular tissue, containing lignin, and forming, when compacted together, the tough fiber of hemp, flax, and vegetables, as well as the bulk of wood.

WOOL. Ranking with cotton, as a clothing material, the wool industry of the world is, year by year assuming greater and greater proportions.

Large as is the area in the United States adapted to the keeping of sheep, the wool supply has always been unable to keep up with the yearly increasing demand of the manufacturers. Of late years, however, or since 1870, our imports of wool have not increased. For the first half of the decade, two-thirds of the manufactured product was home grown, the bulk of the imports being low grade carpet wool and unwashed merino, but constituting only about one-fourth of the value of the wool manufactured. Among the wool producing countries of the world, Australia has made the most marvelous growth in the production of this staple. In 1840, England imported thence only 10,000,000 pounds of wool. In 1874 England imported from that country 238,000,000 pounds of wool, and the flocks, including New Zealand, consisted of 55,496,907 sheep. The following table, compiled from late sources of information, carefully verified, places the sheep and the wool of the world as follows:

Countries.	Number of sheep.	Pounds of wool.
Europe:		
Great Britain	35,000,000	218,000,000
German Empire	29,000,000	125,000,000
Austria-Hungary	21,000,000	60,000,000
Russia	50 000,000	138,000,000
France	26,000,000	124,000,000
Spain	22,000,000	69,000,000
Portugal	2,750,000	11,000,000
Italy	11,000,000	38,000,000
Turkey	15,000,000	37,500,000
Greece	2,600,000	7,500,000
Switzerland	550,000	2,500,000
Denmark	1,900,000	8,000,000
Holland	900,000	4,500,000
Belgium	600,000	3,500,000
Sweden	1,700,000	6,000,000
Norway	1,750,000	6,250,000
Total	221,750,000	858,750,000
America:		
United States	36,000,000	185,000,000
Canada	2,000,000	8,000,000
South America and Mexico	58,000,000	174,000,000
Total	96,000,000	367,000,000
Asia	175,000,000	350,000,000
Africa:		
Northern	20,000,000	45,000,000
Cape of Good Hope	12,000,000	51,000,000
Total	32,000,000	96,000,000
Australia	60,000,000	235,000,000
Grand Total	584,750,000	1,926,750,000

The estimate of Great Britain is based upon four and three-quarter pounds of wool per fleece, with 52,000,000 pounds for wool of sheep butchered during the year. The number thus disposed of is usually reckoned at three-eighths of the standing numbers of the flocks. In the German Empire the average is placed at three and two-thirds pounds, with 6,000,000 fleeces of three pounds from slaughtered sheep. Hungarian fleeces are lighter, and in Austria-Hungary the extra fleeces are assumed to bring the average nearly to three pounds for each sheep. France produces heavier sheep and fleeces than the German States, more mutton sheep, with a larger proportion annually slaughtered, making 124,000,000 pounds for standing flocks of 26,000,000 sheep a reasonable estimate. The South American fleeces are variable, but the average is much lower than in South Africa or Australia, and the sheep of Asia can not be safely estimated to yield more than two pounds each. There are some sheep in the islands of the Pacific, rendering the total estimate of 2,000,000,000 pounds very probable, and the number of sheep of the world 600,000,000 in round numbers is at least approximately correct. In the United States the sheep are kept almost entirely for their wool. The mutton product is really a minor consideration, except in the vicinity of large cities. In some portions of the country the pelts are even yet considered the more valuable portion of the dead animal. In England, mutton is of fully as much importance as the wool; hence when an Englishman buys, he feels the animal and asks how much it will weigh. An American parts the wool and asks how much wool it will shear. Thus in the United States the efforts are in the direction of wool; in England in the production of mutton. The shearing and handling of wool may be summed up as follows: If the sheep have been washed, shearing should take place when the oily-feeling matter, termed yolk, has so far reappeared in the wool as to give it its natural brilliant appearance and silky feeling. The mode of shearing can not be described here in detail. The wool should be cut off evenly and smoothly. reasonably close, but not leaving the skin naked and red, which renders the sheep very liable to receive injury from cold. Stubble shearing and trimming, leaving the wool long, so as to give the next fleece the appearance of extraordinary length, or leaving it long in places, in order to affect the apparent shape of the animal, are both frauds. The fleece should be as little broken as possible in shearing. It should be gathered up carefully, placed on a smooth table, with the inside ends down, put into the exact shape in which it came from the sheep, and pressed close together. If there are dung-balls, they should be removed. Fold in each side one-quarter, next the neck and breech one-quarter, and the fleece will then be in an oblong square form, some twenty inches wide, and twenty-five or thirty inches long. Then fold it once more lengthwise and it is ready to be rolled up and tied, or placed in the press. The improved wool-press, worked by a lever, or by a crank etc., does the work far more expeditiously, far better, and with much less labor than doing it up by hand. Three bands of moderate sized twine, flax or hemp once round are enough for the fleece. It is fraudulent to put the unwashed wool of sheep that have died of disease, or of those which have been killed, or unwashed tags, into washed fleeces. It is also fraudulent to sell burred wool so done up as to conceal the burs, without giving notice to the buyer. The burred wool should be put by itself, so that the buyer can open and examine it. Wool should be stored in a clean dry room, tight enough to keep out dust, vermin, and insects. If sacked and sent off to market, it is put up in bales nine feet long, formed of two breadths of burlaps thirty-five or forty inches wide.

WOLF TEETH. In so called moon-blindness, small, black, imperfect teeth, sometimes found between the nippers and grinders, and called wolf teeth, are credited with the cause of the disease. Both names are incorrect. So called moon blindness is periodical ophthalmia, which see. The teeth have nothing to do with the disease, except that when loose they should be extracted. So also the other teeth should be looked to, as a diseased condition of the teeth produces intensity of ophthalmia by sympathy of the several parts. (See Eyes, Inflammation of.)

WOMB, INVERSION OF. It is not unusual in protracted and difficult labor in farm animals, especially the mare and cow. Thus from excessive straining, the womb is inverted and protruded in the form of a large red or violet colored bag. If not discovered for some time, engorged and purple with thick blood. The treatment is to cleanse thoroughly with warm water. If it be much engorged, puncture lightly, just deep enough to draw blood, and with a sharp lancet, to relieve the engorged blood vessels. When the bleeding has proceeded far enough, stop the flow with cold water. Then while two helpers support the mass by means of a cloth held underneath it, the operator oils the bag, and placing his right hand, well oiled, against the horn or point of the bag furthest from the vagina, presses it gently, but steadily and firmly into its place, as far as may be possible. Then with the left hand the dependent parts are pressed inwards, the assistants helping by following the bag to keep it from again extruding, until it can be fixed by a pledget of oiled tow, supported by a bandage kept in place by extend to a surcingle and collar forward. If there is continued straining, give the cow half an ounce of chloroform and two ounces of laudanum in a quart of milk. In any case the bowels must be restrained from acting for twenty-four hours by means of laudanum. This accomplished and the pains having ceased, the tow may be removed, and finally the bandage; but the animal must have quiet for some time. (See article Parturition.)

WORMING. An operation performed on puppies, consisting in the removal of a vermiform ligament from under the tongue; it is ignorantly supposed to prevent madness, but, in fact, merely breaks them of their habit of gnawing.

WORMSEED. Goosefoot, Jerusalem oak. An oil is distilled from the seeds, and called worm-seed oil: it is exceedingly nauseous, and is given to children in the dose of five to ten drops, and followed by cathartics. (See Goosefoot.)

WORMWOOD. The genus *Artemisia*, including southernwood, mugwort, etc. They are composite, bitter perennials, with a strong, rank odor, and have been much used as tonic bitters, and some species are vermifuges. Common wormwood is *A. absinthium:* the French flavor a cordial with it, but its habitual use is deleterious.

WIRT. A decoction of malt; an old name for an herb.

WOUNDS. The treatment of wounds, says the late Dr. Dadd, depends altogether upon their nature and cause. It is very difficult in the horse—although not so in man—to heal a wound by what is called first intention, which means union by medium of coagulable lymph without suppuration. The definition of wound, technically, is, a solution of continuity in the soft parts, produced by some mechanical agent. Wounds are divided into incised, contused, lacerated, punctured, and penetrating, of these our authority says: Incised wounds are those inflicted by sharp instruments. On the human body they often heal without any subsequent inflammation, beyond what nature sets up in the restorative process; but the difficulty in the horse is, that we can not always keep the parts in contact, and therefore it is not so easy to unite them. In many cases, after having been at the trouble to adjust by sutures the edges of divided parts, and when all seems going on favorably, the animal gets his head round, and tears the wound open afresh, so that our labor is all in vain. This puts a damper on healing by first intention. There are several other difficulties in the way of healing by this method, well known to anatomists. We shall just merely refer to the principal one, because it may satisfy the reader that some wounds had better not be sutured, for they put the subject to a great deal of pain for no purpose. Horses, as well as some other animals, have, in lieu of hands, a peculiar muscular arrangement under the skin, by means of which they can shake off flies and other foreign bodies; and it is owing to the facility with which they can jerk or move the skin that we often fail in uniting flesh wounds. Other obstacles are to be met with, both in relation to the size of the wound and as regards its anatomical direction. If the wound is seen immediately after infliction, and there seems to be the least probability of healing by first intention, we place a twitch on the horse's nose, and examine the part. If there be found neither dirt nor foreign body of any kind, the blood had better not be washed off; for this is the best healing material in the world. The edges are then to be brought together by interrupted sutures, taking care not to include the hair between the edges of the wound, for that would effectually prevent union. Nothing more is needed but to secure the animal so that he can not get at it. If he is to be kept in the stable, without exercise, for any length of time, he had better be put on half diet. Pure air will not hurt him. Contused wounds are generally occasioned by hooks, or some blunt body connected with the harness or vehicle. They generally leave a gaping wound with bruised edges. We have only to remember that nature possesses the power of repairing injuries of this kind—of filling up the parts and covering them with new skin; all we have to do is, to attend to the general health of the animal, and keep the wound in a healthy condition. A usual application and a good one, is the compound tincture of myrrh. If the part assume an unhealthy aspect, a charcoal poultice will rectify that. If such can not be applied, owing to the situation of the wound, dress it with pyroligneous acid. Lacerated wounds are generally in the form of a rent rather than cut, inflicted by the calking of a shoe tearing off the integuments and subcellular tissue, leaving a sort of triangular flap. In these cures we generally employ sutures, and treat them the same as incised wounds. Punctured wounds are those inflicted by a pointed body, as a nail in the foot, point of a fork, or splinter of wood. These are the most dangerous kinds of wounds, for they are frequently the cause of fistula and locked-jaw. We make it an invariable rule, in the treatment of punctured wounds, to first examine by probe or otherwise, and remove any foreign body that may be present, and then poultice with flaxseed, into which we stir a small quantity of fir balsam. In puncture of the foot by nail, instead of plastering it with tar, and forcing a tent into the orifice, and then covering the sole with leather, as most blacksmiths are wont to do, we have the shoe taken off, the foot washed clean, and a moderately warm poultice applied, and renewed daily, until the suppurative stage commences. That once established, we consider our patient safe; for many men, as well as animals, have lost their lives from the absorption of pus formed in the wound after the external breach had healed. When a bone is injured by the point of a nail, or fork, the cure is rather tedious; the primary means, however, are the same. The poultices may be followed by astringent injections as alum water, etc. In case of injury to the bone, we use pyroligneous acid; to be thrown into the wound by means of a small syringe. If extensive disease of the bone sets in, the services of a veterinary surgeon will be required. A very profuse or unhealthy discharge from a punctured wound must be met by constitutional remedies. Sulphur and sassafras, to the amount of half an ounce each, every other day, to the amount of three or four doses, will arrest the morbid phenomenon. The local remedy in all cases of this kind is diluted acetic or pyroligneous acid. Penetrating wounds are inflicted by the horns of cattle, stakes, shafts, etc., and have to be treated according to the nature of the case. A penetrating wound of the walls of the abdomen is generally followed by protusion of the intestines; this has to be returned; the wound is then closed by strong sutures, and the belly must be encircled with a long bandage. In such cases we generally keep the bowels soluble with scalded shorts, well seasoned with salt, and empty the rectum occasionally by enema. Of penetrating wounds of intestines, to illustrate the mode of procedure when they are wounded, the following case is introduced: The animal had a wound on the off side, about four inches in length, in the iliac region, through which a portion of the small intestine protruded. On exploring the breach, it was found to run in a slanting direction, and as it approached the peritoneum, was found quite small, scarcely admitting the little finger; here the bowel was both strangulated and lacerated, the intestinal opening being external to the stricture. Before proceeding to cast the horse, a twitch was placed on the nose, and the edges of the wounded intestine were neatly sewed together with a very fine suture needle. Our reason for doing this before casting was, lest in the animal's struggles the bowel might recede, and give us some trouble in getting hold of it again. There was not much danger of it, however; still we wanted to be on the safe side. The intestinal wound was not produced by the cow's horn, but took place some three hours afterwards, and two hours before we saw the case, in the following manner: the protruded bowel had then become distended with gas, and according to the owner's account, was about the size of his two fists. The animal, probably being in pain, got down and rolled on the injured side, and thus burst the gut. After sewing up the wounded intestine, it was cleansed with warm water, and attempts were made to return it within the abdomen, but to no purpose. The patient was then cast, and, by means of a bundle of straw on each side, propped him on his back; the bowel did not return so easily as we had expected, for it was found necessary to dilate the stricture by means of a button-pointed bistoury. The several layers of abdominal muscles were then sutured with as much nicety as the nature of the wound admitted; and lastly the integuments were brought together by interrupted suture. This case terminated unfavorably, for the animal died on the sixth day from peritonitis. It may be well to observe that the accident happened on a very cold day, in the depth of winter; and the bowel being so long exposed to the depressing influence of cold, probably led to the fatal result; for it is well known that operations of this kind often prove successful. It may be interesting to the reader to know that wounds of the intestines heal as readily as those of other parts, as the following cases will show: An incision one inch and a half in length was made in the bowels of a dog; the wound of the integuments was closed by suture; the animal was scarcely affected by the operation, took food as usual, and had natural evacuations. At the end of a fortnight, when perfectly recovered, he was killed for the purpose of examining the bowel, when the wound appeared to be completely healed. In the eighteenth volume of the Philosophical Transactions a similar experiment is related by Mr. W. Cooper: An opening was made in the abdomen of a dog; a large wound was made in the intestines, and the wound in the abdomen was stitched up, etc.; the dog recovered without any bad symptoms, and became perfectly well in a few days after. It should be observed that the bowel does not appear to have been stitched up when returned into the belly. The following experiment by Mr. Travers is still more remarkable: A ligature of thin packthread was firmly tied round the first intestine (duodenum) of a dog so as completely to obstruct it; the ends of the string were cut off, and the parts returned; the wound in the abdomen was closed, and the animal expressed no sign of suffering when the operation was concluded. On the following day he was frequently sick, and vomited some milk that was given him; his respiration was hurried. Third day his sickness continued, and he vomited some bilious fluid. Fifth day he passed a copious stool of the same appearance as the fluid discharged by vomiting; his sickness from this time ceased, and his breathing was natural; he took bread and milk, and drank abundantly of water. Seventh day he had three similar evacuations, and appeared well, eating animal food freely. On the fifteenth day, his cure being established, he was killed for the purpose of examination. The ligature which was fastened around the intestine divided the interior coats of the gut, in this respect resembling the operation of a ligature upon an artery; the peritoneal or outer coat alone maintained its integrity. The inflammation which the ligature induces on either side of it is terminated by the deposition of a coat of lymph, exterior to the ligature; this quickly becomes organized; and the ligature, thus enclosed, is liberated by the ulcerative process, falls of necessity into the canal, and passes off by stool. Penetrating wounds of the chest are not fatal, provided the lungs or heart are not perforated. All that can be done is to suture the wound, pass several turns of a roller round the chest, and adopt such constitutional means as the case seems to require.

WOUNDWORT. The genus *Stachys*, weeds.

WREN. All the wrens are beneficial to the farmer in the highest degree, and should be sedulously protected. The most of them will build in boxes put out for that purpose, and this should invariably be done. The common house wren, *Troglodytes œdon*, is a most familiar visitor, which, if allowed, will build in the piazza or window casements of the house, especially if cosy breeding places are provided. They arrive in the North as soon as the trees begin to put forth their foliage, and remain while insect food lasts. Species less known at the North, are the long-billed, and the short-billed marsh wren, Bewick's Carolina, or mocking wren, said to be, in imitative powers, little short of the mocking bird, the ruby crowned and golden crested. and and wood and the winter wren.

WROUGHT. Materials which have been brought to a surface by hammering or other labor.

X

XANTHINE. A yellow principle in madder.

XANTHIUM. Cockle-bur, clot-bur. A class of vile weeds from their production of hooked spines, which become matted with the burs, in the manes and tails of horses, and fleeces of sheep, in the most annoying manner. The principal species are the common cockle-bur, *X. strumarium*, and its variety, *echinatum*, and the thorny clot-bur, *X. spinosum*.

XANTHOPHYL. The yellow coloring matter of autumnal foliage.

XYLITE. *Lignone*, an empyreumatic spirit existing in products of vinegar distilled from wood.

XYLOPHAGANS, XYLOPHAGA. A tribe of coleopterous insects, comprehending those of which the larvæ devour the wood of trees in which they are developed; also applied to a family of dipterous insects, the larvæ of which have similarly destructive habits.

XYLOPHILINS, XILOPHILI. A tribe of beetles, consisting of those which live on decayed wood

XYLOTROGES, XYLOTROGI. A tribe of serricorn beetles, comprehending those which perforate timber. The Serricorn land beetles, include the Buprestidæ, and the Elateridæ.

Y

YAK. The Himalayan bison, resembling the buffalo, three and a half feet high, and with fine, long hair.

YAM. The yam—Iguame—*Dioscorea alata*, is cultivated in every tropical portion of the earth, and also some temperate climates, where the young plants are brought forward early in the season. The Indian archipelago and the southern portion of the Indian continent is said to be the native homes of this, the most widely cultivated of the Dioscorea family. It was carried thence to the eastern coast of Africa, next to the west coast and from there to America, under the name of yam, which, in the negro dialect of Guinea, means to eat. The other species of yam cultivated more or less, and all from the Indian archipelago and continent, are *Dioscorea pentaphylla*, *D. bulb fera*, *D. esculenta*, and *D. deltoides*, (or *Satara*,) the latter being known under both names. The Chinese yam, *Dioscorea batatas*, was widely disseminated in the United States some years ago, at high prices, and with the assurance that it would supersede the potato. It is entirely hardy, even well North, has some good qualities as an ornamental plant, and the roots have the remarkable quality of remaining sound for years in the ground. In fact it takes several years for them to attain full size. The labor of cultivating this running vine, and especcially the labor of digging, precludes all profit, if indeed, it were equal as food to the common and sweet potato, which it is not, all of which the introducers ought to have known. They strike their long tubers into the ground, being thickest at the lower end, so that in gathering the earth must be moved to a depth of two feet, or even more

YARD, DISEASES OF. Diseases of the sex organs of both horses and mares are not uncommon, and for the reason that stallions are given undue and exhaustive connection together with artificial surroundings in care and exercise. The trouble generally is external and internal inflammation of the yard, and inflammation of the vagina. This last in the mare is rare and is due to violence in the service. In external inflammation of the yard, the parts should be washed clean by syringing with warm soapy water inside and out, followed by a wash of one drachm of carbolic acid to a quart of water. If there are granulations wash the yard in the following solution (a powerful caustic and painful but necessary: Two drachms chloride of zinc and one pint of water. Repeat this every day until the granulations are reduced, and the parts assume a healthy character. Internal inflammation attacks geldings as well as stallions. The symptoms are frequent desire to urinate, ineffectual or with difficulty, extension of the yard, and a discharge of whitish or yellowish matter. As a first means relieve the bowels with four or five drachms of aloes. Foment the parts thoroughly with water as hot as can be borne, and give several times a day an ounce of bicarbonate of soda in water. These means not succeeding ulcers may be suspected within the urethra. If so, the animal must be cast and the diseased parts touched with nitrate of silver, followed by injections of from one half to one drachm of sulphate of zinc to the pint of water. In any case, however, of disease of the genital organs, either in the horse or mare, the services of an experienced veterinary surgeon should be procured if possible. (See Vagina, Inflammation of.)

YARD-DUNG. Farm-Yard Manure. The ordinary manure of the farm.

YARD OF LAND. A quantity of land which, in some counties in England, signifies fifteen acres, in some twenty, and in others twenty-four, thirty and thirty-four acres.

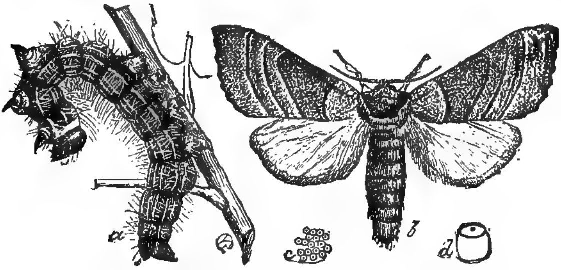
YARROW. *Achillea.* The thousand-leaved Achillea. Yarrow, or milfoil, *A. Millefolium,* is a plant introduced from Europe, as a valuable pasture plant. It is an aromatic, bitter and astringent. It has proved quite inferior as a pasture plant, and has degenerated into a thoroughly naturalized weed, and should be eradicated wherever found.

YEARLINGS. A term applied to calves, colts, and other young stock, when they have completed their first year.

YEAST. The froth or scum which rises on beer during the act of fermentation. It contains a variety of components; among others, carbon, acetic and malic acids, alcohol, potassa, lime, a saccharine, mucilaginous extract, gluten, and water. Yeast is an article of the greatest importance in domestic economy, forming a necessary ingredient in the manufacture of bread, which would otherwise become heavy and unwholesome. When put in contact with saccharine matters, at a temperature of between 50° and 60°, it causes fermentation, and changes the sugar into alcohol and carbonic acid. Yeast may be dried and yet retain its properties, but a temperature of 212° destroys it. The substance called yeast or ferment, derives its name from the power it possesses of causing fermentation in sugar, or saccharine vegetable juices. It possesses, says Liebig, all the characters of a compound of nitrogen in the state of putrefaction and eremacausis. Like wood in the state of eremacausis, yeast converts the oxygen of the surrounding air into carbonic acid, but it also evolves this gas from its own mass, like bodies in the state of putrefaction. When kept under water, it emits carbonic acid, accompanied by gases of an offensive smell, and is at last converted into a substance resembling old cheese. But when its putrefaction is completed, it has no longer the power of inducing fermentation in other bodies.

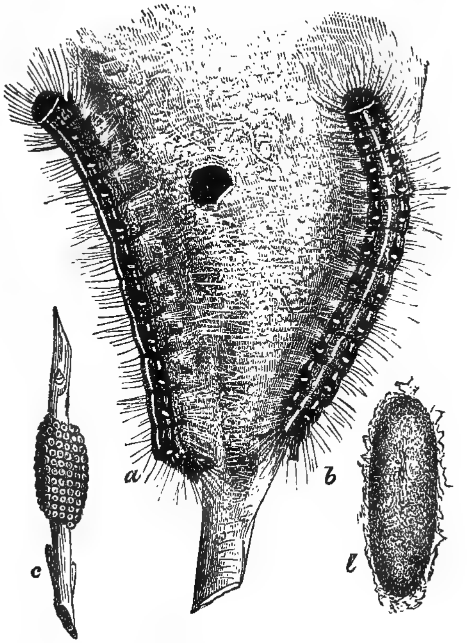
YELLOWBIRD. Yellow warbler, *Dendroica æstiva.* (See Warbler.)

YELLOW DYES. Persian berries, weld, quercitron bark, fustic, turmeric, dyer's broom, annotto, willow leaves, barberry roots, are the principal vegetable dyes. Chrome yellow, oxide of iron, sulphurets of antimony and arsenic, and nitric acid are obtained from the mineral kingdom. Solutions of alum and tin are used as mordants.



YELLOW-NECKED CATERPILLAR.

YELLOW-NECKED CATERPILLAR. Hand Maid Moth. *Datana ministra.* There are a number of caterpillars called "Tent worms." The true tent caterpillars build webs under which they feed. Others, as in the case of the Yellow-necked caterpillar, transform only under webs, within which they congregate, for the purpose, though they often spin webs as they progress in feeding. These species are so nearly alike, in the moth state, as scarcely to be distinguished. Thus, the larvæ, found feeding on the hickory and black walnut, are black-necked, while those on the apple are yellow-necked. Those on the oak, elm, plum and other trees are orange pencilled. The preceding cut will show the form and peculiarities of these insects; *a*, larvæ, *b*, moth, *c*, egg mass, *d*, egg magnified. They should be assiduously sought for and killed where they gather together at night, during the molting season. For comparison, we append a discription of the true tent caterpillar, with illustration, above. The American tent caterpillar, *Clisiocampa Americana*, is most destructive. The report on the Rocky Mountain Locusts, 1877, says: At the same time that the canker-worms are breaking out of their egg-shells, the young tent-caterpillars are following suit. This occurs usually about the 1st of May, in the region of Boston, or a month or six weeks earlier in the latitude of St. Louis, just as the leaves are unfolding. At this time, if one will examine closely the conspicuous bunches of eggs on the twigs of the tree, he may be able to see the little caterpillars clustering about on the outside of the egg-mass. When hatched, they have large heads, and the body is provided with long, scattered hairs, they at once betake themselves to the opening buds, congregating at noon time, when the sun is hot among the axils of the branches, there forming a tent of silk for protection from the sun and rain. As they increase in size, they make extended journeys over different branches, laying pathways of silk wherever they go. The



AMERICAN TENT CATERPILLAR.

tent or nest increases in size until it becomes the conspicuous, but by no means ornamental, object so noticeable on the grounds of slovenly farmers early in June. The caterpillars become fully grown by the middle of June. Then they spin dense, tough, white cocoons under loose bark, or under boards and rails of fences, and the moth appears about the 1st of July. The American tent-caterpillar is about two inches in length, with long, rather dense hairs. Along the back runs a white stripe, accompanied by numerous fine, wrinkled black lines on a yellow ground, united below into a common black line. On the side of each segment of the body is a conspicuous blue spot. The moths hide by day about the garden, and when the lamps are lighted, in they dart and tumble about on the table under the light, in an insensate way, as if frightened out of their wits. So peculiar is their mode of entering a lighted room, that one can usually tell what moth is coming by its peculiar, noisy mode of entrance. The moth is reddish-brown, very thick-bodied, clothed in a thick coat of long hairs, and with short, broad, strong wings, as it flies swiftly. It is reddish-brown, with two oblique, dirty-white lines on the fore wings, which expand when outstretched, about an inch and a half. Early in June the female lays her eggs, in bunches of from 300 to 400. They are placed side by side, in a mass surrounding the twigs, and after they are thus stuck on so as to surround the branch like a collar, the entire mass is covered over with a gummy secretion, which hardens, and serves as a protection to the eggs. Remedies: In the early spring as well as late autumn the bunches of eggs should be picked off and burned. When the tents are formed in June the nest should be removed with a mop dipped in oil or kerosene, at noon-time, when the caterpillars are in the tent. By discharging a gun close to the nest it can be destroyed with a small charge of powder The cut, page 1044, shows *a*, *b*, larvæ, *c*, mass of eggs on twig, *d*, cocoon.

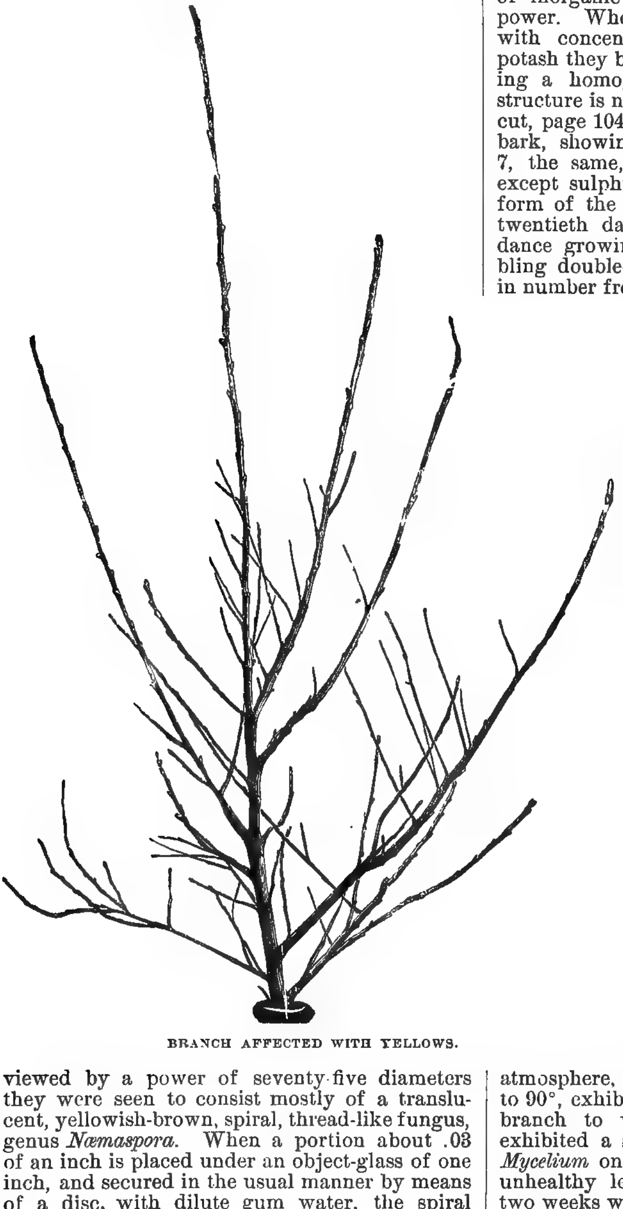
YELLOW RATTLE. The weed *Rhinanthus crista-galli*, sometimes called rattle weed.

YELLOWS. For yellows in horses see Jaundice. In cattle the disease is much similar, and produced by congestion and inflammation of the liver. Over-feeding with rich and heating food, sudden changes in the weather, excessive milking, are the principal causes. The animal ceases to ruminate is dull, languid, hide-bound and has a staring, unhealthy coat of hair. The whites of the eyes and inside of the mouth, will be of a dirty yellow color. The bowels may be costive or there may be scouring, accompanied with a fœtid odor. In cows the secretion of milk also quickly fails. The first thing is change of diet, to plain, sweet, nutritious food. The grooming should be of the best and the comfort of the animal in every way cared for. Give the following as a laxative and tonic: one half ounce each of powdered sugar and of aloes, one ounce each of Castile soap, scraped fine, and of powdered Peruvian bark, mix in a pint of water and give one of the doses every three or four days as the animal may seem to need it. This is for the disease as brought about by ordinary causes. If this does not give relief and, if in addition to a yellow skin and jaundiced eye, there is loss of appetite, incessant thirst, hard and rapid pulse and heaving of the flanks; if the ears are alternately hot and cold, if the urine turns to a transparent, red, yellow or brown, give the following: two ounces laudanum, twenty drops of croton oil, and one pound of sulphate of magnesia, in a quart of linseed tea; hasten the action of the dose by mashes, or something of that kind, turn the animal out to grass, and repeat the dose if the bowels again become costive, and the evacuations are passed in hard dark balls.

YELLOW SEED. The weed *Thlaspi campestre*, false flax, mithridate mustard, a cruciferous annual with mustard-flavored pods, which abounds in flax fields, and is very troublesome It can only be avoided by screening the flax seed carefully, and omitting the cultivation of flax for a season, introducing cleaning or hoed crops instead.

YELLOWS, IN THE PEACH. In the Middle States, especially upon sandy soils, peach trees have been subject for a long time to a disease known as Yellows, a remedy for which has not so far been found, except that of grubbing affected trees and burning. The applications that have produced most good have been iron filings, scales from the blacksmith's anvil, and hot wood ashes applied at the rate of a shovel full about each tree. Salt is also reported to have been beneficial. Trees grown from the seeds of affected fruit, will sometimes show the disease at one year old. Often it is not noticeable until the tree has borne one or two crops of fruit, when it is indicated by slender, erect branches starting up from the larger limbs, a general sickly appearance of the tree, and a dull color of the foliage. The fruit also becomes discolored, and so changes from the natural taste and appearance of the variety as not to be recognizable as the same. When first attacked, a single branch only is sometimes affected; but by the following season it spreads over the whole tree, which struggles feebly for life for a season or two, producing small, immature, and flavorless fruit. The yellows is a contagious disease, and is imparted to other trees by contact or propinquity, as well as by a knife used in pruning trees affected, from buds taken from infected trees, and from the soil in which such trees have grown. The cut will show the appearance of an infected branch. The disease has been known in the West for many years, but does not appear to make much headway except on the loess formation or other sandy soils. On the light sands of the Michigan lake shore region, long famous for its excellent peaches, it has of late years made such ravages that the legislature of the State has been obliged to pass the most stringent laws, involving the destruction even of whole orchards where found, and the appointment of commissioners to see that the law is carried into effect. In relation to this disease, the microscopist of the Department of Agriculture reports to the government experiments as follows: A series of experiments by the moist process with the bark of a peach-tree affected with the yellows, showed as follows: Into five glass receivers I placed respectively, a few drops of water, just sufficient to form a moist atmosphere in each. Into No. 1 I put a piece of bark affected with the yellows; into No. 2 a piece of bark from a healthy peach tree; into No. 3 a handful of peach leaves from the unhealthy tree; into No. 4 a similar quantity from the healthy tree; and into No. 5 portions of bark from the healthy and unhealthy trees mentioned.

All the specimens were secured from the outward atmosphere. The temperature of the room in which the specimens were kept was frequently at 90° Fahr. These conditions were highly favorable to the development of such fungi-germs as mature under excess of heat and moisture. Previous to arranging the specimens in the receivers they were examined minutely with a low power but no signs of fungi were visible. On the fifteenth day the unhealthy specimens in Nos. 1 and 5 exhibited on their external surface a spotted appearance. When viewed by a power of seventy-five diameters they were seen to consist mostly of a translucent, yellowish-brown, spiral, thread-like fungus, genus *Næmaspora*. When a portion about .03 of an inch is placed under an object-glass of one inch, and secured in the usual manner by means of a disc, with dilute gum water, the spiral forms are seen to dissolve gradually, and ultimately to form a yellow stain. On viewing it with a power of one-eighth, it appears to be a mass of curved spores, resembling in form caraway seeds, but invisible to the naked eye. Each spore has a life-like motion confined to a center of its own. When they are treated to the action of nitric, muriatic, and nitro-muriatic acids, no immediate change is observable; and in those strong acids the life-like motion continues, which, I think, proves that the motions are not the result of any form of organic life, but simply what is known as Brownian motion, which is frequently seen when minute particles of inorganic matter are placed under a high power. When the spores are combined either with concentrated sulphuric acid or caustic potash they become completely destroyed, forming a homogeneous mass, and their organic structure is no longer visible. The figures in the cut, page 1047, represent a sectional view of the bark, showing fungus growth; 6, *Næmaspora*; 7, the same, when placed in water or acid, except sulphuric; 8, a very highly magnified form of the spores contained in 6. About the twentieth day mycelium was found in abundance growing from the spiral threads, resembling double-celled *Puccinia*, the spores varying in number from one to ten, and so small that a power of one-eighth was required to give good definition. Since contact with water dissolves this form of *Næmaspora* without destroying the life of the spores, it is evident that the action of rain or washes of pure water will only tend to diffuse the spores over the body of the tree and roots, while the applications of solutions of sulphuric acids and alkalies will destroy them. Hence a remedy may be found for peach-yellows in the application of alkalies and sulphates, and their compounds, to the bark and roots of the trees. Statements have frequently been made that the application of hot lye has been known to cure peach-yellows when applied to the bark and roots. My observations seem to confirm these common rumors. In receiver No. 5 the healthy bark was not contaminated, seemingly, with the *Næmaspora*, notwithstanding its immediate contact during several weeks with the unhealthy bark. As might be expected, the common molds, as *Penicillium* and *Mucors*, grew all over the surface of the specimens, healthy and unhealthy. The leaves in Nos. 3 and 4 were next examined. They had been subjected to the same treatment as the bark. The healthy leaves, although confined during four weeks in a moist atmosphere, at a temperature ranging from 80° to 90°, exhibited no signs of mildew. A split branch to which the leaves were attached exhibited a small portion of *Mucor* fruit, and *Mycelium* on the sap-wood and pith; but the unhealthy leaves were completely covered in two weeks with *Mycelium*, (mold,) and the fruit of the common blue, yellow, and black *Penicillium* and *Mucors*. I have repeated these experi-



BRANCH AFFECTED WITH YELLOWS.

ments several times, always with the same results. It is evident that the healthy leaves possess an antiseptic substance, which prevents the growth of the common molds on them. A portion of healthy and unhealthy leaves from the trees above mentioned was analyzed in the laboratory to determine the respective amounts of moisture, organic matter, and ash in them, and gave the following results:

Healthy peach leaves.	Per cent.
Moisture	29.20
Organic matter	63.22
Ash	7.58
	100.00
Unhealthy leaves.	
Moisture	36.9
Organic matter	59.4
Ash	3.7
	100.00

The fact of the absence of ash or solid matter and of the increase of moisture in the unhealthy leaves, would of itself account for their greater tendency to mold. Since leaves do not absorb earthy matter from the atmosphere, it is evident that the cellular structure of the tree has in some way failed to perform its functions; for, had the ascending sap carried with it potash, lime, or other earthy matter, the leaves would have been stored with them, since the leaves have no power to evaporate them. The deficiency of earthy matters in the leaves may also account for the absence of ash in the fruit. If the theory is well founded that the leaves elaborate juice for the growth of the fruit, the leaves being deprived of proper nourishment, the fruit can not mature. It has been long observed that trees affected with the yellows fruit earlier and mature prematurely, and soon decay. The presence of a larger amount of sap in the unhealthy than in the healthy, indicates an earlier and greater flow than in that of the healthy tree. The presence of watery sap in the leaves, twigs, and buds would induce naturally an early growth of fruit and premature decay. From these and other observations the disease seems traceable to the body of the tree or roots. Applications of washes in this case to the leaves would probably prove useless, but if it should be applied to the bark and roots might possibly prove curative; and for that purpose, judging from microscopic observations, I would recommend the frequent application of hot lye as the best substance. J. M. Asher, National City, Cal., writes to the Department under date October 28, 1872, as follows: One of your writers suggests lye as a remedy for yellows of the peach trees. Our soil in California is more or less impregnated with alkali, and I never have seen a case of yellows in the State. Whether a specific for this disease will soon be found remains in doubt. In its attacks it seems to be epidemic, ravaging a district of country for years sometimes to such a degree as to destroy a majority of the orchards, those of negligent cultivators suffering first and most. It then declines, as it has done from time to time in the peach-raising districts of the Atlantic coast, again and again to reappear. So far, the best remedies are those we have named, good fertilization and cultivation, setting no stocks but those perfectly sound, using no knife on healthy trees that has been used on affected ones, until thoroughly disinfected with carbolic acid, and promptly grubbing all trees at the first knowledge of their infection.

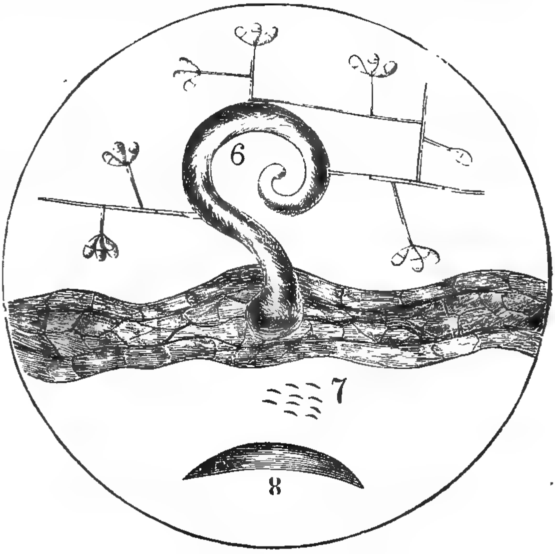
YELLOW THISTLE. (See Thistle.)

YELLOW THROAT. *Geothlypis tricas.* (See Warbler.)

YELLOW TOP. White top. *Agrostis alba.*

YELLOW WEED. The butter cup, Ranunculus. Cuckoo-bud of Shakespeare.

YEW. *Taxus.* The North American yew. *T. Canadensis*, is a low growing shrub, found from Canada to Virginia, spreading, but scarcely ever attaining a height of more than six feet, and found growing in rocky shady places. It is not worthy of general planting. In a collection a single specimen will suffice. The European yew, *T. baccata*, has long been used in Great Britain for decorating cemeteries, and has there long been considered a funereal tree, as much so as the cypress is in the south of Europe.



YELLOWS IN THE PEACH.

In the West, the yews, of which there are many elegant varieties, none can be called hardy. In the Atlantic States they stand better. Some of the new forms are quite striking, among them may be mentioned the Silver, the Golden, the Irish, and the variegated yew. When the yew will stand it is well adapted to hedging, since it is compact, of slow growth and stands the shears well.

YOLK. The yellow of the egg. An animal soap, also called gum, secreted by the skin of sheep, and pervading the wool. The finest fleeces contain most yolk, especially that of the Merinos. It is readily softened by warm water, and may be washed out without trouble; but there remains an oil among the wool, which is only separated with trouble. The amount varies from twenty to fifty per cent. of the fleece, and is most in warm climates and fine fleeces.

YTTRIUM. The metallic base of yttria, a rare earth resembling alumina.

YUCCA. This class of plants are almost entirely of tropical origin and cultivated only in greenhouses and conservatories. *Yucca filamentosa*, called Adam's needle, is indigenous in Virginia and South, and hardy in the West up to and above the Wisconsin line, if planted in a dry situation, better if a bushel of sand be mixed in the soil in which it is planted. It is perennial, throwing up a flowered stalk sometimes six to eight feet high, and is worthy of a place on every lawn.

YULE. Christmas.

Z

ZAMIA. A genus of Cycadeous trees, the stems of which yield a kind of sago. The *Z. integrifolia* and *Z. pumila* grow in Florida, and furnish sago, or what is improperly called arrow-root.

ZANTE CURRANT. The small, stoneless raisins of commerce are made from the Corinth grape, long grown in the islands of the Mediterranean. It should be unnecessary to say that it is a true grape and not a currant. Its cultivation has been attempted in the South, but, we believe, abandoned, probably from the fact that the cost of cultivation, gathering, drying and packing did not give so good profits as the more staple crops. It is said not to be hardy outside of the Gulf States, and the South Atlantic states. In some portions of California, where irrigation is possible, it may perhaps be worthy of trial.

ZEA. The generic name of Indian corn, (*Z. Mays*).

ZEBRA. The zebra is of the size and general appearance of the mule, but with a skin striped with brown or black and white; it has not been domesticated.

ZEDOARY. *Curcuma Zedoaria.* An East Indian plant, of the same family as the ginger, but producing rhizomes not quite as pungent.

ZECKSTEIN. A magnesian limestone, lying below the red sandstone.

ZEIN. The azotized product of Indian corn, similar to albumen.

ZENITH. The vertical point in the sky of any place; the point immediately overhead.

ZEOLITE. A family of minerals which fuse and boil before the blow-pipe; they are silicates of alumina and lime, or soda with water. The soda zeolite is called Natrolite.

ZERO. Nothing; it is used to designate the 0° point of graduated scales, as the thermometer, areometer, and usually means a degree equal to a given test; thus the zero of the areometer is the specific gravity of pure water at 59° Fahr.; the zero of Fahrenheit's thermometer is the temperature of snow mixed with salt. The zero of the Centigrade and Reaumer scales is the freezing point. Degrees above zero are plus, (+), below it minus (—).

ZERUMBET. An East Indian rhizome, similar to ginger.

ZIMOME. That part of the gluten of wheat which is insoluble in alcohol.

ZINC. Spelter. A valuable metal for roofing and the construction of vessels, such as are made of tin plate, than which it is more durable and stronger. In chemistry it is of great use for the construction of galvanic circles and batteries, forming the positive surface or pole of single circles. It is rapidly acted on by the strong acids, and forms an oxide which combines with most acids. Of its salts, the sulphate, or white vitriol, is most employed; it is emetic and irritant, and used chiefly in lotions. Calamine is an impure native carbonate of zinc. Tutty is an impure artificial oxide.

ZINCOUS, ZINCOID, ZINCODE. Resembling zinc. This term is used to designate any metal or other body which, in a galvanic circle, occupies the place of the zinc. It is the same as positive metal or pole, positive electrode, anode, and the derivatives. *Zincolysis* means the same as electrolysis; *zincolyte*, as electrolyte. These terms are indeed to be preferred over those previously in existence, because they refer to the zinc element, or its substitute, as the origin of its galvanic action.

ZINGIBER. The generic name of the ginger plant, (*Z. officinale*).

ZIRCONIUM. A rare metal, the base of zirconium.

ZIZANIA. Wild rice. (See Rice.)

ZIZIPHUS. The generic name of the shrubs yielding the jujube (*Z jujuba*).

ZONE. A word much used by naturalists to denote a band or strip running around any object. In geography, a division of the earth's surface. There are five great zones. The tropic or torrid zone, occupying the central or equatorial regions of the earth to a distance of 23½ degrees north and south, and therefore having a width of 47 degrees. The north temperate zone lies between 23½ N. lat. and 66½ N. lat., and occupies 43° of latitude. The south temperate zone lies in the same space on the south side of the globe. The north and south frigid zones occupy the space beyond 66½ degrees to the poles; they are also called the arctic and antarctic regions.

ZOOLOGY. The history and classification of animals. The objects of the animal kingdom are so extremely various that a classification of them is one of the severest labors. Numerous suggestions have been made as a basis for classification, but the advance of knowledge has shown them all to be wanting in comprehensiveness. When it is remembered that under the term animal is grouped thousands of species differing from the scarcely organized and imperceptible dots of jelly called monads, to the most complicated quadrupeds, the difficulty of classification will be apparent. (See Entomology, Mammalogy, Ornithology, etc.)

HOUSEHOLD DEPARTMENT.

ALCOHOL, PER CENT. OF, in Liquors.

The table will explain itself. The first column shows the beverage, and the second the per cent. of alcohol:

Beverages.	Per cent.
Ale	6 to 8
Small beer	1¼
Lager beer	2
Brandy	50 to 55
Hard cider	8 to 10
Gin, true	50
London porter	4
Wine, Angelica	17 to 20
“ Catawba	12
“ Claret	12 to 17
“ Champagne	12
“ Hock	12
“ Malaga	17
“ Madeira	24
“ Muscat	19

ALLOYS, GOLD, SILVER, ETC.

Gold alloys. Standard gold for coin in Great Britain is: Pure gold, 22; pure copper, 2. This alloy is harder and more fusible but less ductile than pure gold. It is said to be 22 carats fine. Standard gold for coin in United States and France: Gold, 9; copper, 1. Jeweler's gold varies from 22 down to 9 parts gold, with sufficient silver, or copper and silver, to make up 24 parts. The number of parts of pure gold in 24 parts of an alloy denotes its fineness; thus gold 18 carats fine is an alloy containing 18 parts of pure gold and 6 parts silver or copper.

Silver alloys are as follows: Standard silver for coin and plate in Great Britain: Pure silver, 222; pure copper, 18. (Specific gravity, 10.2.) French standard silver for medals and plates: Silver, 95; copper, 5. American and French standard silver for coin: Silver, 90; copper, 10. French standard silver for jewelry work: Silver, 80; copper, 20. Silver solder: Silver, about 66 per cent., with zinc and copper.

Queen's Metal. Tin, 9; antimony, 1; lead, 1; bismuth, 1. Used for teapots, spoons, etc.

Brass is made of copper, 64 parts; zinc, 36 parts; proportions slightly varied to make the metal darker by increasing the copper even to 74 per cent.

Bronze is made of copper, 85 to 90 parts; tin, 10 to 15 parts; sometimes a little lead and zinc is added.

Bell metal is made of copper, 75 parts, and tin, 25 parts.

German silver is made of copper, 16 parts; zinc, 7 parts, and nickel, 8 parts.

Type metal is made of lead, 83 parts; metallic antimony, 7 parts.

Stereotyping metal is made of lead, 9 parts; metallic antimony and bismuth, each 2 parts.

Common solder is made of lead and tin equal parts.

Fine solder is made of lead, 1 part; tin, 2 parts.

Pewter is made of lead, 4 parts; tin, 1 part.

BEVERAGES.

Koumis. The following is a correct formula for making koumis: Best unskimmed milk, one quart; yeast, (brewer's or old baker's), 100 grains; cane sugar, 200 grains. Mix and keep it at 80° Fahr. until fermentation is brisk, stirring it frequently, then bottle and secure the corks with wire or stout cord. In twenty-four hours it may be used.

Ginger powder, effervescing. Powdered ginger, two drachms; bi-carbonate of soda, ten drachms; white sugar, four ounces; essence of lemon, ten drops. Make into twelve powders which fold into blue papers; each of which is to be accompanied by a white paper containing thirty grains of tartaric acid, and they are to be prepared for use the same as seidlitz powders.

Lemonade, effervescing. Bi-carbonate of potash, one-half drachm; sugar, two drachms; essence of lemon, ten drops; citric acid, crystal, two scruples; water to fill bottle. Nearly fill a strong mineral water bottle with water. Put in the potash, sugar and lemon, shake up well, add the citric acid and cork immediately and let it be placed in a cool place upside down until needed for use.

Citrate of Magnesia (effervescent). Take of powdered citric acid, four pounds; calcined magnesia, one and a half pounds; bi-carbonate of soda, three pounds; tartaric acid, three pounds; powdered white sugar, six pounds; oil of lemon, one and a half ounces; rectified spirits a sufficiency. Mix thoroughly the citric acid with the sugar, add the soda, magnesia and tartaric acid; pass the whole through a sieve to facilitate their mixture; moisten with the spirit, pass the whole through a coarser sieve, and place in a wooden tray to dry in a warm place. When dry add the oil of lemon, and bottle instantly.

Effervescing powders, granulated. Mix well dried tartaric acid and bi-carbonate of soda in the proportion of five to six, with sufficient strong alcohol to reduce the mixture to a moist condition; pass it then through a somewhat coarser sieve, and thoroughly dry it. If desired it may be flavored with a little oil of lemon dissolved in alcohol. A mixture thus prepared effervesces. on the addition of water, to the last particle.

BUSINESS HABITS.

A strict attention to business matters is a principal integer to success in life. The following will be especially valuable to farmers as well as other classes: With a business man a sacred regard to the principles of justice forms the basis of every act. He is strict in keeping his engagements. Does nothing carelessly or in a hurry. Employs nobody to do what he can easily do himself. Keeps everything in its proper place. Leaves nothing undone that ought to be done, and which circumstances permit him to do. Is prompt and decisive with his customers, and does not overtrade his capital. He is clear and explicit in all his bargains. Prefers short credits to long ones, and cash to credit at all times, either in buying or selling, and small profits in credit cases, with little risk, to the chance of better gain, with more hazard. Leaves nothing of consequence to memory that he can and ought to commit to writing. Keeps copies of all his important letters which he sends away, and has every letter, invoice, etc., belonging to his business, clasped and put away. Is always at the head of his business, well knowing that if he leaves it, it will leave him. Holds as a maxim, that he whose credit is suspected is not one to be trusted. Is constantly examining his books and sees through all his affairs, as far as care and attention will enable him. He is economical in his expenditures, always living within his means. Keeps a memorandum in his pocket, in which he notes every particular relative to appointments and petty cash matters.

BUSHEL.

What makes a bushel by weight, often perplexes many. The following table will show the general standard: Wheat, sixty pounds; corn, shelled, fifty-six pounds; rye, fifty-six pounds; oats, thirty-two pounds; barley, forty-six pounds; buckwheat, fifty-six pounds; Irish potatoes, sixty pounds; sweet potatoes, sixty pounds; onions, fifty-seven pounds; beans, sixty pounds; bran, twenty-seven pounds; hemp seed, forty-four pounds; clover seed, sixty pounds; timothy seed, forty-five pounds; blue-grass seed, fourteen pounds; dried peaches, thirty-three pounds. Again, to find the measurement of a box the following table will show:

A box	24 by 16	inches square and	22	deep, contains	1 bbl.
"	24 by 16	" " "	11	" "	½ "
"	16 by 16.8	" " "	8	" "	1 "
"	12 by 11.2	" " "	8	" "	½ "
"	8 by 8.4	" " "	8	" "	¼ "
"	8 by 8	" " "	4.2	" "	½ "
"	7 by 4	" " "	4.8	" "	½ gal.
"	4 by 4	" " "	4.2	" "	¼ "

CALCIMINING AND PAINTING.

Calcimining. In calcimining, a great deal depends on the condition of the walls. If they are smoked, they should be thoroughly washed. If they are spongy, or very dry, and soak up too freely, they should be coated with a size made of glue and common soft soap. Take gilders' whiting or Paris white, or about equal parts of each, and soak it in water; put in a trifle of ultramarine blue to give it a blue tint. Dissolve good white glue in water in the proportion of one-fourth pound of glue to a common pail of calcimine. Mix the whiting and glue together and thin with cold water to about the consistency of paste. Strain the mixture through a sieve; lay it on the wall crosswise, viz: making the strokes with your brush to cross each other.

Oil for oiling floors. Mix four quarts raw linseed oil, two quarts spirits turpentine, one pint best coach japan.

To preserve paint brushes, when not in use. Cleanse them thoroughly after using and suspend them in water. Varnish brushes should always be kept in raw linseed oil when not in use.

Painting inside walls. First coat. The paint should be mixed quite thin with linseed oil. Second coat. A trifle thicker, with three parts oil and one part turpentine. Third coat. Thin glue size, made of about three ounces of good glue in one gallon of water. Fourth coat. Paint thinned with equal parts oil and turpentine. Fifth coat. Paint thinned with clear turpentine.

Fireproof paint for woodwork. Owing to the fact that waterglass is gradually dissolved out of the wood, while chloride of zinc is volatile at the temperature where wood ignites, the author, F. Sieburger, proposes the following: Two coats of a hot saturated solution of three parts alum and one part ferrous sulphate are first applied and allowed to dry. A third coat is a dilute solution of ferrous sulphate, into which white potter's clay is stirred until it has the consistency of good water colors. Another method is to apply hot glue water as long as it is absorbed into the pores of the wood. A thick coat of boiled glue is then applied, and, while fresh, is dusted over with a powder composed of one part sulphur, one part ochre of clap, and six parts ferrous sulphate.

COINS, VALUE OF, by U. S. Standard.

Country.	Gold.	Silver.
Austria	Ducat.......... $2 28	Rix Dollar $1 02
Belgium	Twenty-five Frc. 4 83	....
Bolivia	Doubloon 15 50	....
Brazil	....	D'bl Milreis 1 04
Central America	Escudo......... 1 84	....
" "	Dollar.......... 98	....
" "	Four Reals..... 49	....
Chili	Doubloon...... 15 50	Dollar...... 96
Denmark	Ten Thaler..... 7 90	Rigs Daler. 54
France	Twenty Francs. 3 84	Five Francs 96
German Empire	Mark.......... 23	Five Marks. 96
" "	....	Old Thaler. 71
Great Britain	Pound Sterling. 4 86	Half Crown 56
" "	....	Shilling 22
Italy	Twenty Lire.... 3 84	Lire........ 19
Japan	Yen............ 99	Fifty Sen.. 42
Mexico	Doubloon......15 60	Dollar...... 99
Netherlands	Ducat.......... 2 26	Guilder..... 40
"	Ten Guilders... 4 00	Florin...... 38
Peru	....	Dollar...... 92
Portugal	Crown.......... 5 80	Crown 97
"	Milreis,......... 1 08	....
Russia	Five Roubles... 3 97	Rouble..... 73
Spain	Ten Escudos... 5 00	Pistareen 17
"	Peseta 19	Peseta. 19
Sweden	Five Pesetas.... 94	Half Daler. 50
"	Crown.......... 26	Rix Daler.. 27
Switzerland	Franc.......... 19	Franc...... 19

COOKING AND KITCHEN ART.

Cooking in General. Since the advent of cooking stoves, and especially since the later improvements in kitchen stoves and ranges, there is no reason why bad or indifferent cooking should be the rule. However simple the dishes, (and expensive dishes do not constitute good living), the exercise of care and judgment will enable them to be brought to the table, nicely cooked, palatable, and nourishing. In the United States there seems to be a strong objection to soups and stews. There is no reason why this should be so, for there are few dishes more easily prepared, more savory, or more nourishing. There is also a general lack of vegetable dishes. It has been said that the farmers' vegetables are cabbage and potatoes. It might have been said that they were potatoes and potatoes, since the odorous boiled cabbage is by no means a standing dish, nor should it be The increased attention given by farmers to the cultivation of gardens will enable them to have all the principal vegetables and fruits of the season in abundance, and thus allow them to live as well as the best, with some attention to the manner of preparing them. A good vegetable garden will yield nearly or quite half the living of the family. In the body of this Encyclopædia will be found, articles pertaining to the principal vegetables cultivated, under their respective names, with directions for cultivation. In this connection we propose to give plain directions for preparing them for the table, in connection with recipes for cooking and baking in the other departments of the culinary art. In these days of improved cooking utensils the cook is not obliged to depend upon iron pots, nor cheap tin ware, for making stews, sauces, etc., and the modern stove, whether hard or soft coal, coke or wood is used, leaves but little to be desired in baking, broiling or boiling. If the housewife have, in addition to the broiler, frying pan, baking pans, cutters for cake and vegetables, paste boards, rolling pin, skewers, sieves for flour, etc., meat saw and cleaver, various kitchen knives, colanders, basins, and the kitchen clock; if to these be added, a thermometer to mark up to 500°, a good set of scales and weights, a large and a small porcelain lined steam pan, she can do nice cooking and baking, at a pinch, whatever the company may be. It is, of course, better that she have other conveniences; as an egg bowl and whisk, wooden spoons, a fish kettle, steamers, tart moulds, brazing pan, stock (soup) pots, measures, funnels, moulds for jellies, creams, charlottes, and cake; dredgers, ladles, skimmers, a mortar and pestle, large forks, etc. Yet with those we have mentioned the farmer's wife, may easily get along until these can be had. In the making of soup, when it is part of the daily dinner, what is denominated stock, is used. A strong soup, made of lean meat, the soup to be skimmed of all fat when cold. This may be made the basis of any soup. 'In the articles relating to cooking proper, we shall extract liberally from Buckmaster's Cookery, a late and common-sense English work on cooking. In addition, in the various branches of cooking, we shall give original recipes contributed by farmers, wives and daughters, and accumulated during years of editorial life. Any vegetable or meat prepared by simmering till the substance is sufficiently pulpy or soft to be passed through a horse-hair or tammy sieve is called purée. In the case of meat it is sometimes necessary to beat in a pestle and mortar after simmering. The sieve is placed bottom upwards over a dish or tin, and with a wooden spoon or purée-presser the substance is worked through, and what passes through is called purée. It is sometimes necessary to moisten with a little liquor, which facilitates the passing of the purée. The purée of any vegetable stirred into a clear beef stock makes a soup and gives it its characteristic name. Butter required for soups should be added at two different times, except in preparing a Julienne soup. The first butter goes to fry the vegetables and adds little or nothing to the flavor. But, just before serving, two or three small pieces of butter in the tureen are a very acceptable addition; the butter should only be melted, for if boiled it loses its flavor and freshness. The addition of cold butter to soups and sauces is sometimes called a liaison of butter. A less quantity of butter is required for sweating vegetables than for frying or browning them. Liaisons are methods for thickening soups. One liaison is prepared by mixing flour with water, or milk, or broth. Mix the flour smooth with one of the above liquids, strain through a pointed strainer into the soup, continually stirring with the hand. The proper way to mix a liaison is to add some of the soup to it, thoroughly mix, and then add all to the soup or take the yolk or yolks only of eggs, say the yolk of one egg for one pint of soup; separate the white or albumen from the yolk by pouring backwards and forwards, put the yolks into a basin, beat up with a little powdered loaf sugar, (if none has been used with the soup), a small piece of butter, add a quarter pint of cream or half a pint of milk for each yolk; when thoroughly mixed, add a little soup and stir; remove your soup from the fire, and then stir in the liaison with wooden spoon. But never allow your soups to go on the fire after adding the liaison. A faggot of herbs, is constantly referred to in cooking, and is a mixture of parsley, thyme, and bay-leaf, and sometimes marjoram, rosemary and a clove of garlic; these are tied into a bunch, and are used for seasoning; it is called bouquet garni. Wash the parsley, and arrange the other herbs so that they are enclosed within the parsley. The ends of the parsley should be folded over to more effectually enclose the herbs, and then tied round with a string. A small handful of parsley, weighing say one ounce, one-sixteenth in weight of thyme, the same weight of bay-leaves, the same weight of marjoram, and, if used, one clove only of garlic, constitute an ordinary bouquet garni, or faggot of herbs. For a small bouquet garni use half the quantity; for a large, double the quantity. Dried herbs should always be to hand, and are best prepared in the following way: Gather the herbs just before flowering, and dry them quickly in an oven or before a screen, and pick out all the stalks Gouffe recommends the following preparations: quarter ounce of thyme, one-eighth ounce of marjoram, quarter ounce of rosemary. These are to be pounded in a mortar, with half ounce of nutmeg, quarter ounce of whole pepper, half ounce of cloves, one-eighth ounce of cayenne pepper, and passed through a hair sieve, and kept in a dry place in a well-stoppered bottle. In these proportions a good seasoning is secured. The proportion for mixing with salt is one ounce of the mixture with four ounces of dry salt. Before cooking, arrange all your things as nearly as possible in order; no time is lost with this preliminary arrangement, it saves a good many steps; and as soon as you have finished with an article put it out of your way; this will save overcrowding, or in the middle of your cooking you will have to leave off to make room for your work. Wash your hands, clean your nails, read over slowly and thoughtfully the recipe. If you can not understand it in all its details, perhaps it will be better to substitute one that you do understand. No two cooks work exactly to the same recipe, nor is it desirable with persons who think about what they are doing. Rain water is best for all cooking purposes, but it will be necessary sometimes to filter it. About half a pint of soup may be calculated for each person. Thick glutinous soups and sauces require constant stirring, and always use wooden spoons. A small teaspoonful of powdered loaf-sugar may be added to all vegetable soups, and green vegetables. Good oil may often be used instead of butter, or with butter, especially with beans and peas. In the use of butter, or dripping, remember a less quantity is required for sweating than frying or browning vegetables. In seasoning, be careful with vegetables, herbs and spices remarkable for strong flavors.

Custards. A pint of new milk, three ounces of loaf sugar, and the thin rind of half a lemon are to be boiled in a clean enameled saucepan for three minutes; take it off the fire for five minutes; beat up eight eggs, leaving out the whites of four of them, add the milk to the eggs, stirring quickly as it is poured in. Strain the custard into the saucepan, and stir with a wooden spoon over a gentle fire till it begins to thicken; then strain through a fine sieve into a basin. The custard should not be flavored too strongly, and never cease stirring. Watch for the small lumps on the side of the pan (this is the commencement of boiling), and remove immediately.

Orange Custard Pudding. Beat up, as for an omelette, four eggs, with four ounces of powdered loaf sugar, and one pint and a half of milk previously boiled and allowed to cool, then add the grated peel of one orange, beat all up together, strain into a shallow pie-dish, and put into a moderate oven to bake. The safer way is to put the dish containing the custard into a tin dish, with boiling water coming two thirds of the way up the dish containing the custard, then put it into a moderate oven for twenty minutes, and if at the end of this time it is not sufficiently firm let it remain until it is so. When cold, sprinkle over the pudding powdered loaf sugar. The materials should be well mixed, but not too much beaten; if the custard is baked without putting into another dish with water, then the dish containing the custard should be shallow.

Lemon Custard Pudding. Prepare in the same way, using lemon-peel instead of orange.

Bain-Marie Pudding. Take a quart of new milk, and add six ounces of pounded loaf sugar. Put the sweetened milk into a clean stewpan, and reduce to one pint. When reduced, put aside one gill for the sauce. When the milk is nearly cold, mix gradually the yolks of five eggs and the whites of three. Strain into a mould, and steam it for half an hour in a stewpan with boiling water, taking care the water does not enter the mould. Take it out and let it stand for a few minutes before turning out. Put the gill of milk into a stewpan, add the juice of any delicate fruit, let it come to the boil, stir in a little cream, and pour over the pudding. The careful preparation of the sauce is most important.

Marmalade Pudding. Take four ounces of suet chopped finely, four ounces of grated bread crumbs, four ounces of moist sugar, four ounces of marmalade, mix these ingredients well together with three eggs, allow the mixture to stand for an hour. Butter an earthenware mould, put in the mixture, and lay a buttered paper on the top, tie it over with a cloth, and boil for two hours. When turned out, sprinkle it over with powdered loaf sugar. Do not let the water come over the top of the mould.

Lemon Pudding. Take two fresh lemons and three ounces of moist sugar, grate the rind off the lemons into a basin with the sugar, squeeze all the juice out, and mix together. Line a shallow tin with short paste, about a quarter of an inch in thickness, then spread over it some of the mixture, then another layer of paste, then some more of the mixture, and a thin layer of paste to cover; bake in a quick oven and serve hot. Be very careful that the lemons are fresh, and have a clear, good rind.

Baked Rice Pudding. Wash in two or three waters four heaped tablespoonfuls of rice, and boil it in a pint and a half of new milk for half an hour, stir in two tablespoonfuls of pounded loaf sugar, and flavor with anything you like, let it get cold, then add two well beaten eggs, butter a pie dish, put in the pudding, grate a little nutmeg over the top, and bake in a moderate oven for half an hour. The pudding should be baked quickly.

Rice Soufflé. Boil in a quart of milk six tablespoonfuls of rice with two tablespoonfuls of orange flower water and six ounces of pounded loaf sugar. Take six fresh eggs and separate the yolks from the whites; stir in one yolk, then another, till they are all used, and three ounces of butter in parts of one ounce each; stir with a wooden spoon so as to thoroughly mix the ingredients, and continue stirring till the rice is tender and sufficiently thickened. Well whisk the whites of the eggs till they are very stiff; if these are insufficiently beaten the souffle will never rise. Take the stewpan aside, and let the contents cool a little, then add the whites and mix them quickly with the rice. Have ready a warm tin or souffle dish slightly buttered, pour in the souffle mixture, sprinkle with pounded loaf sugar, and put it into a rather brisk oven for seven or ten minutes; a straw run through will indicate when it is sufficiently baked. Serve very hot with a napkin around the tin. A clean stewpan, the proper whisking of the eggs, and a good oven, are all necessary to success.

Apple and Rice Meringue. Peel six apples, core them, cut them in pieces, and place them in a stewpan with half a pint of water, four ounces of loaf sugar, a few cloves, and a little cinnamon, and let them boil gently until they become quite soft, remove the apples, and let the syrup boil away till it is reduced to three tablespoonfuls, then strain it over the apples. Boil half a pound of rice, drain off the water, and add one pint of milk, four ounces of pounded loaf sugar, and the thin rind of a lemon. When the rice has absorbed all the milk, let it get cold, then remove the lemon rind and work into the rice the yolks of three or four eggs. Put the whites aside in a basin to whip up. Then make a shallow wall of rice round the dish in which it is to be served, place the apples in the center, and cover the whole with the whites of the eggs beaten up with a tablespoonful of powdered lump sugar, into a stiff froth, neatly plaster over the whole surface; sprinkle powdered sugar over and bake about fifteen minutes till the surface is nicely browned. Gooseberries or other fruit may be substituted for apples. Use the best rice and spread the white of the eggs neatly over the surface.

Apple Charlotte. Peel fifteen tart apples, slice them, remove the cores, and put them for ten minutes into cold water, to which has been added the juice of half a lemon. Then put them into a clean stewpan over a moderate fire with half a pound of loaf sugar and a little cinnamon; cover the stewpan and occasionally shake it and stir the apples. When quite soft and pulpy pass them through a tammy. Cut the crumb of some stale bread into slices of about a quarter of an inch in thickness, cut out a center-piece to cover the bottom of a mould, then cut some heart-shaped, or other fancy forms, and dip each of them on one side in melted butter as they are wanted, beginning with the large piece, which place at the bottom of the mould, and arrange the heart-shaped pieces round it, overlapping one another, and with the points resting on the piece at the bottom. Cut the remainder of the slices of bread into strips one and a half inch wide, and of the height of the mould; dip them in butter, and stand them all round the mould, also overlapping one another like feather-edged boarding; fill the center with the cooked apples, and put the charlotte in the oven until the bread is well colored. Turn the charlotte out of the mould on to a dish, glaze it over with some boiled apricot jam and serve. Every part of the mould must be well covered with bread and butter or the charlotte will not turn out.

Charlotte Russe. Peel and core twelve large pippins and cook them as just described for apple charlotte. Melt a little sweet butter, and well cover the inside of the mould, using a brush. Line the mould with finger biscuits, and fill it up with the apples. Make a hole in the center; this is best done by standing a clean glass bottle in the mould, remove the bottle and fill up with red currant jelly or apricot jam. Cover with finger biscuits and put the mould into a good oven for five or seven minutes. Turn the charlotte on a dish and serve hot. Be very particular to well cover the mould with butter and biscuits, so that none of the fruit comes into contact with the mould.

Gooseberry Fool. Put the picked fruit with half a pint of water into a stewpan with pounded loaf sugar, and set it over a stove, or in boiling water, till the fruit will pulp, pass it through a hair sieve and mix the *purée* by degrees with cream, or with a plain custard. Green gooseberries are to be preferred.

Strawberry Cream. Soak two ounces of pure gelatine in cold water, just sufficient to cover it. Now take two punnets of strawberries, pick them, and put them in a basin with three quarters of a pound of pounded loaf-sugar. After five or ten minutes pass them through a fine sieve and add the juice of one lemon. Dissolve the gelatine in a small clean stewpan over the fire, and when cold mix it with the strawberries by straining through a pointed strainer into another stewpan containing the purée of strawberries. Surround the stewpan with ice and stir till the contents begin to freeze. Whip three half pints of cream, remove the stewpan from the ice, and lightly and gradually stir in the whipped cream. Take a cylinder mould (not tin) and fill it, place the filled mould in a basin with pounded ice round it, cover the top with the lid of a stewpan and cover the lid with ice, and in about two hours the cream will be set. Have ready a large basin of water, as hot as the hand can bear, dip the mould entirely in the water, take it out quickly, place a dish on the top of the mould, reverse it, and it is ready. If the cream does not leave the mould freely dip it again into hot water. Be careful not to break the jelly in turning out.

Strawberry Ice Pudding. Take two pints of strawberries, pick them, and put them in a basin with half a pound of pounded loaf-sugar, let them remain a few minutes, then pass them through a sieve, (purée.) Melt one ounce of isinglass in half a pint of water, and when cold strain it through a fine sieve into the purée, and thoroughly mix by constantly stirring. Take a plain mould, which may be decorated with blanched almonds, fill it with the purée, put it on ice, cover the top with a stewpan lid, and then with ice. Let it remain two hours and it is ready. Be careful in turning it out, and do not add the water until quite cold.

Clarified Sugar for Water Ices. The water for these ices is prepared by dissolving one pound and a half of sugar in one pint of water, then beat up and stir in half the white of one egg, let it come to the boil and continue boiling for ten minutes with frequent skimming; strain through a hair sieve, and when cold the water is ready for use. This is called clarified sugar. There is often a little difficulty in freezing, which generally arises from the water or cream being too sweet. It will then be necessary to add a little more water or milk. Too much sugar in solution prevents the liquid from freezing. Ices are a very agreeable luxury and easily made, and the quantities given in the following recipes are for one pint and a half of ice.

Cherry-Water Ice. Beat up in a mortar one pound of cherries with their stones, and make them into a purée, then add the juice of two lemons to one pint of clarified sugar and half a pint of water, mix thoroughly and freeze.

Lemon-Water Ice. Rub off the rind of two lemons on some lumps of sugar, add the juice of six lemons and one orange, a pint of clarified sugar, and a half a pint of water, strain through a hair sieve and freeze.

Strawberry and Raspberry-Water Ice. Place in a basin one pound of picked strawberries and half a pound of raspberries, make into a purée and mix with one pint of clarified sugar and half a pint of water, thoroughly mix and freeze.

Raspberry and Currant Ice Cream. Prepare a pound of strawberries and half a pound of red currants, pass them through a sieve, and mix with three-quarters of a pound of powdered loaf-sugar, and a pint of cream. Freeze.

Pine-Apple Cream. Remove the peel and seed from a pine-apple, take one pound and work it to a pulp in a marble mortar, pass the pulp through a large hair sieve, (purée), mix the purée with three-quarters of a pound of pounded loaf-sugar and one pint of cream. Thoroughly mix and freeze.

Ginger Ice Cream. Bruise in a mortar six ounces of the best preserved ginger, and pass it through a hair sieve, add the juice of a lemon, half a pound of powdered loaf-sugar, and a pint of cream. Thoroughly mix and freeze.

Lemon Ice Cream. Rub off the rind of two lemons on some lumps of loaf-sugar, squeeze the juice of the lemons into a basin with the pieces of sugar, and add half a pound of powdered loaf-sugar and one pint of cream. Thoroughly mix, pass through a horsehair sieve, and freeze. A glass of good brandy added will make Italian ice cream.

Strawberry Ice Cream. Take a pound of fresh strawberries, remove the stalks and cast aside the bad ones. Put them in a basin and sprinkle them with half a pound of powdered loaf-sugar, then add the juice of a lemon, make a purée by passing through a horsehair sieve, and add one pint of cream. Mix thoroughly and freeze.

Italian Cream. Simmer half an ounce of isinglass in a little milk with the thin outer rind of half a lemon. Whip up half a pint of cream with the juice of two lemons, half a gill of sherry, and a dessertspoonful of pounded loaf-sugar. When the isinglass is all dissolved, remove the lemon rind, and, while warm, stir the whole together in a basin. Put it into a mould, stirring to prevent any settlement. This cream may be flavored with any liqueur, with raspberry, strawberry, or any other fruits, instead of lemon, and colored, if necessary, with cochineal. The isinglass must be thoroughly dissolved in the milk before mixing.

Apple Fritters. Prepare a batter as for any fritters. Peel some tart apples, remove the core with a vegetable cutter, and cut the apples across into slices of about three-eighths of an inch. Roll in pounded loaf-sugar and dip the slices into frying batter and fry in hot fat till they are of a nice yellow color and crisp. Remove them on to a cloth and sprinkle with pounded loaf-sugar. Arrange them in a heap on a hot napkin and serve. The temperature of the fat should be slightly increased after adding the fritters, and they should be well covered with batter before frying.

Orange Salad. Take one or two good oranges, wipe them, and cut them with the peel into slices of not more than a quarter of an inch in thickness. Arrange them round a circular dish, and let each piece overtop its predecessor. Sprinkle over two ounces of pounded loaf-sugar and add a gill of brandy, or any liqueur; but if sweet liqueurs are used, only half the quantity of sugar need be employed.

Omelettes. In preparing omelettes remember that, the eggs are not too much beaten; that you have a clean pan; that the omelette is not too large—three or four eggs are enough; that it is quickly cooked; and, that it is eaten hot. In making a plain omelette, we must be careful that the frying pan is perfectly clean. Place in the frying-pan about one ounce of sweet butter. Break three eggs separately to see that they are fresh, beat them up with a little chopped parsley and a pinch of pepper and salt. The eggs should not be beaten too much, (about four seconds will be sufficient), or the white separates, and you produce a watery mixture, which destroys the flavor and appearance of the omelette. Now that the butter is melted and in a state of froth, pour into the frying-pan the omelette mixture, and stir till it begins to set or thicken; shake the pan occasionally, and when sufficiently firm, fold the omelette over neatly into an oval shape, strike the handle of the frying-pan so as to produce a gentle vibration, which keeps the omelette detached from the pan, and when the omelette is of a golden color turn it quickly into a dish. To be able to prepare a plain omelette is to be able to prepare every kind of omelette. The chief thing to be borne in mind in cooking an omelette, is that the mixture does not adhere to the frying-pan. A cheese omelette. If you require a cheese omelette, introduce into the omelette mixture about a dessertspoonful of grated dry cheese, with a little pepper and salt, and sometimes a few grains of cayenne pepper; sprinkle the omelette when it is turned out with a little grated cheese. Sweet omelette. Beat up a teaspoonful of pounded loaf-sugar with the eggs, and just before the omelette is ready, distribute evenly over it a little jam, and fold the omelette over it; turn it into a hot dish, and sprinkle it with pounded loaf-sugar. Bacon omelette. A few pieces of previously cooked bacon cut into small dice, added just before folding the omelette, and so on; for the principle is the same for all omelettes. Omelette soufflé. Take three eggs, separate the yolks from the whites, and turn the yolks into one basin and the whites into another. Add to the yolks a dessertspoonful of pounded loaf-sugar and a tablespoonful of cream, stir these together with a wooden spoon. Whip the whites for four minutes into a stiffish froth, then add them to the yolks, and mix altogether same as for an omelette. Have ready in a state of froth about half an ounce of butter in a small clean frying-pan. Pour in the mixture and proceed in precisely the same way as for a sweet omelette The only difference between a plain omelette and an omelette soufflé is that cream is used, and the whites are whipped, and added to the mixture for a soufflé. Keep the mixture free from the pan while cooking.

Paste, Pies, Puddings, etc. Farinaceous foods are characterized by their large amount of starch, but the proportion of carbon and nitrogen will give a better idea of the relative value of different starchy substances commonly used as food: One pound of household bread yields 1,994 grains of carbon and eighty-nine grains of nitrogen. One pound of oat-meal contains 2,800 grains of carbon and 140 grains of nitrogen. One pound of pearl barley contains 2,660 grains of carbon and ninety-one grains of nitrogen. One pound of maize contains 2,800 grains of carbon and 121 grains of nitrogen. One pound of rice contains 2,730 grains of carbon and seventy grains of nitrogen. One pound of potatoes contain 770 grains of carbon and twenty-four grains of nitrogen. One pound of sago and arrowroot contain, 2,555 grains of carbon and thirteen grains of nitrogen. One pound of peas, or beans, contains 2,730 grains of carbon and 255 grains of nitrogen. When substances containing a large proportion of starch are used as food, milk is a valuable and almost a necessary addition. If we bear in mind the quantity of carbon, twelve and one-half ounces, and of nitrogen, 250 grains, required daily by a laboring man, we can form some idea of the relative value of cereals as food substances. The form in which they are chiefly used is as wheaten bread. In the conversion of wheat into bread we grind the grain and reject the lining membrane of the bran, which is rich in nitrogen and phosphates; but the presence of this inner lining of the bran and small portions of the bran itself give a brown color to the bread, and in our craze for white flour and white bread, a prejudice difficult to overcome, (especially among the poor), we waste a considerable portion of our food. The utility of finely bolting meal, by which all the bran and pollards are removed, is very doubtful, because you not only get rid of much nitrogen, but also of the salts which are especially valuable in the nourishment of the young.

Puff Paste. This paste can not be made with certainty in summer time without a refrigerator, because the butter is liable to become oily. Wash your hands, using a nail brush, and place on a clean paste-board or marble slab one pound of fine sifted flour, make a hollow in the center of it, then add half a teaspoonful of salt and about half a pint of water. Mix the flour and water gradually, and when about half mixed sprinkle the paste with a little more water so as to collect all the flour. Work the paste lightly till it ceases to stick either to the board or the fingers. Take three-quarters of a pound of butter, work it in a clean cloth to remove the water. Have the paste about one inch in thickness, place the butter in the center of it and fold over the four sides of the paste so as to enclose the butter in a square. The paste will now be from two to three inches in thickness. Put it aside for five minute in a cold place or a refrigerator. Then roll the paste to a length of three feet, fold over from one end one-third of this length, and now fold over the other end. There are now three thicknesses of paste of equal lengths, and this folding into three is called one turn. Put the paste aside for ten minutes, then give it two turns, beginning at right angles to the first rolling, then in the same direction as the first rolling. Put it aside for another ten minutes, then give it two more turns, in all five or six turns. Gather the paste into a lump and finish by rolling to the required thickness, about a quarter of an inch.

Short Paste. Wash your hands and place on a clean paste-board or marble slab one pound of sifted flour, make a hole in the center and add two tablespoonfuls of pounded loaf-sugar, and half, or better three-quarters, of a pound of butter, previously freed from water Mix gradually with half a pint of water. Work thoroughly but lightly with the hands. Roll it into a smooth lump, and, if you have time, it will be the better if put aside for one hour. Then roll it out two or three times, folding over each time, and the paste is ready. If fresh butter has been used, a small pinch of salt may be added.

Suet Crust. To every pound of flour allow five or six ounces of beef suet. Free the suet from the skin and mince it finely, then rub it well into the flour with a pinch of salt; work the whole to a smooth paste with a half pint of water, roll it out, and it is ready. This crust is quite rich enough for most purposes; but when a better one is desired, use from a half to three-quarters of a pound of suet to every pound of flour. For rich crusts pound the suet in a mortar, with a small quantity of sweet butter. It should then be laid on the paste in small pieces, the same as for puff crust, and will be found exceedingly good for hot tarts. Five ounces of suet to every pound of flour will make a good crust, and even a quarter of a pound will answer very well where the crust is wanted very plain.

Suet Pudding. Put a pound of sifted flour in a basin with half a pound of beef suet, finely chopped; add two eggs with a pinch of salt and a quarter of a pint of water; beat well together with a wooden spoon, making a rather thick batter; flour a pudding-cloth and lay it in a small round-bottomed basin, pour in the mixture, tie the cloth tightly, and put the pudding to boil in boiling water; an hour and a quarter would be sufficient to cook it. When done, remove the cloth, turn the pudding over upon a dish, and serve very hot. The water must be kept boiling.

Pease Pudding. Soak a pint of peas for ten hours in rain or soft water—the bad ones float and can be removed. Drain them and tie them up loosely in a clean cloth, and put them into plenty of cold rain water; let them come to the boil and then simmer till the peas are tender; the time will vary with the kind of peas, but never less than two hours. Drain them over a colander and pass them through a clean wire sieve. Season the pulp with pepper and salt, beat up one or two eggs with an ounce of sweet butter and stir it into the pulp. Thoroughly mix with a wooden spoon. Have a clean cloth, and tightly tie up the pudding. Let it boil for another half hour. Turn it on to a dish and serve. This is usually served with fat pork, and is a very sensible and nutritious dish for working people. Be careful in the selection of the peas, and be sure that they are soft enough to pulp before turning them out.

Roly-Poly Pudding. Make a nice light suet crust and roll it out to the thickness of about half an inch. Spread jam, or currants and treacle, equally over it, leaving a small margin of paste without any treacle. Roll it up, fasten the ends securely, and tie it in a floured cloth, then put the pudding into boiling water and boil for two or three hours. Fresh suet and a light crust are necessary.

Apple Pudding. Take a basin, butter it, and line it with a suet crust; pare, core, and cut the apples into pieces, and fill the basin with them, with sugar according to taste; add one small teaspoonful of finely minced lemon-peel, one tablespoonful of lemon juice, and cover with crust; close the edges well together, flour the cloth, and tie it securely over the pudding, and put it into plenty of boiling water. Let it boil from one and a half to two and a half hours, according to the size, then turn it out of the basin and send to the table quickly. Apple pudding does not suffer by being boiled an extra hour, if care be taken to keep it well covered with the water all the time. The water must be kept constantly boiling, and if more is added, let it be boiling water.

Baked Batter Pudding. Take six ounces of fine flour, three eggs, and a pinch of salt; add by degrees as much milk as will, when well beaten, make it the consistency of thick cream; pour into a pudding dish, and bake three-quarters of an hour; or it may be boiled in a basin, or tied up in a cloth. It will require two hours' boiling. The milk should be added gradually.

Yorkshire Pudding. Use for every egg as much flour as a tablespoon will carry, and a small pinch of salt. Whisk the eggs well, strain and mix them gradually with the flour, then pour in by degrees as much new milk as will reduce the batter to the consistence of rather thin cream. The tin or pan which is to receive the pudding, must have been placed for some time previously, under a joint which has been put down to roast; one of beef is usually preferred. Beat the batter briskly and lightly the instant before it is poured into the pan, watch it carefully that it may not burn, and let the edges have an equal share of the fire. When the pudding is quite firm in every part and well colored on the surface, turn it to brown on the under side. This is best accomplished by first dividing it into quarters. Be careful in mixing the batter, which should be rather more liquid than for a boiled pudding.

Pigeon Pie. Prepare three or four house pigeons, and take half a pound of tender beefsteak, cut into convenient pieces, lightly fry the steak first, and then the pigeons, in a clean stewpan with a little butter, season with chopped mushrooms, one eschalot, a little parsley, and pepper and salt. Place the steak at the bottom of the dish, upon this place the halves of the pigeons, rinse out the stewpan in which the things have been fried, with half a pint of stock or water, and strain into the dish; add the yolks only of five hard boiled eggs, cover with a puff paste, and bake for an hour and a quarter in a moderate oven. The pigeons must be young and the steak tender; and do not fry too long in the butter.

Giblet Pie. Glean and blanch the giblets (except the liver), and put them, with the wings, feet, head and neck, in boiling water; and remove the skin from the feet and beak. Put into a stewpan a piece of butter the size of a walnut, one onion cut in slices, a bay-leaf, a little salt, pepper and sugar: place them on the fire until the onion is brown; put in the giblets with the head cut in two, let them remain on the fire for about three minutes, stirring them round; then add nearly a quart of boiling water, and let them stew gently for two hours; remove from the fire and let them get cold. Take a pie dish and place a piece of steak on the bottom, then place over that the giblets with the liver, and steak again over them; add the liquor the giblets were stewed in, season and cover with good paste. The giblets must be fresh and well stewed.

Squab Pie. Trim part of the fat off some mutton cutlets, and season them with pepper and salt, place them in a pie dish, and cover with a layer of sliced apples sprinkled with sugar and chopped onions, previously blanched; if the pie is large, arrange another layer of cutlets, and again cover with onions and apples, then cover with a good suet crust and bake. When done, pour out all the gravy at the side, remove the fat, and add a spoonful of mushroom ketchup to the liquor; and return it to the pie. The fat must be well removed from the gravy.

Rumpsteak Pie. Take three pounds of tender rump steak, cut it into pieces half the size of your hand, trim off all the skin, the sinews, and every part which can not be eaten, and beat the steak with a chopper or a kreatone. Chop very finely half a dozen eschalots, and mix them with half an ounce of pepper and salt, strew some of the mixture at the bottom of the dish, then a layer of steak, then some more of the mixture, and so on till the dish is full; add half a gill of mushroom ketchup and the same quantity of rich stock; cover it with a good paste, and bake it two hours. Large oysters blanched, bearded, and laid alternately with the steak, is a great improvement, and the liquor in which they were blanched, when reduced, may be used instead of the ketchup or stock. The steak must be tender, or made so by beating.

Preparing Forcemeat. Remove the rind, gristle, bone, and brown parts from three-quarters of a pound of fat bacon, take three-quarters of a pound of veal with any trimmings, mince them very finely, and add a good dessertspoonful of spiced salt. Work all these well together in a mortar till it is of a rather stiff paste, and put it aside in a basin. Make a short paste and line the inside of a plain oval pie mould. Now arrange a layer of the forcemeat on the paste at the bottom of the mould; use about one-fourth. Then a layer of rashers of ham; then another layer of forcemeat; then the veal, cut into convenient pieces. Sprinkle over with spiced salt. Now another layer of forcemeat, then rashers of ham, then forcemeat. Cover the surface with three rashers of fat bacon and a bay-leaf; cover with paste, and bake for two hours in a moderate oven, covering the top with a piece of buttered paper. A fine plated skewer thrust in will enable you to judge when the meat is sufficiently baked. If the spice is at hand this pie is no more trouble, nor does it take more time, than an ordinary veal and ham pie, and is much better. The chief point to be borne in mind is not to have it too highly seasoned, and the meat should be free from gristle and skin.

Veal and Ham Pie. Take about two pounds of lean veal, from the breast or fillet, free it from fat, skin, bone, and gristle, and three-quarters of a pound of ham or bacon, in thin rashers free from rind and coarse parts. Cut these in convenient pieces. Prepare a short or puff paste and line the dish. Mince finely half-a-dozen button mushrooms, a sprig of parsley, and sweat these in a clean stewpan with an ounce of butter and a little flour; add a gill or half a pint of good stock, or in default water, and a dessertspoonful of ketchup. Bring these slowly to the boil and stand it aside. Prepare three hard boiled eggs and cut them into dice; if preferred use only the yolks. Now arrange the meat, a layer of veal, then ham, and so on, finishing with ham mingled with the egg, (some use a little grated lemon-peel, others add oysters, sweetbreads, mushrooms, etc.) The pie may be made rich and savory in a dozen ways, according to taste. Finish the pie and strain through the hole at the top all but a wineglassful of the gravy; cover the hole with an ornamental piece of paste and bake. When ready remove the ornament at the top, make the remainder of the gravy very hot and strain it in, cover the hole again and serve. In meat pies it is essential that the meat should be tender and free from skin and gristle.

Rissoles. Take the trimmings of puff paste; roll the paste out to the thickness of a penny piece; place small balls of meat, the same as those prepared for croquets, and put them at distances of two inches from each other; moisten the paste round these balls of meat with a brush dipped in water; fold the flap of the front part of the paste over the balls, just as you would fold a sheet of paper lengthwise; press all round them with the edge of the thumb; cut them out with a fluted round tin cutter, and place them on a dish sprinkled with flour: having cut out a sufficient number, fry them in hot fat, and serve up with fried parsley on a napkin. The difference between a croquet and a rissole is this,—the rissole is always fried in a paste, the croquet in egg and bread-crumb. Take care to have a good paste and the rissoles neatly made.

Open Jam Tarts. All fruit pies and tarts require a light, good crust. Take an open tart mould and line it with paste about a quarter of an inch in thickness. Make a few holes in the bottom; this is to prevent the paste puffing up in the center. Bake in a brisk oven ten or fifteen minutes. Let the paste cool, then add the preserve, but if the tart is to be served hot, warm the jam in a clean stewpan and add at once. The tart may be decorated with leaves, flowers, or stars, cut out of the paste and baked. It is not desirable to bake the jam in the tart; it spoils its flavor and appearance. A good oven is essential for all fruit pastry.

Apple Pie. Prepare the apples, by peeling and removing the cores, and cutting them into eight pieces, moisten the edge of the dish with a little butter and lay a slip of puff paste round it. Arrange a layer of apples at the bottom, then sugar, and flavor with cinnamon, cloves, lemon-peel, orange-peel, candied citron, or whatever flavoring you prefer; a little quince is a great improvement. Keep adding the apples till the dish is full and well heaped up in the center. Cover with puff paste and decorate the top. Cream is a good addition to apple pie. In baking pies and tarts a light crust is essential.

Plain Cake. Take half a quartern of common paste, four eggs, a quarter of a pound of sugar, a quarter of a pound of butter, or dripping, a quarter of a pound of currants, carefully washed and dried, and a little salt. Break the paste lightly in a basin, put in the sugar, the butter, and two eggs, thoroughly mix the whole together, then add the other two eggs, one at a time, work the mixture well, and, lastly, work in the currants. Fill a plain mould, previously buttered, with the mixture, and set it in a warm place to rise. As soon as it has risen put it into a moderate oven to bake to a brown color. The chief thing is to carefully mix the ingredients.

Seed Cake. Mix a half pound of pounded loaf-sugar with two pounds of flour in a large bowl or pan. Make a hole in the center, and pour into it a half pint of lukewarm milk and two spoonfuls of yeast. Draw a little of the surrounding flour into this, and throwing a cloth over the vessel, set it in a warm place for an hour or two. Then add half a pound of butter just liquefied, an ounce of caraway seeds, a little allspice, ginger, and very little nutmeg, and milk sufficient to make the whole of a proper stiffness. Mix it thoroughly; butter a plain mould, and pour in the mixture; let it stand half an hour at the mouth of the oven to rise, and then bake it. Be careful to prove your yeast before using it.

Ginger Cakes. Take one pound of flour, twelve ounces of fresh butter, twelve ounces of pounded loaf-sugar, two ounces of best ground ginger, add the yolks of eight eggs. Work the whole of these together on a paste board or slab, and after having gathered the paste up into a compact mass, separate it by cutting with a round patty cutter, and then place them on a slightly buttered baking sheet. Bake them to a light brown color in a moderate oven. The ingredients must be thoroughly well mixed.

Roasting, Baking, Broiling, and Boiling. Beef constitutes by far the larger portion of animal food consumed by man; and in selecting a piece of beef or mutton, see that the grain is not too coarse, that the meat is of a bright red color, soft to the touch, and that the fat is nicely intermixed with the lean. Mutton and beef will be more tender if the weather will admit of their being hung, knuckle downwards, some days before cooking; but two days in summer are often equal to a week in winter. The flavor and the quality of meat will depend on the breed, age, and food. The lean is the muscular part of the animal, and consists of fibrin, gelatine, and albumen. Experiments, which have been carefully made, show that a sirloin of beef, weighing twelve pounds, lost in roasting forty-four ounces, of which twenty-seven were water and seventeen fat or dripping. A flank of beef, weighing twelve pounds, made into pot-au-feu, or bouilli, lost twenty-five ounces. It is therefore quite clear that boiling, especially when the liquor is turned to an account, as it should be, is the most economic kind of cooking. When meat is boiled, much of the albumen remains in the water, and when flavored with vegetables and herbs, and thickened with meal, you have a highly nutritious soup, much used in every country except our own. Glue is an impure gelatine. The white of egg is nearly a pure albumen; this albumen surrounds the fibers of the meat; and the stringy threads of stewed meat afford an example of fibrin. The osmazome is that extract or essence which gives meat its peculiar odor and taste by long stewing. The osmazome is dissolved in the water, and this is the secret of all meat flavors in soup. Roasting appears to exalt the flavor of meat more than any other method of cooking. The best joints for roasting are the ribs and fillet, the rump and sirloin; for making soup, the neck, tail, and tops of ribs; and for stewing all the inferior pieces. To roast properly a good fire is most important: it should be evenly lighted, bright and radiant, and never allowed to get low. No reliable time can be given for roasting, because the nature and the qualities of meat vary. About two hours for seven pounds of beef, and one hour and three-quarters for a leg of mutton of the same weight, or roughly, about a quarter of an hour to the pound, will generally be found sufficient. To tell whether the meat is done, press the fleshy part with the thumb; if the meat yield to the pressure it is done. In the case of poultry or game, the flesh of the leg may be tried in the same manner. Cooks attach importance to the steams drawing to the fire. When the meat is nearly done, remove the buttered paper, if any has been used, and sprinkle over the meat a little salt, and put the ends of the joint to the fire; well baste the meat, and endeavor to obtain a clear brown color before the fire. If you wish the meat to be frothed, dredge very lightly a little well-dried flour over the surface, and give it time to crisp; do not baste after the flour. Practice is the only way to learn to roast properly. In the United States but little roasting is done before an open fire. Meats are baked. The general principles, however, are the same. Broiling is a very acceptable kind of cooking when well done, but anything broiled requires constant watching. It is an easy method of making a small portion of fish or meat savory, and may be recommended to bachelors. It is not the cooking for families. Things broiled should be turned with steak tongs; a fork should on no account be used; and without a clear, bright fire broiling is impossible. The principle is the same as roasting; the albumen of the meat or fish is coagulated, which forms a crust, and so retains all the juices. Delicate appetites are often encouraged with a nice broiled fish. The bars of gridirons are often too large and obstruct much of the heat. The gridiron should be very clean, and if bright when purchased it should be kept so, and always be washed before putting away. Before putting anything on the gridiron let it get thoroughly hot; the reason for this is obvious; much of the heat of the fire is conducted away by the iron, and if a piece of meat be placed on at once the albumen coagulates but slowly, and allows the juices to drop into the fire instead of being preserved in the meat. When your gridiron is thoroughly clean and warm, rub the bars with a piece of suet, this prevents the meat sticking and coming to table with black stripes. If you like the flavor, just rub the gridiron with a clove of garlic, or eschalot. Perpendicular gridirons are objectionable, because there is always a current of cold air on one side of the thing broiled. For fish, the gridiron should be rubbed with chalk; as the things broiled are usually small they should be served on a very hot dish. When the fat smokes and blazes too much remove the gridiron for an instant, and just sprinkle the fire with a little salt. Arrange your gridiron, if possible, so that it may be from two to five inches above the fire and slightly inclined toward the cook. In relation to boiling, some cooks think, after a piece of meat has been placed in the saucepan, it requires no more attention, but boiling requires as much care as almost any kind of cooking. If you wish to retain all the flavors and juices of the meat plunge it into soft boiling water, and after three minutes stand it aside to simmer, at about 170° or 180°. Always remember that a boiling temperature coagulates the albumen on the surface. If you want to make stock or broth, on no account allow the water to boil; the scum must always be removed, and a little cold water facilitates its rising. Some cooks boil mutton and fowls in a floured cloth, to make them look whiter, but its utility is very doubtful.

Bouilli or Boiled Beef. Beef used for the pot-au-feu is called Bouilli, and has no doubt given much of its flavor to the broth; but it may be made into a very inviting dish. As soon as the beef broth has been prepared the meat should be taken out and placed on a dish, garnished with vegetables that can be eaten.

Bouilli with Sharp Sauce. Take about a pound and a half of cold beef and cut it across the grain into slices a quarter of an inch thick. Trim off the gristle and outside parts, put the meat into a small gratin dish, sprinkle with pepper and salt, and moisten with a gill of stock: let the meat bake for a quarter of an hour in a moderate oven. Serve either with piquante or tomato sauce poured over the meat. The preparation of the sauce is most important for this dish. In roasting we have given directions as though the meat were really to be roasted before an open fire. When stoves are used place it in the oven. The other directions will apply as well in this as in other cases.

Roast Sirloin of Beef. Take a piece of sirloin of beef, weighing seven or nine pounds, cut off the chine bone, flatten the flap part and tie it under the fillet, or cut it off. Trim up the joint, then tie a layer of suet over the fillet. Cover the meat with buttered paper, secure it with a piece of tape, and roast before an even fire. Put it close to the fire for ten minutes, then remove to a short distance. Ten minutes before the meat is ready, remove the paper and sprinkle with salt. A little water or stock without flavor should be put into the dripping-pan, but not butter nor dripping. Baste frequently, and if you have to add coals during the roasting, do so in such a way as not to deaden the fire.

Roast Ribs of Beef. Saw off the chine-bone, trim the joint, wrap it in buttered paper, and roast as sirloin.

Roast Neck of Veal. Roasted veal is rather tasteless; it is greatly improved by larding. Veal should be thoroughly cooked before a moderate fire. The neck, loin, and chump are best for roasting. Take a neck of veal and saw off the chine-bone, as for cutlets, and cut through the ribs about the middle, so as to roll the flaps underneath, and tie the meat with a piece of tape. It is better to wrap the veal in buttered paper; and about ten minutes before it is ready remove the paper, sprinkle with salt, and let it come to a golden color. Baste every ten minutes, skim off the fat, and strain the gravy over the meat. The French make a great many delicate dishes from the liver, tongues, ears, feet, brains, kidneys, and sweetbreads of calves.

Roast Loin of Veal. Take four or five pounds, including the kidney, remove the chine-bone, and trim off some of the fat, then roll the flap underneath, and tie it with a piece of tape, so as to enclose the kidney.

Roast Leg of Mutton. Mutton for roasting is all the better for having been kept a few days, if the weather be favorable, in a dry, airy place, free from flies. A short thick leg is the best; the lean rather of a dark red, and the fat firm and white. Saw off the shank bone two inches below the knuckle. A clove of garlic may be introduced near the knuckle for those who like the flavor. Place it before a sharp fire for fifteen minutes, to keep in the gravy, then remove it a short distance to finish roasting; put half a pint of broth in the dripping-pan, and five or ten minutes before taking from the fire, sprinkle with salt; place the mutton on a dish, and put a white paper frill around the knuckle-bone; skim off all the fat, and strain the gravy over the meat. You may serve with this joint white haricot beans, or macaroni under the meat or separately. Constant basting is necessary for all roast meat.

Roast Hind Quarter of Lamb. Saw off the knuckle-bone of a hind-quarter or leg of lamb, and roast before a sharp, even fire; when ready, place it on a dish, and garnish with watercresses. Horseradish or mint sauce may be served in a boat. Frequent basting and a clear uniform fire are necessary.

Roast Breast of Lamb. Select a nice breast or leg of lamb, and put it before a clear fire. Take some stale bread-crumbs, minced parsley, and a little salt and pepper; mix these thoroughly together. After about a quarter of an hour, when the fat begins to melt freely, sprinkle the mixture uniformly over the surface. When done, skim the fat from the gravy, and strain over the joint. Garnish with watercresses, and serve with hot mint sauce in a boat. A lemon is often sent up with roast lamb. A clear uniform fire and basting are essential for all roast meat.

Roast Duck. Stuff the duck with a stuffing prepared as follows:—Take two or three onions, say six ounces, cut them in slices with six or eight sage leaves, blanch both for five minutes; drain and chop them fine; put the whole in a stewpan with one ounce of butter, two pinches of salt, and two small pinches of pepper; simmer gently for ten minutes, stirring with a wooden spoon; add a handful of bread-crumbs, and stir for two minutes more; the stuffing is then ready for use; an apple mixed with the stuffing is thought by some to be an improvement. Truss the duck, and put it down to roast before a very hot fire. A young duck, a good fire, and occasional basting are necessary.

Roast Goose. A goose weighing six or eight pounds is to be preferred. Pick, draw, singe and wipe, and stuff it with stuffing as for roast duck. Sprinkle with a little salt, baste frequently, skim off all the fat, strain the gravy and serve separately or on the dish, as preferred. It is essential that the goose should be young, and roasted before a good fire, but not a fierce one. Try the pinion, and if the lower part of the beak breaks easily, the goose or duck is young.

Roast Fowl. Pick, draw, wipe, singe and truss a fowl. Unless stuffed, an onion inside and a piece of butter are thought to be an improvement. Tie a rasher of fat bacon over the breast and put the fowl before a bright, clear fire, then roast slowly, with occasional basting. When ready, strain the gravy and pour it under the fowl. Garnish with watercresses. A young fowl is essential, which may be known by the large size of its feet and knee joints, and the smallness of the spurs. Try the pinions and breast. Baste occasionally.

Roast Turkey. Prepare a turkey; one of about six or seven pounds is to be preferred. Put the turkey before a good fire and roast till of a golden color. Skim off the fat, strain the gravy, and garnish with watercresses. It is necessary to have a young turkey with white flesh. Avoid one with long hairs and flesh inclined to a violet tinge.

Boiled Leg of Mutton. Cut off the shank, wipe it, put it into a clean saucepan or stewpan with plenty of lukewarm water, and let it come slowly to the boil; skim when necessary. For a leg of eight pounds, let it simmer for two hours. The mutton should be well done, but not overdone, it should retain all the juices and look plump; when the meat is not very white it is sometimes blanched for ten minutes in hot water or wrapped in a floured cloth. A few minutes before it is ready add half a teaspoonful of salt. Wether mutton, four or five years old, is the best both for boiling or roasting; for boiling it is a whiter color if cooked fresh, but more tender if kept four or five days. Serve with boiled turnips, and caper sauce not poured over it, but served in a boat. Skimming and simmering are necessary, or the meat will be hard and tough.

A Fricasée of Fowl. To prepare a fricasée of chicken, which may be slightly varied from the following recipe, is one of the best examples of good English cooking. Draw, pick, wash and singe a chicken, cut off the head and legs at the first joint and the wings at the second. In singeing be careful not to break, burn or blacken the fowl. It is necessary to singe all fowls; it not only destroys the small down but tightens the skin. Put the chicken into a clean three-quart stewpan with sufficient warm water to cover it; add one onion with a clove, a little salt and a bunch of parsley. Skim when necessary. Let it boil for ten minutes, remove it to sieve and let it drain for three minutes. With the liquor in which the chicken was boiled prepare a sauce by adding two ounces of butter and two tablespoonfuls of flour, and thoroughly stir. Prepare and blanch for five minutes a dozen mushrooms, in just sufficient water to cover them; add the juice of half a lemon. Strain into the sauce and put the mushrooms aside; be careful that they are not broken. Neatly cut up the fowl into ten pieces, keeping the skin on each piece, and finish cooking the pieces in the sauce, which will take from twenty to twenty-five minutes. Arrange them neatly on a dish, strain over them the sauce and garnish with the mushrooms. Four crayfish make a good garnish, or croutons of bread fried in butter. It is necessary to have a young fowl, and it must not remain in the sauce longer than is necessary for cooking.

Boiled Fowl. Neatly truss and prepare a fowl; be careful not to break the skin in picking, and wrap it in a sheet of white buttered paper, put it into a clean stewpan or saucepan with plenty of lukewarm water, and let it just boil, skim, and in fifteen minutes turn the fowl over for another fifteen minutes, and for a fowl of about three pounds this will be sufficient. Young fowls and all poultry will be the better for being kept two or three days before boiling. Serve with a white sauce, or bechamel sauce, or parsley and butter, according to taste. Choose a young fowl with white or pale-colored legs. Occasional skimming is necessary.

Calf's Liver and Bacon. The liver should be cut in slices, each about a quarter of an inch in thickness; cut also some streaky bacon into thin rashers of uniform thickness and fry them first, and drain on a plate, and add the fat to the frying pan; after having covered each piece of liver with flour, fry them in the fat from the bacon, and when nicely browned on both sides dish up the liver and bacon in a circular row, placing a piece of each alternately; strain off the fat from the pan in which the liver has been fried, add a little flour and a tablespoonful of ketchup, a little pepper and salt, and half a gill of stock or water; a few minced gherkins or mushrooms, pickled walnuts, or mixed pickles may be mixed with the sauce; stir all together over the fire until the sauce just boils, and pour it over the liver and bacon. Be careful to flour the pieces of liver uniformly; and the bacon should be young.

Beef or Rump Steak. A rump steak should be one and a half inch thick. Slightly flatten it with a chopper, which should be moistened on the side with water, to prevent its adhering to the meat. Trim it into an oval shape and oil the surfaces; this oiling is not to flavor the steak, but to prevent the outside hardening on the fire, and to quicken the cooking. Sprinkle with a little pepper and salt, and broil over a clear fire. Let the gridiron incline a little toward you. Have a clear, brisk fire and turn the steak with tongs; a fork should never be used for broiled meat or fish.

Veal Cutlets. Trim and flatten the cutlets taken from a neck of veal. Remove the chine-bone and all the skin and gristle. Sprinkle the cutlet with pepper and salt, oil it on both sides and put it on the gridiron over a clear fire, and dish up with brown gravy, or a sharp sauce, or with maitre-d'hotel butter under the cutlet, or with tomato sauce. A clear bright fire and the gridiron slightly inclined towards the cook are necessary.

Sweetbreads. Whatever the dish, sweetbreads are always first prepared as follows: Soak for three hours in cold water three sweetbreads, change the water occasionally if it becomes discolored, put them into boiling water for half an hour, or long enough to become firm, but not hard, press them into shape by placing them between two paste-boards or baking tins, with a four or five pound weight on the top, then lard them with bacon about one-eight of an inch in section. Bacon for larding should be cured without saltpetre, or it gives a pink tinge to all white meat. Put them in a clean stewpan with three gills of rich stock, and season with salt; when the stock thickens add another half-pint and baste frequently with the stock; arrange them on a dish, strain the gravy over them, and serve with sorrel, green peas, or tomato sauce. Throat sweetbreads are the best, and the gravy should be rich and free from fat. Do not allow the sweetbreads to harden in boiling or they will be difficult to lard.

Beans and Bacon. Put a pint of beans into cold water the over-night. Cut half a pound of bacon into half-inch dice, put the bacon and beans into a clean saucepan with just sufficient cold water to cover them; let the beans boil till they are tender, then stir in one or two tablespoonfuls of flour, a little pepper, and a bouquet garni, with a clove of garlic or an eschalot, Let the contents simmer slowly, and when the sauce is sufficiently thickened the beans and bacon are ready. The beans, if old, will require long soaking, or much longer boiling than is desirable for the bacon.

Fat Pork or Bacon and Beans. Soak a quart of beans in cold water for ten or twelve hours, then boil them with a little salt till they are tender. Take a common yellow dish, and put the beans at the bottom, and on a tripod place two pounds of fat bacon or pork and bake for an hour, or the meat may be roasted and the beans placed in the dripping-pan. The beans should be quite tender before baking.

Gravy for General Use. It is often necessary to prepare a gravy for general use. Take about two pounds of fillet of veal, remove any fat, cut it into three or four pieces and add any odd portions of uncooked meat. Put them all into a six-pint saucepan or stewpan with half a pint of soft water. Let it come slowly to the boil and continue reducing till it forms a glaze. Turn the pieces of meat over and add three pints of water, a teaspoonful of salt, a pinch of pepper, a bouquet garni, a small carrot split into four, and one onion, with two cloves. Let the contents come to the boil and simmer slowly for two hours with the lid removed. Skim as occasion requires and strain the liquor through a tammy sieve and put it aside for use. The pieces of meat can be served with a sharp sauce. The contents must not boil or the gravy will not be clear, and freedom from fat is most essential.

Stuffing. Melt in a clean stewpan one ounce of butter and season with pepper and salt. Blanch for seven minutes three-quarters of a pound of sliced onions and fifteen sage leaves, remove the stalks and mince them finely and then stir into the butter. Stir for ten minutes with a wooden spoon. Now add stale bread-crumbs, sufficient to bring the stuffing to its proper consistency, and the stuffing is ready for use. The mixture requires constant stirring. Or, take half a pound of stale bread-crumbs, four ounces of finely-chopped suet, two eggs, a dessertspoonful of minced parsley, a very small teaspoonful of minced eschalots, marjoram, and thyme, then season with pepper and salt and two grated nutmegs. Work these thoroughly well together with the hands and it is ready.

Salads. Salads are a very simple and harmless luxury, and they make an agreeable addition to our ordinary food, and if taken with plenty of oil, are very wholesome. In this country we are perfect savages in the making of salads. The dressing is often served up in a twisted bottle, and the wet vegetables are heaped up on a dish like food for cows, with the polite invitation to every one to help himself. A salad properly prepared should be one of the most attractive dishes on the table. There are many little things necessary to secure a good salad, and their variety is only limited by the ingenuity of the cook. The Spanish proverb is that four persons are necessary to make a good salad—"A spendthrift for oil, a miser for vinegar, a barrister for salt, and a madman to stir it up." Young ladies in the country, where they have an abundance and variety of vegetables, might render a national service if they would turn their attention to salads as well as croquet. If you wish to preserve the crispness and flavor of green vegetables for salads they should be gathered either early in the morning or late in the evening, and put in a cool, damp place. To soak green vegetables in water to keep them fresh, or to keep up the appearance of freshness, is a mistake. Lettuce, which is the chief thing in most green salads, should be eaten young, or the leaves are too strong for a delicate salad, and if possible, lettuce should never be washed or cut with a steel knife: the best way is to break the lettuce into the bowl, or to cut it with a silver knife. If you must wash the vegetables, do it quickly, and thoroughly dry them in a clean cloth before putting into the salad bowl. A salad should never be prepared till a few minutes before it is wanted. A variety of vegetables may be used according to taste, but the fewer the better; cress is often too thready to be used agreeably; the chief vegetables are lettuce, endive, radishes, onions, basil, mustard, watercress, cucumber, celery, mint, parsley, beetroot, dandelion, tarragon, chervil, sorrel and tomatoes. In Europe cold meat, fish, fowl and game are more often served as salads than green, uncooked vegetables. Our forefathers had the same notion of salads, which were frequently prepared by them from previously cooked meat and vegetables. Above all things be particular with the sauces and jellies, meat or fish, served as part of the salad.

Vegetable Salad. Boil separately equal weights, according to the quantity required, of the following vegetables:—French beans, carrots, green peas, turnips and asparagus points; dry these vegetables in a clean cloth, and when quite cold cut them into dice of one-quarter or three-eighths of an inch; the French beans should be cut into squares; now arrange them on a dish; begin by placing the French beans at the bottom and in the center, arrange round the French beans in about equal quantities in narrow rows the carrots then peas, then turnips, then asparagus points, and if the dish is large enough and the vegetables sufficient, proceed again in the same order; sprinkle the surface with a tablespoonful of Ravigote—*i. e.*, finely minced chervil, tarragon, burnet, chives and garden cress, all previously blanched, strained, cooled and dried in a clean cloth. Serve with mayonnaise sauce in a boat. The success of this salad depends on the vegetables being young and tender.

Fish Salad. Take the remains of any cold boiled fish and cut them into small scallops about two inches, and dip them into mayonnaise sauce; wash, if necessary, two freshly gathered young Goss lettuce, a little endive and water-cress, and drain over a colander and dry in a clean cloth, by shaking to remove all the water; break up the lettuce, watercress, and endive into pieces about three-quarters of an inch in length, mince a small sprig of chervil, two leaves of tarragon, and a few leaves of sorrel, peel and slice one cucumber and one beetroot, mix all together thoroughly, and begin by rubbing the dish with garlic; now arrange at the foundation a layer of the green vegetables, then a layer of cold fish, meat, chicken, lobster, shrimp, fowl or game; now a thin layer of mayonnaise sauce, then a layer of vegetable, and so on, finishing with mayonnaise sauce, and garnishing with nasturtium flowers; some of the beetroot and cucumber may be reserved to arrange alternately round the edge of the dish, or aspic jelly and hard boiled eggs, or olives may also be introduced: this makes a very pretty foundation. With all fish salads mayonnaise sauce should be served in a boat. The mayonnaise sauce must be good and the vegetables fresh, and taste should be shown in the arrangement of the materials.

Lettuce Salad. If necessary wash two lettuces, dry them thoroughly in a cloth, and break the leaves or cut them with a silver knife into convenient pieces; put the yolks of two hard-boiled eggs into a basin, (not boiled more than eight or nine minutes or the yolks will be dark colored), with a teaspoonful of dry mustard, pepper and salt to taste, and one tablespoonful of oil; work the mixture into a smooth paste and add gradually three tablespoonfuls of oil and two of vinegar; when mixed to the consistency of cream add two or three leaves of tarragon, and one small eschalot finely minced, and the whites of two eggs cut into half-inch dice, then add the lettuce and a small handful of garden cress, and when the sauce is thoroughly mixed with the vegetables the salad is ready. See that you have young tender lettuce, and be careful to mix the sauce thoroughly before adding the vegetables.

Tomato Salad. Take six tomatoes, but not too ripe to handle, cut them into slices and remove all the seeds, rub a dish with garlic and lay them in a mixture of oil and vinegar in the proportion of two of oil to one of vinegar; sprinkle pepper and salt over them according to taste, and a few leaves of fresh basil finely minced. Let them lie in the sauce for two hours, and the salad is ready. Be careful in the selection of the tomatoes and well free them from seed.

Potato Salad. Cold boiled potatoes make a very good salad. Take one pound, cut them into slices the thickness of a penny, arrange them neatly on a dish which has been rubbed with eschalot or garlic. Mince equal quantities of capers and parsley, two or three leaves of tarragon and thyme, altogether about a tablespoonful, add oil and vinegar in the proportion of two of oil to one of vinegar, and pepper and salt to taste; work all well together, and pour over the potatoes. For this salad the potatoes should be dry and well boiled.

Cauliflower Salad. Boil a cauliflower till tender, but not so as to break in pieces; when cold cut it up neatly into small sprigs. Beat up three tablespoonfuls of oil added gradually to one tablespoonful of tarragon vinegar, and half a tablespoonful of common vinegar, add pepper and salt to taste. Rub the dish very slightly with garlic; arrange the pieces of cauliflower on it, strew over them some capers, a little tarragon, chervil, and parsley, all finely minced, and the least bit of powdered dried thyme and marjoram. Pour the oil and vinegar over and serve. The cauliflower should be fresh and carefully boiled, and the salad not too much flavored. The garlic may be omitted, or an eschalot finely minced used instead.

Sauces. As beef stock is the foundation of all meat soups, so plain melted butter is the foundation of most of our sauces. All starchy compounds when exposed to heat and moisture begin to swell and then burst. If you were to see the starch of flour, or any kind of starch, under a microscope, the particles would appear something like the shape of a flattened egg. These particles are called granules, and they are made up of cells, which burst in cooking. Uncooked starch is anything but pleasant. Now the art of making melted butter consists in bursting the starch cells of flour in the presence of sufficient fat or butter, so that the starch is well cooked. Making melted butter is one of those simple things which every servant of all work is expected to know by instinct, but it is one of those things rarely ever properly done. It is often brought to the table more like starch, or billsticker's paste, than melted butter. It has always been our chief sauce, and has obtained for us the distinction of a nation with twenty religions and one sauce, a circumstance, probably, which led the late Earl of Dudley to speak of one of the Barons of the exchequer as a good man, sir, a most religious man, he had the best melted butter I ever tasted.

Plain Melted Butter. Suppose we wish to make a pint of melted butter:—Take three ounces of good butter; one ounce of flour; a pinch of pepper and salt; half a pint of warm water· put one ounce of the three ounces of butter and the one ounce of flour into a quart stewpan, mix the butter and flour into a soft paste, add the pepper and salt and half a pint of warm water. Stir over the fire with a wooden spoon till the contents boil. If it should be too thick (which will depend on the flour, for some flour requires more water), add half a gill or so of warm water, before putting in the remainder of the butter. The sauce should then be thick enough to coat the spoon. Cut the remaining two ounces of butter into pieces to accelerate the melting, take the stewpan off the fire and stir till the butter is melted. It must not be placed on the fire again. The great point in preparing melted butter is this:—as soon as it has come to the boil to take it off the fire, and then add the cold butter, which gives it the flavor. The failure in properly making melted butter may arise from the flour being in excess, which destroys the flavor of the butter; or it may arise from mixing the whole quantity of butter with the flour at once. If too thin, mix a tablespoonful of flour with half an ounce of cold butter, take the sauce off the fire and allow it to cool for a few minutes, add the mixture of flour and butter and stir while off the fire. When melted, put the sauce over the fire again till just boiling, then add a small piece of butter before serving. The essential condition of success is that the flour and butter should be of the very best, or good, melted butter is impossible, no matter what recipe is followed. The butter, unless good and fresh, gives an unpleasant flavor to the sauce. Melted butter is sometimes preferred slightly acid, when a little lemon juice is stirred into the sauce before serving. All plain sauces should have a simple but decided character, and be served as hot as possible. They should, therefore, never be made until just before they are required for use. Sauces with liaisons or creams should be well stirred, and never allowed to boil after the liaison or cream is added. The same care must be exercised with lemon juice, pickles and other acid mixtures. For sauces use clean stewpans, those of enamel or porcelain are the best, and stir always with a wooden spoon.

Fennel, Parsley, and Tarragon Sauces. A little fennel blanched for a few minutes in boiling water and finely minced, then stirred into the butter, makes fennel sauce, and so with tarragon or parsley.

Mayonnaise Sauce. This sauce is used as a dressing for salad and cold meat or fowl, it is the foundation of all cold sauces, and must be well made. Separate thoroughly the yolk of one egg and put it into a basin with half a tablespoonful of tarragon vinegar, one tablespoonful of good vinegar, and just a little salt and pepper. Mix these with a wooden spoon, then take the oil bottle and place your thumb over the top and let the oil fall in at short intervals, drop by drop, and well mix. The great art is to thoroughly mix the oil before adding more. After adding about forty or fifty drops of oil you may now add it, in quantities of a teaspoonful, till you have used about four ounces altogether, which will make about half a pint of sauce. Taste it, and add more vinegar or pepper, and salt, if necessary. As a rule this sauce should be well seasoned. If desirable, slightly rub the basin in which the sauce is mixed with an eschalot or garlic. Some think a finely minced eschalot and parsley are agreeable additions to this sauce. Thoroughly stir in the oil till the sauce is of the consistency of cream.

Green Mayonnaise Sauce. Mince finely two or three tablespoonsful of chervil, garden cress, tarragon, burnet, and any other herbs you may fancy, mix these together then stir them into the sauce. This mixture is called *ravigote,* if tarragon vinegar has been used; in preparing the white mayonnaise sauce no tarragon should be used in the ravigote. When tarragon is scarce tarragon vinegar may be used instead. The two or three tablespoonsful of ravigote are intended for the quantity of sauce indicated in the previous recipe. The herbs should be finely minced and used in equal quantities.

Piquant Sauce. Chop up a good half ounce of eschalots, a tablespoonful of parsley, and a tablespoonful of gherkins. Take a clean quart stewpan and put into it one ounce of butter, four tablespoonfuls of vinegar and the chopped eschalots, and stir over the fire with a wooden spoon; the vinegar is sufficiently reduced when the butter is clear. When the eschalots have absorbed all the vinegar add one ounce of flour and stir four or five minutes, then add a pint of broth or stock, (if unflavored with vegetables the better), season with pepper and salt according to the saltness of the broth, bring it to the boil and continue boiling gently for ten minutes and skim. Now add the parsley and gherkins. Boil up and skim again if necessary. Any additional seasoning may now be added and the sauce is ready. This reducing is necessary to produce the proper sharpness to the sauce and secure a right mixture of the flour and butter. A brisk boiling is necessary when anything has to be reduced.

Dutch Sauce. When well made this is the first and best of white sauces. Reduce two tablespoonfuls of vinegar to one tablespoonful in a clean stewpan, with a little salt and coarsely-ground white pepper (mignonette). Remove the stewpan from the fire, and add two tablespoonfuls of cold water and the yolks of two eggs. Put the stewpan on the fire and stir, but do not boil. Divide four ounces of sweet, fresh butter into six parts Take the stewpan off the fire and stir in till melted one part only of the butter. Place the stewpan again on the fire for about a minute, constantly stirring. Remove it again from the fire and add another part of the butter and repeat in the same way till all the butter has been used. It will be necessary to add at intervals a tablespoonful of cold water, to prevent the sauce from thickening. Season with pepper and salt and serve hot. The yolks of the eggs are to be well freed from the white, and constant attention is necessary.

Hot Mint Sauce. Take a clean quart stewpan and reduce half a pint of vinegar with half an ounce of brown sugar. Add a pint of water, boil up, simmer for ten minutes, then add a tablespoonful of young mint finely minced. Well mix and serve. The large stalks should be removed from the mint before mincing.

Cold Mint Sauce. Take three ounces of brown sugar, three tablespoonfuls of young mint, previously picked and washed and then finely minced, and half a pint of vinegar, mix well in a basin, and when the sugar is melted put the sauce into a tureen and serve. Remove the large stalks from the mint.

Bechamel Sauce. If you have no rich white stock cut up some lean veal, free from fat, into two inch cubes, and put them into a three-quart stewpan. Add one moderate sized onion two and a half inches in diameter, one small carrot cut into pieces, and six ounces of butter. Fry the vegetables in the butter for ten minutes, without coloring, then stir in three ounces of flour and continue stirring five minutes longer. Add three pints of stock, one pint of cream, five ounces of sliced mushrooms, a small bouquet garni, half a teaspoonful of salt and a pinch of mignonette pepper (white pepper). Stir till it comes to the boil, skim occasionally to remove the fat, and simmer for two hours. Strain through a tammy sieve into an enameled or porcelain stewpan with a gill of cream. Simmer over the fire till it coats the spoon, strain again through a tammy sieve into a basin and stir till the sauce is cold. This sauce especially requires the cook's utmost attention.

Horseradish Sauce. Boil half a pint of rich cream or new milk, then add one ounce of finely-grated horseradish, a pinch of pounded loaf sugar, and a little salt. The horseradish should be young.

Onion Sauce. Peel the onions, blanch them, and roughly mince them, put an ounce of butter into a clean stewpan, then add a teaspoonful of flour, stir for two minutes, add the onions, and stir to prevent coloring, now add a little pounded loaf sugar, and pepper and salt to taste. When the onions are sufficiently soft, pass them through a sieve, return the pulp to the stewpan, and bring the sauce to its proper consistency with milk or cream, continually stirring. Serve hot. Do not let the sauce boil after adding the cream.

Tomato Sauce This sauce is best made with fresh tomatoes. Take six or eight tomatoes and remove the stalks, then squeeze out the juice and seeds; take a three pint stewpan with a close-fitting lid, put in the tomatoes and add a gill of water, a little salt and pepper, and a small bouquet garni· boil for twenty minutes or half an hour, with frequent stirring. When soft, pass them through a wire sieve. Melt half an ounce of butter, and stir into it a teaspoonful of flour; stir for two or three minutes. Take it off the fire, and add in small portions the *purée* of tomatoes, constantly stirring; add a gill of stock, better if flavored with a rasher of ham or bacon, and boil for a quarter of an hour. Should the sauce be too thick, add a little more stock. If preserved tomatoes are used, begin with them as if a *purée*, and proceed as already described, and the sauce is ready. Almost constant stirring is required.

Bread Sauce. Take a clean stewpan and put in six ounces of stale bread-crumbs with one pint of new milk and one eschalot, boil for ten minutes and the sauce is ready. See that the bread-crumbs are good, and take care that the sauce does not boil over.

Oyster Sauce. Open a dozen oysters, and let them boil for two minutes in their own liquor, drain them over a colander, and strain the liquor. Mix to a smooth paste three-quarters of an ounce of butter with the same weight of flour, then add the liquor of the oysters, and make nearly a pint by adding milk; stir over the fire till it comes to the boil, take it off the fire and stir in half an ounce of butter till melted, remove the beards from the oysters, and return the oysters into the sauce to warm. The sauce must not boil after the oysters are added.

Mushroom Sauce. Wash and pick a pottle of mushrooms, remove the gritty part near the stalk, and put them into a basin of cold water for three or four minutes, then dry them on a cloth trim them, and, if you like, whiten them in a stewpan with a tablespoonful of lemon-juice and the same quantity of water, mince them, stalks and all, and put them into a clean quart saucepan with an ounce of butter; when the mushrooms are nearly done add half a pint of Bechamel sauce, and simmer for half an hour. Pass the whole through a strainer, and serve hot. Good Bechamel sauce and young mushrooms will be required.

Lemon and Liver Sauce. Wash and score the liver of a fowl or a rabbit, blanch it for a few minutes cut half a lemon into small slices, remove all the white and seeds, take a quarter of the lemon-rind and mince it and the liver finely, prepare half a pint of melted butter, add the minced liver and lemon, and season with a little salt. Let it come gradually to a good temperature without boiling, and then serve. Be sure the livers are fresh and healthy.

Liver and Parsley Sauce. Proceed as in the last recipe by blanching the parsley and liver, mincing them separately, and stirring the melted butter. The same as the preceding.

Roux. Melt three ounces of butter, and stir in one ounce of flour, until it becomes of a light brown color. Cover the stewpan and let it remain for half an hour on the stove, then add half a pint of boiling water, season with pepper and salt, and stir gently till well mixed. Continue the stirring five minutes after it comes to the boil. Stock, as I have before explained, is better than water. Roux is used for thickening sauces and gravies; when wanted white it must not remain on the fire long enough to brown. The difference between brown roux and white roux is simply in the browning of the butter. It can be kept for some days in a clean earthenware jar in a cool place. Great care must be given to the preparation of roux, for if the butter and flour are not good, or allowed to become too brown, the flavor of the sauce is strong and acrid.

Soups. In the article on Cooking some general directions are given for making soups and stews. In the making of soups the meat should be put into cold water and heated gradually, and throughout the cooking the water should only simmer, the object being to extract the juices of the meat. It may also be added that the broth should be thoroughly skimmed during the operation of bringing it to the scalding point.

Pea Soup. Take half a pound of good split peas, wash them in several waters, and let them soak all night in a pint of water. In the morning put two ounces of good butter or sweet dripping into a saucepan; when it is melted add the peas, well drained from the water, with a lump of sugar the size of a walnut; stir the peas frequently, and as they begin to thicken add from time to time a little water (half teacupful); when they have been on the fire about an hour add an onion, shredded very finely, half a teaspoonful of dried herbs, and half a teaspoonful of dried mint. Let all boil gently for two hours longer, add water as it thickens, and stir frequently to prevent burning, then rub through a coarse sieve, return the pulp to the saucepan with a quart of good stock; add salt and pepper to taste, let it boil five minutes and the soup is ready. This soup may be made with mutton broth, or the liquor in which beef has been boiled, if not too salt. Then the water may be omitted and the broth used instead. If the soup is required to be very thick, use one pound of peas instead of half a pound. This soup will require frequent stirring. Beans may be cooked in the same way.

Scotch Broth. Take a neck of mutton, and trim it as for cutlets, remove eight of the chops and put them aside on a dish. Put the remaining part of the neck into a three-quart saucepan with two quarts of cold water, with a little pepper and salt, and two onions, one with two cloves. When the water comes to the boil skim, add altogether half a pint of the following vegetables, made up of about equal quantities, carrots, turnips, leeks and onions, cut up into quarter inch dice. Simmer for three hours. Blanch two ounces of Scotch barley, and finish cooking it in water with a little butter and salt. Put the chops into another stewpan, with some of the broth or stock, and nicely cook them. Drain the barley and put it into the tureen with the chops. Remove the neck of mutton on to a dish, pour over it the broth, add a dessertspoonful of coarsely chopped parsley, previously blanched, and serve. Do not boil after adding the vegetables.

Mutton Broth. Take two pounds of scrag of mutton, and put it into a large basin, cover with cold water and a little salt to remove the blood, let it remain one hour. Then put it into a stewpan, with two quarts of water, with either one ounce of Scotch barley or rice or oatmeal according to taste, and one onion. Let it come to the boil slowly, skim, and add two or three turnips cut into quarters. Let the contents simmer for two hours. A little chopped parsley or petals of marigolds are sometimes added; season with salt, strain into the tureen and serve. For sick persons this broth should be prepared without any vegetable flavor, and should be carefully freed from fat. This broth should be prepared slowly, and not too strong with turnip.

Julienne Soup. Take carrots (three ounces), turnips (three ounces), onion (one ounce), leeks (one ounce), celery (half ounce)—shred in small strips about one and a quarter inch long, melt one ounce and a half of good butter in a stewpan, and add the shredded vegetables; fry to a nice brown color, add three pints and a half of stock, and leave it to boil at one corner of the fire. When the vegetables are cooked, skim, put in a few leaves of sorrel, and a sprig of chervil, chopped finely, add a little powdered loaf sugar, and serve in a soup tureen after having put in several crusts of bread cut up in small pieces. Wash and dry the vegetables before shredding.

Soup from Remnants of Joints. After all the meat available for a hash has been cut away from a leg of mutton, break the bones into pieces, the addition of a pound or two of fresh bones will be desirable, put them into a three-quart saucepan with two carrots and two turnips cut in quarters, and two whole onions and a *bouquet garni.* Nearly fill the saucepan with water, add three cloves, a full tablespoonful of whole pepper and allspice in equal parts, and salt to taste. Set the saucepan on the fire and let the contents simmer for four hours. Strain the broth, free it from fat, and use it as stock for any kind of thick soup. Pass through a hair sieve the carrots and one of the onions; melt an ounce of butter in a two-quart saucepan and stir in a tablespoonful of flour. When the two are well mixed add a little of the stock, then the carrot and onion pulp, and gradually the remainder of the stock, or so much as will produce a purée of the consistency of pea soup. Pour it boiling hot over small dice of toasted or fried bread. Take care that the soup is not too strongly flavored with the vegetables.

Chantilly Soup. Put into a two-quart stewpan one pint and a half of green peas, a small bunch of parsley, and a small bunch of mint with two finely shredded onions, (two and a half inches in diameter), and a small cucumber, peeled and cut into thin slices, add sufficient water to cover the vegetables, and boil with a teaspoonful of pounded loaf-sugar till they are soft enough to pass through a tammy sieve. Strain over a colander and make a purée of the vegetables. Stir the purée into three or four pints of stock, but do not boil after adding it or you will spoil the color of the soup. A proper mixture of the vegetables so as to agreeably blend the flavors, is requisite.

Soup Maigre. Melt slowly in a clean stewpan about one-half ounce of butter; when melted add two onions, a quarter of a head of celery, a small carrot and turnips, all coarsely shredded. Let these vegetables stew in the butter for fifteen or twenty minutes until they are nicely browned, and stir frequently with a wooden spoon to prevent burning. Add three pints of boiling water, and, if at the proper season, three-quarters of a pint of green peas and six white peppercorns. When the vegetables are quite tender let the soup stand for a few minutes to clear, then strain into another stewpan. Boil up and add an onion, half head of celery, a carrot and a turnip cut into fillets, or into wheels or into stars, with a vegetable cutter. When these vegetables are sufficiently cooked, the soup is ready. If necessary season with pepper and salt. Cleanliness, tender vegetables and good butter are essential. Stir occasionally to prevent burning.

Poor Man's Soup. Shred three ounces of onions and put them into a clean three-quart saucepan, with one ounce of butter or dripping or skimmings of saucepans, cook to a pale brown color, constantly stirring; now add one ounce of flour, and cook it for five minutes in the dripping, add three pints of boiling water and stir till it boils up, skim, add one pound of potatoes, shredded or cut into small slices, and boil till they are cooked, add pepper and salt and a dessertspoonful of chopped parsley, boil up, and pour into the tureen over half inch squares of bread. This soup can be made very nourishing by using oatmeal or peameal instead of flour. If too thick, add a little more water. A milk liaison is a valuable addition to this soup. See that the fat and onions do not burn, or get too dark a color.

Ox Tail Soup. Take two ox tails of average size, cut them up at the joints, obtain as nearly as possible pieces of the same bulk. Put them into cold water with a little salt, and let them remain two hours to remove the blood.

Drain them and dry them in a clean cloth; put them into a three-quart stewpan with two ounces of butter, and a few pieces of lean beef, and cook till nicely browned. add two quarts of stock, one onion with two cloves stuck in it, and a *bouquet garni.* Bring to the boil, and skim and simmer for three or four hours, till the tails are cooked. While the soup is simmering slice three young carrots, and cook them with fifteen, button onions in a little stock. Take the pieces of tail from the soup, remove the bones, and put the meat only into the tureen with the carrots and strain over the soup and serve. Careful cooking in the butter, and tender carrots are required.

Mulligatawny Soup. Take a small knuckle of veal, cut it up, break the bones, and put it into a stewpan with one half ounce of butter, a quarter of a pound of lean ham, a small carrot and turnip, two onions and four apples, all cut into quarters; add half a pint of water. Set the stewpan over a brisk fire, moving the meat frequently with a wooden spoon; let it remain until the bottom of the stewpan is covered with a brownish glaze, then add three tablespoonfuls of curry-powder, one of curry paste, and a quarter of a pound of flour; stir well in, and add four or five pints of water, a teaspoonful of salt, half a teaspoonful of sugar; when boiling place it at the corner of the fire, and let it simmer for two hours and a half, skimming off all the fat, then pass it through a tammy into a tureen. Trim some of the pieces of veal and put them back into the stewpan to boil up, and add them to the soup, and serve with plain boiled rice, on a separate dish. Ox-tails, or pieces of rabbit, or fowl, left from a previous dinner, may be served in it instead of veal, or the pieces of veal may be prepared separately, and the soup strained over them in the tureen. Have a good curry powder, and give constant attention until water is added.

Giblet Soup. Scald and pick very clean two sets of goose, or four of duck giblets, (the fresher the better), wash them well in two or three warm waters, cut off the beaks and split the heads, divide the gizzards and necks into mouthfuls. If the gizzards are not cut into pieces the rest of the meat will be done too much. Crack the bones of the legs, put them into a stewpan, cover them with cold water; when they boil take off the scum, then put in a bundle of herbs, such as lemon thyme, winter savory, or majoram, about three sprigs of each, and double the quantity of parsley. Twenty berries of allspice, the same of black pepper; tie these up in a muslin bag and stew very gently till the gizzards are tender. This will take from an hour and a half to two hours and a half, according to the size and age of the giblets Take them up with a skimmer, put them into the tureen, and cover down close to keep warm till the soup is ready. Melt an ounce of butter in a clean stewpan, stir in a dessertspoonful of flour; then pour to it by degrees, a gill or half a pint of the giblet liquor, add the remainder by degrees; let it boil about ten minutes, stirring it all the while; skim it and strain through a fine sieve into a basin; wash out the stewpan, then return the soup into it, and season it with a glass of wine, a little mushroom catsup, and a little salt; let it have one boil up, and then put the giblets in to get hot, and the soup is ready. Young giblets and freedom from scum are essential.

Vegetable Soup. Shred three good sized onions, fry them to a nice brown color in an ounce and a half of sweet dripping or butter, then put them into a saucepan with three pints of water. Cut into small slices one large or two small turnips, and the same of carrots, add them to the onions with a pinch of dried herbs, pepper and salt. Boil gently three hours without the lid, then thicken with a spoonful of flour or oatmeal; boil ten minutes longer, and serve with pulled bread. Young turnips and sweet dripping are necessary, and the onions carefully fried.

Potato Soup. Take two pounds of potatoes, after they are peeled, and cut them into thin slices, or shred them ; shred six ounces of onions. Take a three-quart saucepan and melt two ounces of butter or sweet beef dripping; put in the onions, let them cook five minutes in the butter, stir occasionally, then add the potatoes and three pints of water, or milk and water, or skim milk; when the potatoes and onions are thoroughly soft, strain through a horsehair sieve, return the liquor to the stewpan, and pass through the vegetables; stir the purée into the soup, season with pepper and salt. The addition of a milk or cream liaison is a great improvement. Do not blacken the onions; and frequently stir before making the purée.

Stewed Eels. Skin, and cut into pieces about two inches in length, two pounds of eels; wash in salt and water, and dry in a cloth. Take a three-pint stewpan, put into it one ounce and a half of butter, one onion shredded thinly; add a little flour, pepper and salt, an onion with two cloves, a bay-leaf or a bouquet garni, and a piece of lemon peel; add the pieces of eel and fry to a nice color, with constant stirring. Add a half pint or three gills of good stock. Stew gently till the eels are done. Take them out, arrange on a dish, strain over the sauce, and serve with toasted bread cut into triangles and arranged round the edge of the dish. The stew requires constant attention, and must only simmer.

Hotch-Potch. Grate rather coarsely two young carrots, and slice three carrots, three turnips, and three onions; shred one lettuce and a bunch of parsley, altogether say a quart. Take a pint of green peas when shelled, and the sprigs of a cauliflower. Put aside half the peas in a basin. Have ready, in a clean four-quart stewpan, three pints of mutton stock or broth. Put in all the vegetables except the peas put aside in the basin. Have ready cutlets as for Irish stew, and put them in the stewpan. Let the contents come slowly to a boil, then add two ounces of pearl barley or rice, previously blanched in a little water or stock, and simmer till the meat is ready. Skim and season with white pepper and a small teaspoonful of pounded loaf sugar. Boil the remaining peas separately, and add them just before serving. Hotch-potch should be thick. Young vegetables are very necessary in preparing a good hotch-potch.

Stewed Pigeons. Take three house pigeons, (they are the best), draw, pick, and singe them. Put the livers inside, and truss them with legs inside. If the pigeons are large you may divide them into halves. Take a quarter of a pound of streaky bacon, cut it into one and a half inch dice, and fry with an ounce of butter in a stewpan till of a light brown color. Put the pigeons in the stewpan and fry till they are of a light brown color. Then take out the bacon and pigeons and put them aside on a plate. Thicken the butter in the stewpan with flour; add a pint of stock with a few button mushrooms or ketchup. Season with pepper and salt, stir till it comes to the boil, and strain in a basin. Rinse out the stewpan with a little hot water, and put in the pigeons, breasts downwards, with the gravy and bacon and a bouquet garni; add ten button onions previously blanched and fried in a little butter to a nice brown color. Simmer about half an hour. Take out the pigeons, put them on a dish. Bring the sauce to a boil, skim, and strain the sauce over the pigeons, and garnish with the onions, bacon, and mushrooms. Instead of onions and mushrooms garnish with green peas or French beans. It will be necessary occasionally to move the pigeons in the stewpan, or they are liable to burn.

Stewed Fowls. Prepare and cut up at the joints a fowl or chicken. Take a six-pint stewpan, melt two ounces of butter, and fry in it for five minutes one ounce of sliced carrot, and one sliced onion, stirring with a wooden spoon. Put in the pieces of fowl, with a little pepper and salt; add two tablespoonfuls of flour, stirring so as to thoroughly mix with the butter. When mixed, add at intervals about a pint of good stock, and four ounces of picked tomatoes with the skins and seeds removed, and broken in pieces. Stir, and let it come slowly to the boil, then simmer. Now add six button mushrooms cut into slices and a tablespoonful of chopped parsley. Let it come to the boil, simmer for ten minutes, then skim, baste and serve. Fresh tomatoes and mushrooms are essential.

Stewed Rabbits. Cut up a young rabbit into small joints, and put them aside. Take a quarter of a pound of streaky bacon, and cut it into small slices. Melt in a clean stewpan one ounce and a half of butter, or sweet dripping; add the bacon, and when lightly fried add the pieces of rabbit, and fry to a nice brown, constantly stirring the whole with a wooden spoon. Now add a tablespoonful of flour, work it well, and add at short intervals a little water or stock, stirring all the time till the pieces are just covered, season with pepper and salt, and a small piece of lemon peel. Skim, then simmer slowly, and add a dozen button onions and six mushrooms, both previously blanched. When the rabbit is done, take it out, and arrange it on a dish. Boil the sauce, which should just coat the wooden spoon, skim, and pour it over the rabbit. The rabbit must be young, and see that it does not burn or boil. The flavoring should be delicate, and the sauce free from fat.

Stewed Breast of Veal. Cut off the neck, and remove the bone from a breast of veal, and stew them for stock. Stuff the thin part of the breast with some savory forcemeat. Secure the stuffing nicely by sewing or with skewers. Simmer for nearly two hours the veal in the stock made with the neck and bones. Take a pint of the stock for sauce, and thicken it with a little flour and a dozen oysters previously stewed, the beards removed, and cut up six button mushrooms, minced, and a dozen white peppercorns in a muslin bag. Strain the sauce hot over the veal, and garnish with slices of lemon and forcemeat balls. Cream, wine, truffles, ketchup, anchovy, are all occasionally put into this dish. The stock should be made some time and allowed to cool before putting in the veal.

Stewed Steak. Take two pounds of beefsteak, or better rumpsteak, an inch and a quarter or inch and a half in thickness, and not too fat. Beat it with the flat side of a chopper, or what is better a kreatone, which is an instrument invented by an English medical man to make steaks tender, and which may be used for such purposes with advantage. Cut the steak into convenient pieces, and fry them in two ounces of butter to a nice brown on each side. Cut into thin slices two onions and two young carrots, and cut into quarter-inch dice two young turnips, or cut them into shapes with a vegetable cutter, and fry these vegetables in the same butter. Put the meat and vegetables into a clean stewpan, with half a pint or three gills of water or stock, simmer slowly till the meat is tender. When half done, turn the meat on the other side. Skim, season with a little salt and pepper, add a little ketchup or six button mushrooms, or flavor the gravy with anything you prefer. Take out the meat, thicken the gravy with a little flour, let it come to the boil, skim, pour over the steak, and serve. Garnish with green peas or French beans. The steak must stew very slowly, be free from fat, and by all means be not too highly seasoned.

Minced Veal. Cut up with a sharp knife, into small slices, the remains of any cold veal; trim off all the fat, gristle and brown parts which have seen the fire. If you have no stock, prepare a little in the following manner: Take a clean stewpan, break up the bones, add the trimmings of the veal and any odd pieces in the larder, (a slice of ham is acceptable), cover with water, and season with pepper and salt, a bouquet garni, a blade of mace, and fifteen peppercorns, a slice or two of lemon peel (and a small sliced carrot and onion if the flavors are liked). Let these simmer for two or three hours. Strain into a basin, let the stock cool, and remove all the fat. Melt in a stewpan an ounce of butter, stir in a tablespoonful of flour, add the stock, boil, skim if necessary, and stand it aside to cool a little; then stir in the veal; let it gently simmer, just sufficient to warm the meat through. A spoonful of cream is an acceptable addition to the mince. Serve with toasted or fried sippets of bread. The careful preparation of the sauce is important, and the meat should be cut into pieces of uniform size.

Haricot Mutton. Haricot properly means French beans; it now means meat cut into chops, and stewed with vegetables. Divide three pounds of the best end of neck of mutton into chops; trim and shape them and remove the fat. Cut two onions into slices, cut three moderate-sized turnips and three carrots into fancy shapes with a vegetable cutter. Take a clean fryingpan and fry the cutlets lightly in butter over a brisk fire, but do not cook them. Fry the vegetables in the same butter for three or four minutes, but do not brown them or change their color. Put the cutlets into a stewpan, lay the vegetables on them, and cover with stock, and let the contents come slowly to the boil. Skim off all the fat, then put aside to simmer until the chops are tender; season with pepper and salt, and finish with a teaspoonful of mushroom or walnut ketchup, and mixed pickles finely minced. Dish the chops in a soup dish, pour over the gravy and vegetables, and serve. Freedom from fat and delicate flavoring are necessary.

Stewed Onions. Take half a dozen large onions, peel them, and cut off the tops and bottoms, but not so as to fall into pieces. Blanch them in two quarts of boiling water for twenty minutes, drain on a colander and take out the center of each onion and fill it with fine meat flavored with chopped parsley, eschalot, and button mushrooms, butter the onions, put them into a stewpan with white stock, and let them simmer over a slow fire, turn them over, and, when tender and covered with a glaze, they are ready. Be careful in the selection of the onions, and let them stew gently.

Stewed Lentils and Bacon. Soak for three hours in cold water half a pint of beans, put them into a saucepan with plenty of cold water, and let them boil for half an hour, then strain them over a colander. Return the beans to the saucepan, and cover with barley water, which is the water in which pearl barley has been boiled; add an onion with three cloves, and a *bouquet garni.* Scrape and trim a pound of bacon or salt pork, which will be all the better if previously blanched for a few minutes. Put it in the saucepan with the lentils, and simmer till the beans are thoroughly cooked: season with pepper and salt, and a little chopped parsley. Turn on a dish, and place the bacon on them, and serve. The bacon or pork should not be old or coarse; and add just sufficient water to cover.

Tripe and Onions. Tripe is usually purchased ready boiled, it should be thick, white and fresh; but it still requires cooking. Cut it into pieces about three inches by two inches, trim off the fat, wash it well in cold water, and dry it on a clean cloth. It may be whitened like veal, chicken or turbot, by rubbing over with lemon-juice. First blanch the tripe for five or ten minutes in water, then take some new milk, put it into a stewpan, and add the tripe. Simmer very gently for two or three hours, stir frequently with a wooden spoon to prevent the tripe sticking or burning at the bottom of the saucepan. Boil six or eight onions, and when done, chop them up, add to the tripe, and season with pepper and salt, and a small teaspoonful of pounded loaf-sugar. Two dessertspoonfuls of flour may be stirred into the milk to thicken it, a quarter of an hour before serving. Tripe may be boiled in plain water, and served with onion sauce and mustard, or it may be boiled in veal stock with fresh beef bones, or baked in milk and served with onion sauce, or, after it is boiled, it may be dipped in batter, and fried for five minutes in butter with finely minced eschalots to a golden-brown color. It is necessary that the tripe should be fresh and slowly simmered, with frequent attention.

Stewed Kidneys, Skin half a dozen kidneys, and remove all the fat. Cut them across into slices the thickness of a penny. Mince a small eschalot, two mushrooms, and a little thyme finely, and use double the quantity of minced parsley. Sprinkle the sliced kidneys with the mixture and a little salt and pepper, with just the smallest sprinkle of cayenne. Melt two ounces of butter in a clean stewpan, and fry the kidneys to a brown color, first on one side then the other. Thicken with a little flour, and finish with a gill or half a pint of hot stock or gravy, and a squeeze of lemon. Let it come to the boil, skim if necessary, and serve with sippets of fried bread. The kidneys are not to be opened but cut into slices across, and be careful not to fry them too much before adding the flour and stock.

Stewed Cheese. Cut into thin slices half a pound of good Gloucester or Cheddar cheese. Take a clean quart stewpan and put in the cheese with a little old ale or chablis, and stir over the fire till it is melted, beat up the yolks only of two eggs and a small teaspoonful of dry mustard and a very little cayenne; stir for two minutes over the fire, and serve very hot with toasted or fried sippets of bread. The top may be browned with a hot iron or salamander, or in front of a brisk fire. Sometimes the cheese is spread over toast and served. Do not let it burn, and if the cheese is not very rich add a little butter or salad oil; serve hot, and be careful with the cayenne.

Beef a la Mode. This is a very popular dish, and, if nicely prepared, is one which never fails to give satisfaction. Take five pounds of thick flank of beef, and two slices of fat bacon half an inch in thickness. Remove the rind and cut the bacon into strips of half an inch; this will give you pieces half an inch in section; sprinkle the strips of bacon with pepper; lard the beef in the direction of its grain, and tie it up. Place it in a stewpan, with three pints of stock, the rind of bacon, and two calf's feet, all previously blanched, and the feet boned. Proceed exactly as for the pot au feu, add a teaspoonful of salt, let it come gradually to the boil, and skim; then add four small carrots, one onion with three cloves stuck in it, a bouquet garni with a clove of garlic, and a little pepper. Close the stewpan tightly, and simmer slowly for four hours. When the beef is done take it out, with the calf's feet and carrots, and put aside to keep hot. Remove all the fat and strain the liquor through a pointed strainer into another stewpan, reduce it over a brisk fire for half an hour. Remove the string, place the beef on a dish, and garnish with carrots and calf's feet. Pour over the reduced liquor, and serve. If required cold, put it into a basin, or earthenware mould, with the calf's feet, vegetables, and liquor, which will gelatinize into a solid mass. When cold it can be turned on to a dish. The gravy should be thick and gelatinous, and cooking very slowly is necessary.

Vegetables. All vegetables intended for boiling should be well washed, but not soaked, in water; a little vinegar in the water will be more effecual in removing insects than salt. Green vegetables should have plenty of room, and be plunged into boiling water with a small teaspoonful of pounded loaf sugar. The saucepan should be uncovered and the contents occasionally skimmed, and the vegetables should not remain in the water an instant after they are cooked. We do not attach sufficient importance to vegetables; they may be prepared in different ways, and eaten as separate dishes. In many countries they form quite a distinct part of the dinner. It is sometimes said that plain boiled vegetables are the best; but this would also apply to plain boiled meat and fish. Carefully cooked vegetables are more wholesome and digestible. Very few vegetables can be eaten with safety without cooking, and if some of the following recipes are rather more expensive they may often economically replace meat, which is the most costly thing on a table.

Potatoes, Plain Boiled. To boil potatoes properly they should all be of the same sort, and as nearly as possible of the same size. Wash off the dirt, and scrub them very clean with a hard brush, but neither scoop nor apply a knife to them in any way, even to clear the eyes. Rinse them well and arrange them compactly in a saucepan so that they may not lie loose in the water, and that a small quantity may be sufficient to cover them. Pour the water in cold and when it boils throw in one large teaspoonful of salt to each quart of water, and simmer the potatoes till they are nearly done, but for the last two or three minutes let them boil rapidly. When they are tender quite through, which may be known by probing them with a fork, pour all the water from them immediately, lift the lid of the saucepan to allow the steam to escape, and place them by the side of the fire till the moisture has entirely evaporated, then peel and send them to table as quickly as possible, either in a hot napkin or in a dish in which the cover is so placed that the steam may pass off. There should be no delay in serving after they have been once taken from the fire. Irish families always prefer them served in their skins. Some kinds will be sufficiently boiled in twenty minutes, others in not less than half an hour. Pour away the water as soon as the potatoes are cooked, and dry them.

Mashed Potatoes. Boil or steam the potatoes half an hour, turn them into a basin, and with a wooden spoon bruise them into flour, to three pounds of potatoes add a teaspoonful of salt, three ounces of fresh butter, and a gill of cream or hot milk. Stand the basin in a saucepan of boiling water and beat the potatoes for five minutes. Serve on a very hot dish, either in a rough cone-shape or smoothed over with a knife. The potatoes should be well mixed with the butter and cream.

Potatoes with Milk. Have ready some boiled potatoes, and when nearly cold, cut them into slices and cover them with a clean cloth. Take a stewpan and melt three ounces of butter with two ounces of flour, stir with a wooden spoon, and add gradually a gill of warm milk; season with pepper and salt and a litttle grated nutmeg. When the sauce comes to the boil put in the sliced potatoes, and let them gently boil for about fifteen minutes, then stand the stewpan aside. Mix the yolks of two eggs with a gill of cream and pour into the stewpan, stirring until it becomes thick. Turn it on to a hot dish and serve. Take care to prepare the sauce carefully.

Potatoes and Spinach. Boil a pound of potatoes and mash them. Have ready the same quantity of boiled spinach, chop it up, and thoroughly mix with the potatoes; add salt, pepper, a little grated nutmeg, and three ounces of sweet butter. Work the whole together, put it into a pie-dish and bake. When the top is of a nice brown color, it is ready. The ingredients should be well mixed before baking.

Potatoes and Bacon. Take half a pound of bacon, scrape it and cut it into half-inch dice. Put the pieces into a stewpan with three ounces of sweet dripping or butter; let the bacon brown lightly. Then add a tablespoonful of flour, and when thoroughly mixed add a pint of hot water, or, better, stock, and a bouquet garni, with a clove of garlic. Cover the stewpan and let the contents come to the boil. Wash and peel about a pound of good potatoes, (the kidney variety is the best), slice them in pieces about a quarter of an inch in thickness. Cover the stewpan and let the potatoes boil till they are cooked. Take out the seasoning and serve. Good potatoes and careful preparation of the sauce is essential.

Potato Soufflé. Boil six large potatoes and mash them with three ounces of sweet butter, a little pepper and salt, and four ounces of grated cheese, (half Parmesan and half Gruyere is the best mixture), add the yolks of four eggs and the whites, previously whisked to a rather stiff paste. Mix these thoroughly and put into a pie-dish and bake. When the top is nicely browned in the oven it is ready. The ingredients should be thoroughly mixed before baking and the whites well whisked before mixing.

Fried Potato Chips. Peel six large potatoes, and cut them in slices each an eighth of an inch in thickness; wash and dry them in a cloth. Melt your frying fat over a brisk fire, and when the temperature rises to 385° throw the potatoes in; stir with the skimmer occasionally to secure an even cooking; eight or ten minutes' frying will be sufficient. Drain them on a wire sieve, sprinkle with salt, and serve. When potatoes are required very crisp, let them fry three or four minutes longer. Do not put in too many potato chips or the fat will fall too low for frying. A slight increase of temperature while the potatoes are frying is desirable.

Fried Potatoes and Onions. The remains of cold potatoes may be used thus: Put two ounces of butter and one of oil in a frying pan, in which fry three sliced onions; put on the potatoes, cut in thin slices each about the thickness of half a crown, and toss them now and then until they have a nice yellow color; add a spoonful of chopped parsley, salt, pepper, and the juice of a lemon. Shake the pan well that they may mix thoroughly together, dish, and serve very hot. An excellent dish to serve with a chop, a steak, or a joint. A clean fryingpan and good oil are essential.

Potato Croquets. Cold mashed potatoes may be used up as croquets. Stir an egg or two into your potatoes, add a little spice, pepper and salt to taste, and some minced parsley; mix well, and roll the mixture into balls, or in the shape of corks; cover with egg and bread-crumbs, and fry to a nice golden color in hot fat, and garnish with fried parsley. Careful frying of the croquets to a nice color is essential.

Cauliflowers. Wash the cauliflower thoroughly clean, and remove the coarse outer leaves, split the stalk into four by cutting it across, but not deep enough to separate the flower. Plunge the flower downward into plenty of boiling water with a teaspoonful of sugar and salt; keep the saucepan lid off, and skim; when it is cooked, (which will be in about ten or fifteen minutes), remove the cauliflower carefully with a slice, and drain on a sieve. Plenty of boiling water and plenty of room are essential.

Spinach. Pick and wash perfectly clean two or three pounds of spinach; put it into a saucepan with a very little water, and let it boil till quite done. Turn the spinach on to a colander to drain, squeeze the water out between two plates, and pass the spinach through a sieve. Put two ounces of butter into another saucepan, fry the butter a light brown, add a small teaspoonful of flour, mix well, and then put in the spinach with pepper and salt to taste, and a little milk The spinach should only remain in the second saucepan long enough to thoroughly mix with the butter and seasoning.

Cabbage. Wash and trim off the outer leaves of a cabbage, divide it, or split the stalk into four, throw the cabbage stalk upward into boiling water, with a teaspoonful of pounded loaf sugar or salt. When cooked well, drain it on a colander and serve, if preferred, with a white sauce. The cabbage should be young and have plenty of room in the saucepan.

Asparagus. Scrape the sticks of the asparagus, wash them, and cut them into equal lengths. Divide the sticks into bundles of ten or twelve, tie them together, and put them into plenty of salted boiling water and a tablespoonful of vinegar. Take care not to over-cook—about fifteen or twenty minutes will be sufficient — or the heads, which are the most delicate part, will break off in the saucepan. When sufficiently cooked, remove them carefully and serve on buttered toast. Care is necessary to prevent the heads breaking off.

Carrots. Scrape clean and wipe, but not wash, fifteen or twenty small young carrots. Put them in a stewpan with three ounces of butter, cover the stewpan, and from time to time give it a shake. After fifteen minutes add a little pepper and salt, and some finely minced parsley or chives, or eschalots. Put on the lid, occasionally shake till the carrots are tender. Old carrots should be previously well blanched, and cut into slices and finished cooking in the sauce. If the carrots are not young they should be nearly cooked before adding to the sauce.

Carrots with Ham or Bacon. Melt in a stewpan three ounces of butter, and mix with it one ounce of flour; stir for five minutes. Now add a gill of boiling stock or water, stirring with a wooden spoon. Add half a pound of ham or bacon, cut into half-inch dice, with a little pepper, (and, perhaps, a little salt, but this will depend on the saltness of the ham or bacon), a bouquet garni, with a clove of garlic, or a large onion instead of the garlic. Cut into slices, about the thickness of a penny, six large carrots and put them in the stewpan. Let the contents boil till the carrots are tender. Remove the onion and bouquet garni and serve. Constant attention is necessary after adding the sliced carrots.

Colcannon. Boil potatoes and greens or spinach separately; mash the potatoes; squeeze the greens dry; chop them quite fine, and mix altogether in a basin, with a little butter, pepper, and salt; put the whole into a mould, previously well buttered with a brush. Let it stand in a hot oven for ten minutes and then turn out. Let the vegetables be firm and the mould properly buttered, or the colcannon breaks on turning out.

Green Peas. Tie into a small bunch a small head of lettuce and one or two onions, and throw them with the peas into plenty of boiling water, with some salt, and a little pounded loaf-sugar. When cooked strain off all the water and remove the bunch. Mix with about an ounce of butter a small quantity of finely minced mint, previously blanched, put this in a dish and turn the peas over it. The peas should be young, quickly boiled, and not shelled before wanted.

String Beans, Plain. Take fresh beans, remove the strings and stalks, and, if they are old, split them. Turn them into a saucepan with plenty of boiling water and a teapoonful of sugar and salt to each quart, boil them till they are tender, which can be ascertained by trying them. When this vegetable is too old, no cooking will ever make it good. In boiling green vegetables the color can only be retained by quick boiling in plenty of water in an uncovered saucepan.

Diet for the Sick Room. In no branch of domestic economy is it more desirable or important to know how to prepare tempting dishes than in that pertaining to such light, nourishing foods as are commonly allotted to the sick. To this end rules, for the proper preparation of articles of diet for the sick, are given below. The capricious appetites, often the attendant of sickness, will tax the ingenuity and resources alike of nurses and cooks; hence the necessity for plain, simple modes of serving dainty dishes for the sick room.

Arrow Root Custard. Dry Bermuda arrow root, two drachms or two teaspoonfuls; sugar, one drachm or one teaspoonful. Mix by rubbing or careful stirring with a little cold milk until all lumps are broken, and it forms a perfect mixture a little thicker than heavy cream. Boil half a pint of milk or water, and as soon as it comes to a boil pour it over the paste, stirring until it thickens. If any flavor is desired add it just before pouring on the boiling milk.

Oat Meal Gruel. Oat meal, of medium fineness, four drachms or a tablespoonful; salt to season to the taste. Mix with enough milk to form a paste and stir well, then add half a pint of milk and heat to a boil, maintaining this temperature five or six minutes while constantly stirring. Remove from the fire and add an even teaspoonful of sugar and a piece of butter as large as a cherry. Mix thoroughly.

Restorative Jelly. Russian isinglass, one ounce; gum arabic, two drachms; sugar, two ounces; cassia buds, broken, ten ounces; lemon juice, one drachm; pure port wine, half a pint. Mix altogether and let them stand in a glass or porcelain vessel about two hours, then place the dish in a vessel of warm water, heat gently and stir until the isinglass and gum are dissolved, and finally bring the water to a boil a few minutes; then remove and strain the jelly into shallow moulds. A small slice of this jelly placed in the mouth of an unconscious or helpless invalid will gradually dissolve and pass into the stomach without effort of the patient.

Beef Tea, quickly made. Put any desired quantity of thoroughly lean beef, cut across the grain and into small pieces, in a dry saucepan and allow it to rest over a slow fire for a few minutes, stirring to keep it from sticking to the pan; when of a whitish color pour on its own weight (pint for pound) of cold water and bring it to the boil, let it gently simmer ten minutes and strain under ordinary pressure into a shallow dish; if any fat appears on the surface remove it with white filter or blotting paper. This makes a strong and excellent beef tea.

Toast Water. Take one slice stale bread, half inch thick and four by four inches in length and breadth, thoroughly toasted without scorching, put while hot into half pint boiling water, cover tightly and allow to cool, and then strain. This is quite refreshing to invalids unable to use stronger food.

Panada. Take two slices stale bread one-half inch thick, toast well without scorching, cut into small squares, put into a bowl, sprinkle a little salt over them and pour on a pint of boiling water, and grate in a little nutmeg.

Sago Jelly. Sago, four tablespoonfuls; juice or rind of one lemon; sugar, to suit the taste, perhaps two ounces; water, one quart. Mix and let them stand an hour, then boil, stirring frequently, until all is dissolved, and add one ounce of port wine. Mix, and allow to cool.

Castillon's Powder. Powdered tragacanth, powdered sago, powdered salep, and sugar, each one ounce; prepared carbonate lime, two drachms. Mix thoroughly and make into powders containing one drachm; for use, put one powder in four tablespoonfuls of cold milk, put into a pan and stir well, and add slowly one pint of boiling milk, and boil for fifteen minutes and add sugar to the taste.

Fluid Extract of Coffee. A good article may be prepared on a small scale as follows: Light brown coffee, roasted, five ounces; dark brown, five ounces; alcohol, three ounces; cold water, twelve ounces; hot water, sufficient. Grind the two kinds of coffee together, and macerate them for two days in a closed percolator with the alcohol and the cold water. Then add enough hot water to obtain fifteen ounces of percolate. Set this aside, and continue the percolation till ten ounces more have passed through. Evaporate this down to five ounces, filter, and add to the reserved liquor. Dose, two or three teaspoonsful to a cup of hot water.

Dried Meat for Medicinal Purposes is prepared by cutting fresh meat finely, spreading upon muslin, drying rapidly in a current of air, and rubbing into a brown powder, which is almost inodorous, and has a slightly saline taste. It is readily taken by patients, spread upon bread or a teaspoonful of it mixed with a cupful of broth or soup, or by children if baked into biscuits.

Ice Cream and Beef Juice. The following is an excellent dietary article: Cream, 120 grams; sugar, thirty grams; extract of vanilla, 8 grams; beef juice, eight grams. Any confectioner can make it, or it may readily be prepared at home with a freezer.

DIGESTION OF VARIOUS FOODS.

	Average Time.			
Apples, sweet	1	hours,	30	minutes.
“ sour	2	“	00	“
Beans, pod, boiled	2	“	30	“
Beef, fresh, rare, roasted	3	“	00	“
“ “ dried	3	“	30	“
“ “ fried	4	“	00	“
Beets, boiled	3	“	45	“
Bread, wheat, fresh	3	“	30	“
“ corn	3	“	15	“
Butter (melted)	3	“	30	“
Cabbage, with vinegar, raw	2	“	00	“
“ boiled	4	“	30	“
Cheese (old, strong)	3	“	30	“
Codfish	2	“	00	“
Custard (baked)	2	“	45	“
Ducks (domestic), roasted	4	“	00	“
“ (wild), “	4	“	30	“
Eggs, fresh, hard boiled	3	“	30	“
“ “ soft “	3	“	00	“
“ “ fried	3	“	30	“
Goose, roast	2	“	00	“
Lamb, fresh, boiled	2	“	30	“
Liver, beef, boiled	2	“	00	“
Milk, boiled	2	“	00	“
“ raw	2	“	15	“
Parsnips, boiled	2	“	30	“
Mutton, roast	3	“	15	“
“ broiled	3	“	00	“
“ boiled	3	“	00	“
Oysters, raw	2	“	55	“
“ roast	3	“	15	“
“ stewed	3	“	30	“
Pork (fat and lean), roast	5	hours,	15	minutes
“ “ “ boiled	3	“	15	“
“ “ “ raw	3	“	00	“
Potatoes, boiled	3	“	30	“
“ baked	2	“	30	“
Rice, boiled	1	“	00	“
Sago. “	1	“	45	“
Salmon (salted), boiled	4	“	00	“
Soup (beef, vegetable)	4	“	00	“
“ (chicken), boiled	3	“	00	“
“ (oyster), “	3	“	30	“
Tapioca, boiled	2	“	00	“
Tripe (soused), boiled	1	“	00	“
Trout, fresh, boiled or fried	1	“	30	“
Turkey (domestic), roast	2	“	00	“
“ (wild) “	2	“	18	“
Turnips (boiled)	3	“	30	“
Veal, fresh, broiled	4	“	00	“
“ “ fried	4	“	30	“
Venison steak, broiled	1	“	35	“

DISINFECTANTS.

In addition to what may be found, in the body of this work, upon disinfection in connection with the diseases of animals, the following will be found valuable: The value of chloride of lime and sulphuric acid, which form the most effectual disinfecting material, is here expressed by 100, while the remaining numbers show the value of the other materials as compared with this standard:

Chloride of Lime with Sulphuric Acid	100-0
Chloride of Lime with Sulphate of Iron	99-0
Carbolic Acid—disinfecting Powder	85-6
Slaked Lime	84-6
Alum	80-4
Sulphate of Iron	76-7
Chloralum	74-0
Sulphate Magnesia	57-1
Permanganate of Potash with Sulphuric Acid	51-3

Dry Earth. Makes an excellent disinfectant of privy vaults, cesspools and sinks.

To Disinfect Clothing. Subject it to dry heat, as great as it will bear without injury to the texture.

Condie's Disinfectant. Crude permanganate of potash half ounce; water half pint. Put a few teaspoonfuls in the room to be disinfected and renew as often as the solution loses its color. For purifying foul water a teaspoonful to the barrel is sufficient to sweeten, and if added until a faint tinge of color shows in the water, all injurious organic matter will be destroyed. If the water is for drinking put in a little coffee or tea, a teaspoonful, and the tinge will disappear leaving the water pure and wholesome.

For Privy Vaults or Cess Pools—having a rotten egg smell, sulphuretted hydrogen, use copperas in coarse powder. One or two pounds to an ordinary vault will be ample, as a general rule, to remove all unpleasant odor. Where the odor of carbolic acid or chloride of lime is not objectionable, they will prove valuable disinfectants, especially for drains, etc.

To Ascertain Whether the Air of a Sick Room is Pure or Not. Dampen a piece of white linen or muslin in a solution of nitrate of lead. If impure the cloth will darken, otherwise remain white.

FOOD, in Relation to Hunger and Thirst.

Food consists of substances taken into the stomach for the purpose of digestion, or of conversion into blood. Food is rendered necessary by the waste of the system. Food is the primary source of nervous and muscular power. Food which supplies calorific power is termed heat-forming, respiratory, carbonaceous, or fuel food, and consists of starchy, saccharine, or oleaginous bodies which contain a preponderance of carbon, or of carbon and hydrogen. Food which supplies dynamical (mechanical and mental power) is termed histogenetic (tissue-forming), nitrogenous, azotized, proteinous, or albuminous; and consists of substances which are comparatively rich in nitrogen, as milk, eggs, flesh, cheese, peas, beans, and other bodies containing fibrin, albumen, caseine, or gluten. A small portion of the respiratory food also probably contributes to the formation of the tissues; and likewise a portion of histogenetic or albuminous food to the development of the animal heat The student and the hard-laboring professional man require even more tissue-forming food than the ordinary physical laborer. A due supply of animal food is necessary to the development of a high civilization; that is, to the development of races who are capable of sustained muscular and mental labor. Alcohol, either strong or dilute, can not possess any histogenetic power from its deficiency of nitrogen; and, as far as the results of modern experiments can show, is neither oxidized nor burnt in the system, and therefore is probably neither a heat-former nor a flesh-former. It is consequently deficient in true food power, or, in other words, can neither nourish the body nor develop heat. A due mixture of heat-forming and flesh-forming food is most beneficial, economizing both food and digestive (vital or nervous) power. An excess of animal food is much more injurious than a corresponding excess of vegetable food. Cooking renders food more savory, wholesome, and digestible, and destroys the parasitic animals which might otherwise excite serious if not fatal disease; it saves food, and enables the same amount of digestive (vital) power to do more effective work, and diminishes the quantity which would otherwise pass away undigested. Any system of instruction in cooking which does not include some knowledge of the chemistry and physiology of food must be defective. What is food? how is it converted into blood? how does the blood circulate? and how is the body nourished and kept in health? are questions of the greatest importance in their relation to public health and morality, and should be generally taught in our schools. The following may be taken as correct as to the qualities of human food mentioned, and their characteristics when introduced into the stomach. Beef. When it is the flesh of a bullock of middle age, it affords good and strong nourishment, and is peculiarly well adapted to those who labor, or take much exercise. It will often sit easy upon stomachs that can digest no other kind of food; and its fat is almost as easily digested as that of veal. Veal is a proper food for persons recovering from indisposition, and may even be given to febrile patients in a very weak state, but it affords less nourishment than the flesh of the same animal in a state of maturity. The fat of it is lighter than that of any other animal, and shows the least disposition to putrescency. Veal is a very suitable food in costive habits; but of all meat it is the least calculated for removing acidity from the stomach. Mutton, from the age of four to six years, and fed on dry pasture, is an excellent meat. It is of a middle kind between the firmness of beef and the tenderness of veal. The lean part of mutton, however, is the most nourishing and conducive to health, the fat being hard of digestion. The head of the sheep, especially when divested of the skin, is very tender; and the feet, on account of the jelly they contain, are highly nutritive. Lamb is not so nourishing as mutton; but it is light, and extremely suitable to delicate stomachs. House lamb, though much esteemed by many, possesses the bad qualities common to the flesh of all animals reared in an unnatural manner. Pork affords rich and substantial nourishment; and its juices are wholesome when properly fed, and when the animal enjoys pure air and exercise. But the flesh of hogs reared in towns is both hard of digestion and unwholesome. Pork is particularly improper for those who are liable to any foulness of the skin. It is almost proverbial, that a dram is good for promoting its digestion; but this is an erroneous notion, for though a dram may give a momentary stimulus to the coats of the stomach, it tends to harden the flesh, and of course to make it more indigestible. Smoked hams are a strong meat, and rather fit for a relish than a diet. It is the quality of all salted meat that the fibers become rigid; and therefore more difficult of digestion; and when to this is added smoking, the heat of the chimney occasions the salt to concentrate, and the fat between the muscles sometimes to become rancid. Bacon is also of an indigestible quality, and is apt to turn rancid on weak stomachs; but for those in health it is an excellent food, especially when used with fowl or veal, and even eaten with peas, cabbages, or cauliflowers. Goat's flesh is hard and indigestible; but that of kids is tender as well as delicious, and affords good nourishment. Venison, or the flesh of deer, and that of hares, is of a nourishing quality, but it is liable to the inconvenience, that, though much disposed to putrescency of itself, it must be kept for a little time before it becomes tender. The blood of animals is used as an aliment by the common people, but they could not long subsist upon it unless mixed with oatmeal, etc., for it is not very soluble, alone, by the digestive powers of the human stomach, and therefore can not prove nourishing. Milk is of very different consistence in different animals; but that of cows being the kind used in diet, is at present the object of our attention. Milk, where it agrees with the stomach, affords excellent nourishment for those who are weak and can not digest other aliments. It does not readily become putrid, but it is apt to become sour on the stomach, and thence to produce flatulence, heart-burn, or gripes, and in some constitutions a looseness. The best milk is from a cow at three or four years of age, about two months after producing a calf. It is lighter, but more watery than the milk of sheep and goats; while, on the other hand, it is more thick and heavy than the milk of asses and mares, which are next in consistence to human milk. On account of the acid which is generated after digestion, milk coagulates in all stomachs; but the caseous or cheesy part is again dissolved by the digestive juices, and rendered fit for the purposes of nutrition. It is improper to eat acid substances with milk, as these would tend to prevent the due digestion of it. Cream is very nourishing, but, on account of its fatness, is difficult to be digested in weak stomachs. Violent exercise, after eating it, will, in a little while, convert it into butter. Butter. Some writers inveigh against the use of butter as universally pernicious; but they might with equal reason condemn all vegetable oils, which form a considerable part of diet in the southern climates, and seem to have been beneficially intended by nature for that purpose. Butter, like every other oily substance, has doubtless a relaxing quality, and if retained long in the stomach is liable to become rancid; but, if eaten in moderation, it will not produce those effects. It is, however, improper in bilious constitutions. The worst consequence produced by butter, when eaten with bread, is that it obstructs the discharge of the saliva in the act of mastication or chewing, by which means the food is not so easily digested. To obviate this effect, it would be a commendable practice at breakfast, first to eat some dry bread, and chew it well, till the salivary glands were exhausted, and afterwards to eat it with butter. By these means such a quantity of saliva might be carried into the stomach as would be sufficient for the purpose of digestion. Cheese is likewise reprobated by many as extremely unwholesome. It is doubtless not easy of digestion; and when eaten in a great quantity, may overload the stomach; but if eaten sparingly, its tenacity may be dissolved by the digestive juices, and it may yield a wholesome, though not very nourishing, chyle. Toasted cheese is agreeable to most palates, but it is rendered more indigestible by that process. The flesh of birds differs in quality according to the food on which they live. Such as feed upon grain and berries, afford, in general, good nourishment; if we except geese and ducks, which are hard of digestion, especially the former. A young hen or chicken is a tender, delicate food, and extremely well adapted where the digestive powers are weak. But of all tame fowls, the capon is the most nutritious. Turkeys, as well as guinea or India fowls, afford a substantial nutriment, but are not so easy of digestion as the common domestic fowls. In all birds those parts are the most firm, which are most exercised; in the small birds, therefore, the wings, and in the larger kinds, the legs, are commonly the most difficult of digestion. The flesh of wild birds, in general, though more easily digested, is less nourishing than that of quadrupeds, as being more dry on account of their almost constant exercise. Those birds are not wholesome which subsist upon worms, insects and fishes. The eggs of birds are a simple and wholesome aliment. Those of the turkey are superior in all the qualifications of food. The white of eggs is dissolved in a warm temperature, but by much heat it is rendered tough and hard. The yolk contains much oil, and is highly nourishing, but has a strong tendency to putrefaction; on which account, eggs are improper for people of weak stomachs, especially when they are not quite fresh. Eggs boiled hard or fried are difficult of digestion, and are rendered still more indigestible by the addition of butter. All eggs require a sufficient quantity of salt, to promote their solution in the stomach. Fish, though some of them be light and easy of digestion, afford less nourishment than vegetables, or the flesh of quadrupeds, and are, of all the animal tribes, the most disposed to putrefaction. Salt water fish are, in general, the best; but when salted, though less disposed to putrescency, they become more difficult of digestion. Whitings and flounders are the most easily digested. Acid sauces, and pickles, by resisting putrefaction, are a proper addition to fish, both as they retard putrescency, and correct the relaxing tendency of butter, so generally used with this kind of aliment. Oysters and cockles are eaten both raw and dressed; but in the former state they are preferable, because heat dissipates considerably their nutritious parts as well as the salt water, which promotes their digestion in the stomach; if not eaten very sparingly, they generally prove laxative. Muscles and periwinkles are far inferior to oysters, both in point of digestion and nutriment. Sea muscles are by some supposed to be of a poisonous nature; but though this opinion is not much countenanced by experience, the safest way is to eat them with vinegar, or some other vegetable acid. Bread. At the head of the vegetable class stands bread, that article of diet which, from general use, has received the name of the staff of life. Wheat is the grain chiefly used for the purpose in this country, and is among the most nutritive of all the farinaceous kinds, as it contains a great deal of starch. Bread is very properly eaten with animal food, to correct the disposition to putrescency; but is most expedient with such articles of diet as contain much nourishment in a small bulk, because it then serves to give the stomach a proper degree of expansion. But as it produces a slimy chyle, and disposes to costiveness, it ought not to be eaten in a large quantity. To render bread easy of digestion, it ought to be well fermented and baked, and it never should be used till it has stood twenty-four hours after being taken out of the oven, otherwise it is apt to occasion various complaints in those who have weak stomachs; such as flatulence, heartburn, watchfulness, and the like. The custom of eating butter with bread, hot from the oven, is compatible only with very strong digestive powers. Pastry, especially when hot, has all the disadvantages of hot bread and butter, and even buttered toast, though the bread be stale, is scarcely inferior in its effects on a weak stomach. Dry toast, with butter, is by far the wholesomest breakfast. Brown wheaten bread, in which there is a good deal of rye, though not so nourishing as that made of fine flour, is both palatable and wholesome, but apt to become sour on weak stomachs. Oats, barley, and rice.—Oats, when deprived of the husk, and particularly barley, when properly prepared, are each of them softening, and afford wholesome and cooling nourishment. Rice likewise contains a nutritious mucilage, and is less used in Great Britain than it deserves, both on account of its wholesomeness and economical utility. The notion of its being hurtful to the sight is a vulgar error. In some constitutions it tends to induce costiveness; but this seems to be owing chiefly to flatulence, and may be corrected by the addition of some spice, such as caraways, aniseed, and the like. Potatoes are an agreeable and wholesome food, and yield nearly as much nourishment as any of the roots used in diet. The farinaceous or mealy kind is in general the most easy of digestion, and they are much improved by being toasted or baked. They ought almost always to be eaten with meat, and never without salt. The salt should be boiled with them. Green peas and beans, boiled in their fresh state, are both agreeable to the taste and wholesome, being neither so flatulent, nor so difficult of digestion, as in their ripe state; in which they resemble the other leguminous vegetables. French beans possess much the same qualities; but yield a more watery juice, and have a greater disposition to produce flatulence. They ought to be eaten with some spice. Salads, being eaten raw, require good digestive powers, especially those of the cooling kind; and the addition of oil and vinegar, though qualified with mustard, hardly renders the free use of them consistent with a weak stomach. Spinach affords a soft lubricating aliment, but contains little nourishment. In weak stomachs it is apt to produce acidity, and frequently a looseness. To obviate these effects, it ought always to be well beaten, and but little butter mixed with it. Asparagus is a nourishing article in diet, and promotes the secretion of urine; but in common with the vegetable class, disposes a little to flatulence. Artichokes resemble asparagus in their qualities, but seem to be more nutritive, and less diuretic. Cabbages are some of the most conspicuous plants in the garden. They do not afford much nourishment, but are an agreeable addition to animal food, and not quite so flatulent as the common greens. They are likewise diuretic, and somewhat laxative. Cabbage has a stronger tendency to putrefaction than most other vegetable substances; and, during its putrefying state, sends forth an offensive smell, much resembling that of putrefying animal bodies. So far, however, from promoting a putrid disposition in the human body, it is on the contrary, a wholesome aliment in the true putrid scurvy. Turnips are a nutritious article of vegetable food, but not very easy of digestion, and are flatulent. This effect is in a good measure obviated, by pressing the water out of them before they are eaten. Carrots contain a considerable quantity of nutritious juice, but are among the most flatulent of vegetable productions. Parsnips are more nourishing and less flatulent than carrots, which they also exceed in the sweetness of their mucilage. By boiling them in two different waters, they are rendered less flatulent, but their other qualities are thereby diminished in proportion. Parsley is of a stimulating and aromatic nature, well calculated to make agreeable sauces. It is also a gentle diuretic, but preferable in all its qualities when boiled. Celery affords a root both wholesome and fragrant, but is difficult of digestion in its raw state. It gives an agreeable taste to soups, as well as renders them diuretic. Onions, garlic, and shallots are all of a stimulating nature, by which they assist digestion, dissolve slimy humors, and expel flatulency. They are, however, most suitable to persons of a cold and phlegmatic constitution. Radishes of all kinds, particularly the horse radish, agree with the three preceding articles in powerfully dissolving slimy humors. They excite the discharge of air lodged in the intestines. Apples are a wholesome vegetable aliment, and in many cases medicinal, particularly in diseases of the breast and complaints arising from phlegm. But, in general, they agree best with the stomach when eaten either roasted or boiled. The more aromatic kinds of apples are the fittest for eating raw. Pears resemble much in their effects the sweet kinds of apples, but have more of a laxative quality, and a greater tendency to flatulence. Cherries are in general a wholesome fruit, when they agree with the stomach, and they are beneficial in many diseases, especially those of the putrid kind. Plums are nourishing, and have, besides, an attenuating as well as a laxative, quality, but are apt to produce flatulence. If eaten fresh, and before they are ripe, especially in large quantities, they occasion colics, and other complaints of the bowels. Peaches are not of a very nourishing quality, but they abound in juice, and are serviceable in bilious complaints. Apricots are more pulpy than peaches, but are apt to ferment, and produce acidities in weak stomachs. Where they do not disagree they are cooling, and tend likewise to correct a disposition to putrescency. Gooseberries and currants, when ripe, are similar in their qualities to cherries, and when used in a green state, they are agreeably cooling. Strawberries are an agreeable, cooling aliment, and are accounted good in cases of gravel. Cucumbers are cooling, and agreeable to the palate in hot weather; but to prevent them from proving hurtful to the stomach, the juice ought to be squeezed out after they are sliced, and vinegar, pepper, and salt, afterward added. Tea, by some, is condemned in terms the most vehement and unqualified, while others have either asserted its innocence; or gone so far as to ascribe to it salubrious, and even extraordinary virtues. The truth seems to lie between these two extremes; there is, however, an essential difference in the effects of green tea and of black, or of bohea; the former of which is much more apt to affect the nerves of the stomach than the latter, more especially when drank without cream, and likewise without bread and butter. That, taken in a large quantity, or at a later hour than usual, tea often produces watchfulness, is a point that can not be denied; but if used in moderation, and accompanied with the additions just now mentioned, it does not sensibly discover any hurtful effects, but greatly relieves an oppression of the stomach, and abates a pain of the head. It ought always to be made of a moderate degree of strength: for if too weak it certainly relaxes the stomach. As it has an astringent taste, which seems not very consistent with a relaxing power, there is ground for ascribing this effect not so much to the herb itself as to the hot water, which not being impregnated with a sufficient quantity of tea, to correct its own emollient tendency, produces a relaxation, unjustly imputed to some noxious quality of the plant. But tea, like every other commodity, is liable to damage, and when this happens, it may produce effects not necessarily connected with its original qualities. It is allowed that coffee promotes digestion, and exhilarates the animal spirits; besides which, various other qualities are ascribed to it, such as dispelling flatulency, removing dizziness of the head, attenuating viscid humors, increasing the circulation of the blood, and consequently perspiration; but if drank too strong, it affects the nerves, occasions watchfulness, and tremor of the hands; though in some phlegmatic constitutions it is apt to produce sleep. Indeed, it is to persons of that habit that coffee is well accommodated; for to people of a thin and dry habit of body it seems to be injurious. Turkey coffee is greatly preferable in flavor to that of the West Indies. Drank, only in the quantity of one dish, after dinner, to promote digestion, it answers best without either sugar or milk; but if taken at other times, it should have both; or in place of the latter, rather cream, which not only improves the beverage, but tends to mitigate the effect of coffee upon the nerves. Chocolate is a nutritive and wholesome composition, if taken in a small quantity, and not repeated too often; but is generally hurtful to the stomach of those with whom a vegetable diet disagrees. By the addition of vanilla and other ingredients, it is made too heating, and so much affects particular constitutions as to excite nervous symptoms, especially complaints of the head.

FREEZING MIXTURES WITHOUT ICE.

Use water not warmer than 50° Fahrenheit:

Mixtures.		Down to	Change
Nitrate Ammonia, Water, } each one part..	50°	4°	46°
Muriate Ammonia Nitrate of Potash, } each five parts.. Water, sixteen parts..............	50	10	40
Muriate Ammonia, Nitrate of Potash, } each five parts.. Sulphate of Soda, eight parts........ Water, sixteen parts	50	4	46
Sulphate of Soda, three parts........ Dilute Nitric Acid, two parts........	50	—3	53
Nitrate of Ammonia, Carbonate Soda, Water, } each one part	50	—7	57
Phosphate Soda, nine parts.......... Dilute Nitric Acid, four parts	50	—12	62
Sulphate of soda, five parts........... Dilute Sulphuric Acid, four parts ...	50	3	47
Sulphate of Soda, six parts .... Muriate Ammonia, four parts...... Nitrate of Potash, two parts.. ...... Dilute Nitric Acid, four parts.	50	—10	60
Sulphate of Soda, six parts.......... Nitrate of Ammonia, five parts...... Dilute Nitric Acid, four parts.......	50	—14	64

FREEZING, FUSING & BOILING POINTS.

The following table will explain itself, and will be valuable to many readers:

Substances.	Reau-mer.		Centi-grade.		Fahr h't.
Bromine freezes at..............	—16°	=	—20°	=	— 4°
Oil Anise "	8	=	10	=	50
" Olive "	8	=	10	=	50
" Rose "	12	=	15	=	60
Quicksilver "	—31 .5	=	—39 .4	=	—39
Water "	— 1	=	0	=	32
Bismuth metal fuses at...........	200	=	264	=	507
Cadmium "	248 .8	=	315	=	592
Copper "	874 .6	=	1093	=	2000
Gold "	961	=	1200	=	2200
Iodine "	92	=	115	=	239
Iron "	1230	=	1538	=	2800
Lead "	255 .5	=	325	=	617
Potassium "	46	=	58	=	136
Phosphorus "	34	=	44	=	111
Silver "	816 .8	=	1021	=	1870
" Nitrate "	159	=	198	=	389
Sodium "	72	=	90	=	194
Steel "	1452	=	1856	=	3300
Sulphur "	72	=	90	=	194
Tin "	173	=	230	=	446
Zinc "	328	=	410	=	770
Alcohol boils at...........	63	=	78	=	173
Bromine "	50	=	53	=	145
Ether "	28	=	55	=	95
" Nitrous boils at...........	11	=	14	=	57
Iodine "	140	=	175	=	347
Olive Oil "	252	=	315	=	600
Quicksilver "	280	=	350	=	662
Water "	80	=	100	=	212

HAIR.

A Safe Depilatory. Take a strong solution of sulphuret of barium, and add enough finely powdered starch to make a paste. Apply to the roots of the hair and allow it to remain on a few minutes, then scrape off with the back edge of a knife-blade, and rub with sweet oil.

Quick Depilatory for Removing Hair. Best slaked lime, 6 ounces; orpiment, fine powder, 1 ounce. Mix with a covered sieve and preserve in a dry place in closely stoppered bottles. In using mix the powder with enough water to form a paste, and apply to the hair to be removed. In about five minutes, or as soon as its caustic action is felt on the skin, remove, as in shaving, with an ivory or bone paper knife, wash with cold water freely, and apply cold cream.

Tricopherous for the Hair. Castor oil, alcohol, each, 1 pint; tinct. cantharides, one ounce; oil bergamot, ½ ounce; alkanet coloring, to color as wished. Mix and let it stand forty-eight hours, with occasional shaking, and then filter.

Liquid Shampoo. Take bay rum, 2½ pints, water, ½ pint, glycerine, 1 ounce, tinct. cantharides, 2 drachms, carbonate of ammonia, 2 drachms, borax, ½ ounce; or take of New England rum, 1½ pints, bay rum, 1 pint, water, ½ pint, glycerine, 1 ounce, tinct. cantharides, 2 drachms, ammon. carbonate, 2 drachms, borax, ½ ounce; the salts to be dissolved in water and the other ingredients to be added gradually.

Moustache Grower. Simple cerate, 1 ounce, oil bergamot, 10 minims, saturated tinct. of cantharides, 15 minims. Rub them together thoroughly, or melt the cerate and stir in the tincture while hot, and the oil as soon as it is nearly cold, then run into moulds or rolls. To be applied as a pomade, rubbing in at the roots of the hair. Care must be used not to inflame the skin by too frequent application,

Cleaning Hair Brushes. Put a teaspoonful or dessertspoonful of aqua ammonia into a basin half full of water, comb the loose hairs out of the brush, then agitate the water briskly with the brush, and rinse it well with clear water.

Burns and Scalds. Glycerite of lime is recommended as soothing the pain and lessening the inflammation of burns. It is made as follows: Freshly slaked lime, 1 part, glycerine, 50 parts, hydrochloric ether, 1 part. Rub the lime with a small portion of the glycerine into a smooth cream, then add the remaining glycerine and ether and thoroughly mix. Another recipe is, lime water and pure olive or linseed oil, equal parts, shake thoroughly to form a uniform and rather thin or liquid salve. Apply freely to burns or scalds, and bind the wounds in rags saturated with it. Lime water is made by pouring a gallon of water on a pound of unslaked lime, and after standing twelve hours decant or filter, and preserve for use when needed. An excellent and available remedy for burns at hand in almost every house, is the bi-carbonate or ordinary baking soda. Make a thin paste with water and apply promptly; it will quickly remove the pain and check inflammation.

MEDICINES, Active, Maximum Doses.

Every person should know the largest doses, which it is safe to give of active medicines. The following table shows the largest doses admissible, in grammes, and also the equivalent in grains for solids, and in minims for liquids. The doses are expressed in fractions, thus: 1-13, 1-64, meaning one thirteenth, one sixty-fourth. In non-professional hands it is the safest plan to strictly observe the rule of never giving the maximum dose of any medicine. Unless in case of some idiosyncrasy, it is rare that a medium, safe dose will not serve the end desired, and, should it become necessary to increase the dose to obtain the full remedial effects, the point of toleration may thus be cautiously reached without detriment to the patient. The table is as follows:

Medicines.	Grammes.	Grains.
Arsenious Acid	.005	1-13
Acid, Carbolic	.05	¾
" Hydrocyanic	.06	1
Aconitia	.004	1-16
Aconite Root	.15	2¼
Arsenic, Iodide	.025	⅜
Atropia	.001	1-64
Atropia Sulph	.001	1-64
Barium, Chlor	.12	1⅞
Belladonna, Herb	.2	3
" Root	.1	1½
Codia	.05	¾
Conia	.001	1-64
Digitalis	.3	4½
Ext. Aconite Leaves	.1	1½
" " Root	.025	⅜
" Belladonna	.1	1½
" Cannabis Indica	.1	1½
" Conium	.18	2¾
" Digitalis	2	3
" Nux Vomica. Alc	.05	¾
" Opium	.1	1½
" Stramon. Seed	.05	¾
Fowler's Solution	.4	6 min.
Lead, Sugar of	.06	9 10
Mercury, Corrosive Chlor	.03	9-20
" Red Iodide	.03	9-20
Morphia and its Salts	.03	9-20
Nitrate Silver	.03	9-20
Oil, Croton	.06	9-10
Opium	.15	2¼
Phosphorus	.015	2-9
Potassa, Arsenite	.005	1-13
" Cyanide	.03	9-20
Santonine	.1	1½
Soda, Arsenite	.005	1-13
Strychnia and Salts	.01	1-6
Tartar Emetic	.2	3
Veratria	.0 5	1-13
Veratrum Viride	.3	4½
Zinc, Chloride	.015	2-9
" Valerianate	.06	9-10

PASTE.

The following paste, it is said, will adhere to any substance to which it is applied: Sugar of lead, 1½ ounces; alum, 1½ ounces; gum arabic, 2½ ounces; wheat flour, 1 pound; water, sufficient. Dissolve the gum arabic in two quarts of warm water; when cold, mix in the wheat flour, and add the sugar of lead and alum dissolved in water. Place the whole on a a fire, stirring constantly, and take it off when it shows signs of ebullition. Let it cool, and the paste is made. If the paste is too thick, add to it some gum water to bring it to the proper consistence.

PERFUMES.

Cologne. Deodorized proof spirit or dil. alcohol, 4 pints; oil lemon, 2 drachms; oil rose, 2 minims; oil citronella, 4 minims; oil bergamot, 2 drachms. Rub the oil thoroughly with one ounce of carbonate magnesia, then add alcohol gradually, rubbing the paste until it is very thin, pour in two pints of alcohol, stir well, and pour into a filter; after most of the liquid has passed, put the remainder of the alcohol into the filter and let it pass through. Another recipe for an excellent cologne, is as follows: Strong cologne spirits, 1 gallon; oil lemon, 2 drachms; oil bergamot, 1 ounce; oil lavender flowers, 4 drachms; oil of rose, ½ drachm; oil jasmin, 1 ounce; tinc. musk, 1 drachm. Dissolve the oils and musk; allow the mixture to stand forty-eight hours, and then filter and keep two weeks, well stoppered, before using.

Inexhaustible Smelling Salts. Sal tartar, 3 drachms; mur. ammonia, granulated, 6 drachms; oil neroli, 5 minims; oil lavender flowers, 5 minims; oil rose, 3 minims; spirits ammonia, 15 minims. Put into the pungent a small piece of sponge filling about one-fourth the space, and pour on it a due proportion of the oils; then put in the mixed salts until the bottle is three-fourths full, and pour on the spirits of ammonia in proper proportion and close the bottle.

Volatile Salts for Pungents. Liquor ammon., fort, 1 pint; oil lavender flowers, 1 drachm; oil rosemary, fine, 1 drachm; oil bergamot, ½ drachm; oil peppermint, 10 minims. Mix thoroughly and fill pungents or keep in well stoppered bottle. Another formula is, sesqui-carbonate of ammonia, small pieces, 10 ounces; concentrated liq. ammonia, 5 ounces. Put the sesqui-carb. in a wide mouth jar with air-tight stopper, perfume the liquor ammonia to suit and pour over the carbonate, close tightly the lid and place in a cool place; stir with a stiff spatula every other day for a week, and then keep it closed for two weeks, or until it becomes hard, when it is ready for use.

Aromatic Spirit of Vinegar. Acetic acid, No. 8, pure, 8 ounces; camphor, ½ ounce. Dissolve, and add oil lemon, oil lavender flowers, each 2 drachms; oil cassia, oil cloves, ½ drachm each. Thoroughly mix and keep in well stoppered bottle.

Rose Vinegar. Best red rose leaves, freshly dried, ½ pound; dilute acetic acid, 1 gallon. Macerate for two weeks with frequent stirring and filter, or macerate twenty-four hours and pour off the vinegar; rub up the leaves with well washed fine sand and pack in percolator and displace with the vinegar taken from the leaves; to this add oil rose, ten drops. Shake well and filter.

Lavender Vinegar. Lavender flowers, freshly dried, ½ pound; dilute acetic acid, 6 pints. Treat as for rose vinegar, and add to the liquid, before filtering, 2 drachms oil lavender flowers.

Orange Flower Vinegar. Fresh orange leaves, 1 pound; dilute acetic acid, 6 pints. Macerate or displace as above, and add oil neroli, 10 minims, and filter.

PLANTS, ETC., USED IN MEDICINE.

The following complete list gives the botanical names in alphabetical order, and the common names and synonyms of plants, etc., used in medicine. It will be valuable for reference:

Achillea Millefolium—Yarrow, Milfoil, Thousand Leaf.
Aconitum Napellus—Aconite, Monkshood, Wolfsbane.
Actæa Alba—White Cohosh, White Beads, Necklace Weed, White Baneberry.
Actæa Rubra—Red Cohosh, Baneberry.
Adiantum Pedatum—Maiden Hair, Rock Fern.
Æsculus Glabra—Ohio Buckeye, Horse Chestnut.
Æsculus Hipocastanum—English Horse Chestnut.
Agathotes Chirayita—Chiretta, Cherayita, Bitter Stick.
Agrimonia Eupatoria—Common Agrimony, Stick Wort.
Ajuga Chamæpithys—Yellow Bugle, Ground Pine.
Ajuga Reptans—Common Bugle.
Aletris Farinosa—Star Grass, Star Root, Blazing Star, Mealy Starwort, True Unicorn Root, Bitter Grass, Aloe Root, Colic Root, Ague Root, Crowcorn, Ague Grass.
Alisma Plantago—Water Plantain.
Alnus Rubra—Red Alder, Tag Alder, Swamp Alder, Smooth Alder.

Alstonia—Dita Bark.
Althæa Officinalis—Marsh Mallows, Bismalva, Hibiscus, Ibiscus, Mortification Root.
Amaranthus Hypochondriacus—Prince's Feather, Red Cockscomb, Pilewort. Amaranth.
Amaranthus Melancholicus—Love-lies-bleeding.
Ambrosia Artemisæfolia——Rag Weed, Roman Wormwood, Hog Weed.
Ampelopsis—Virginia Creeper.
Anacyclus Pyrethrum—Pelitory Root, Pelitory of Spain, Pyrethrum Root.
Anagallis Arvensis—Scarlet Pimpernel, Poor-man's Weather-glass.
Anchusa Tinctoria—Alkanet, Bugloss, Dyers' Alkanet.
Andira—Cabbage Tree Bark.
Anemone Pulsatilla—Pulsatilla.
Anethum Graveolens—Dill Seed, Garden Dill, Dilly.
Angelica Atropurpurea—Purple Angelica, High Angelica.
Angelica Archangelica—Wild Archangel.
Angelica Sylvestris—Wild Angelica.
Anthemis Cotula—May Weed, Dog Fennel, Wild Chamomile, Stinking Chamomile, Dill Weed, Field Weed, Mathen, Flake.
Anthemis Nobilis—Roman Chamomile, Low Chamomile, English Chamomile.
Apium Petroselinum—Parsley Leaves, Seed and Root.
Apocynum Androsæmifolium-Bitter Root, Dogsbane, Bitter Dogsbane, Wandering Milk Weed, Ipecac Milk, Honey Bloom, Catch-fly.
Apocynum Cannabinum—Indian Hemp, Black Hemp.
Aralia Hispida—Dwarf Elder, Wild Elder, Bristly Aralia, Bristle Stem, Sarsaparilla.
Aralia Racemosa-Spikenard, Petty-morel, Life of Man, Spignet.
Aralia Spinosa—Angelica Tree, Toothache Bush, Hercules' Club, Prickly Elder.
Aralia Nudicaulis—Wild Sarsaparilla, Shotbush, Sea Ash.
Arnica Montana—Leopard-bane, Mountain Tobacco.
Artemisia Abrotanum—Southern Wood, Old Man, Boy's Love, Lad's Love.
Artemisia Absinthium—Wormwood.
Artemisia Vulgaris—Mugwort, Wild Wormwood.
Arum Triphyllum—Wild Turnip, Indian Turnip, Pepper Turnip, Bog Onion, Marsh Turnip, Dragon's Root, Dragon's Turnip, Jack in the Pulpit, Canada Turnip.
Arum Maculatum—Wake Robin, Cuckoo's Pint.
Asarum Canadense—Wild Ginger, Indian Ginger, Canada Ginger, Wild Turnip, Kidney-leaved Asarabacca, Canada Snake Root, Heart Root, Coltsfoot, Coltsfoot Snake Root, False Coltsfoot, Vermont Snake Root, Heart Snake Root.
Asclepias Incarnata—Rose-colored Silk Weed, Swamp Milk Weed Root, White Indian Hemp, Flesh-colored Asclepias.
Asclepias Syriaca—Milk Weed, Silk Weed Root, Wild Cotton.
Asclepias Tuberosa—Pleurisy Root, Butterfly Weed, Flux Root, White Flux- Root, White Root, Canada Root, Orange Swallow Root, Swallowwort, Windwort, Tuber Root.
Asplenium Angustifolium—Swamp Spleenwort.
Asplenium Filix Fœmina—Female Fern, Backache-brake.
Aster Puniceus—Red-Stalked Aster, Cold Water Root, Cocash Root, Meadow Scabish.
Atropa Belladonna—Belladonna, Deadly Nightshade, Dwale.
Azedarach—Pride of China, Bead Tree, Pride of India.
Baptisia Tinctoria—Wild Indigo Weed, Indigo Broom, Yellow Broom, Horse-fly Weed Rattlebush.
Berberis Vulgaris—Barberry, Pipperidge.
Betula Lenta—Birch Bark, Sweet Birch, Cherry Birch, Spice Birch.
Borago Officinalis—Borage, Burrage.
Brayera—Kooso.
Bursa Pastoris—Shepherd's Purse.
Calamus Aromaticus—Flag Root, Sweet Flag, Sweet Rush.
Calendula Officinalis—Marigold.
Callitriche—Water Starwort.
Canella Alba—Wild Cinnamon.
Cannabis Indica—Foreign Indian Hemp, Cannabis Ganga.
Capsicum Annuum—Cayenne Pepper, Red Pepper, Bird Pepper, Cockspur Pepper, Guinea Pods.
Carduus Benedicta—Spotted Cardus, Blessed Thistle, Spotted Thistle, Cursed Thistle, Holy Thistle, Star Thistle, Lovely Thistle, Thistle Root, Cardus Plant.
Carthamus Tinctorius—Safflower, Dyers' Saffron, American Saffron.
Cassia Marilandica—American Senna, Wild Senna, Maryland Cassia, Locust Plant.
Castanea—Chestnut Leaves.
Caulophyllum Thalictroides (see *Leontice Thalictroides*) —Blue Cohosh, Leontice, Pappoose Root, Squaw Root, Blueberry Root.
Ceanothus Americana—Jersey Tea, Bohea, Red Root, Wild Snow Ball.
Celastrus Scandens—Bittersweet Bark, Climbing Bittersweet, False Bittersweet, Shrubby Bittersweet, Fevertwig, Wax Work, Staff Wine, Staff Tree.
Centaurea Americana—Great American Century, Wild Succory, Rose Pink.
Chamælerium Luteum—Devil's Bit, False Unicorn.
Chelledonium Majus—Celandine, Tetterwort.
Chelone Glabra—Balmony, Snake Head, Bitterherb, Turtle Bloom, Salt Rheum Weed, Fishmouth, Turtle Head, Shell Flower.
Chenopodium Anthelminticum—Wormseed, Jerusalem Oak, Worm Goosefoot, Jesuit's Tea.
Chimaphila Umbellata—Pipsissewa, Prince's Pine, Ground Leaf, Ground Holly, American Wintergreen, King's Cure, Rheumatism-weed.
Cicuta Maculata—American Water Hemlock, Spotted Cowbane, Beaver Poison, Musquash Root.
Cicuta Virosa—Water Hemlock, Cowbane, Poison Hemlock.
Cimicifuga Racemosa (see *Macrotys Racemosa*)—Black Snake Root, Black Cohosh, Deer Weed, Rattle Root, Bugbane.
Cinchona Pallida—Peruvian Bark, Crown Bark, Jesuit's Bark.
Cistus Canadensis—Rock Rose, Holly Rose.
Clematis Virginica—Virgin's Bower, Traveler's Joy.
Cochlearia Officinalis—Scurvy Grass.
Collinsonia Canadensis—Horse Weed, Horse Balm, Ox Balm, Rich Weed, Heal-all, Knob's Grass, Knob Root, Knot Root, Stone Root, Woundwort.
Comptonia Asplenifolia—Sweet Fern, Sweet Bush, Fern Gale, Sweet Ferry, Meadow Fern.
Convolvulus Panduratus—Bind Weed, Man Root, Wild Scammony, Wild Jalap, Hog Potato, Mechamech, Wild Rhubarb, Kusauda, Wild Potato.
Coptis Trifolia—Gold Thread, Mouth Root, Canker Root.
Corallorhiza Odontorhiza—Coral Root, Crawley, Dragon's Claw, Coral Teeth.
Corallorhiza Hyemale (see *Aplectrum Hyemale*)—Adam and Eve, Putty Root, Chicken's Toes.
Cornus Circinata—Round-leaved Dogwood or Cornel, Cornea, Green Osier.
Cornus Florida—Dogwood, Boxwood, Dog Tree, Box Tree, Budwood.
Cornus Cericea—Swamp Dogwood, Rose Willow, Red Osier, Red Willow, Red Rod, Silky Cornel.
Corydalis Formosa—Turkey Corn, Turkey Pea, Stagger Weed, Squirrel Corn.
Cucumis Colocynthis—Colocynth, Bitter Apple, Bitter Cucumber.
Cunila Mariana—American Dittany, Mountain Dittany, Mint-leaved Cunila, Wild Basil, Stone Mint.
Cynoglossum Officinalis—Hound's Tongue.
Cypripedium Pubescens—Lady's Slipper, Nerve Root, Nervine, Moccasin Root, Umbil Root, Noah's Ark, Indian Shoe, Bleeding Heart, American Valerian, Pine Tulip.
Datura Stramonium—Jimson Weed, Devil's Apple, Stink Weed, Thorn Apple.
Delphinium Staphisagria—Stavesacre, Larkspur.
Digitalis Purpurea—Foxglove, Fairy's Glove.
Dioscorea Villosa—Wild Yam, China Root.
Dorstenia Contrayerva—Counter Poison, Antidote.
Dracocephalum Canariense—Dragon's Head.
Dracontium Fœtidum—Skunk Cabbage, Skunk Weed, Collard, Polecat Weed, Bear's-leaf, Bear's-foot.
Drosera—Sundew.
Dulcamara—Bittersweet, Woody Nightshade, Scarlet Berry, Violet Bloom.
Epigæa Repens—Trailing Arbutus, Gravel Plant, Ground Laurel, Winter Pink, Mountain Pink.
Epilobium Angustifolium—Wickup, Willow Herb.
Epiphegus Americanus—Cancer Root, Beech Drop, Broom Rape.
Erigeron Canadense—Canada Fleabane, Butter Horse Weed, Blood Stanch, Butter Weed, Mare's Tail, Pride Weed.
Erigeron Philadelphicum, Erigeron Purpurum—Philadelphia Fleabane, Cocash, Sweet Scabious, Skavish.
Eriodictyon—Mountain Balm, Consumptive's Weed, Bear's Weed.
Eryngium Aquaticum—Water Eryngo, Rattlesnake's Master, Corn Snake Root.
Erythronium Americanum—Erythronium, Yellow Adder's Tongue, Yellow Snake Leaf, Dogtooth Violet, Rattlesnake Violet.
Euonymus Atropurpureus—Waahoo, Burning Bush, Spindle Tree, Strawberry Tree, Indian Arrow Wood.
Eupatorium Aromaticum—Pool Root.
Eupatorium Perfoliatum—Boneset, Thoroughwort, Crosswort, Indian Sage, Feverwort, Ague Weed, Sweating Plant.
Eupatorium Purpureum—Queen of the Meadow, Gravel Root, Trumpet Weed, Purple Boneset, Joe Pye.
Eupatoreum Urticifolium—White Snake Root.

Euphorbia Corallata—Large Flowering Spurge, Wild Ipecac, Wild Hippo.
Euphorbia Ipecacuanha—Ipecacuanha Spurge, Carolina Ipecac.
Euphrasia Officinalis—Eyebright.
Filix Mas—Male Fern, Golden Fern.
Fraseri Walteri—American Columbo, Pyramid Flower, Yellow Gentian, Meadow Pride, Indian Lettuce, Wild Columbo.
Fucus Vesiculosus—Sea Wrack, Bladder Wrack, Kelp Ware, Blacktang.
Fumaria Officinalis—Fumitory.
Galanga Major and Minor—Catarrh Root, East India Root, Galangal, Kassamac.
Galium Aparine—Cleavers Root, Goose Grass, Milksweet, Clabber Grass, Poor Robin, Catch Weed, Bed Straw, Savoyan.
Gaultheria Procumbens—Wintergreen, Partridge Berry, Spicy Wintergreen, Deer Berry, Grouse Berry, Checker Berry, Tea Berry, Box Berry, Spice Berry, Mountain Tea, Red Berry, Ground Berry.
Gelsemium Sempervirens—Yellow Jessamine, Wild Jessamine, Carolina Jessamine, Bignonia, Woodbine.
Gentiana Catesbæi—Blue Gentian, Southern Gentian.
Gentiana Lutea—Great Yellow Gentian.
Gentiana Quinqueflora—Bitter Plantain, Five-flowered Gentian.
Gentiana Saponaria—Sampson Snake Root.
Geranium Maculatum—Cranesbill, Stork's Bill, Crowfoot, Dovefoot.
Geum Rivale—Avens Root, Water Avens, Purple Avens, Throat Root.
Geum Virginianum—White Avens, Evan Root, Chocolate Root, Cure-all.
Gillenia Trifoliata—Indian Physic, Bowman's Root, Beaumont's Root, American Ipecac, Dropwort, Indian Hippo.
Glechoma Hederacea—Ground Ivy, Gill Run, Gill go over the Ground, Catfoot, Alehoof.
Glycyrrhiza Glabra—Licorice, Sweetwood, Spanish Root
Gnaphalium—Life Everlasting, Cud-Weed, Field Balsam, Live Forever, Sweet Balsam, White Balsam, Indian Posey, Mouse Ear, Dysentery Root.
Goodyera Pubescens—Rattlesnake Root, Adder Violet, Netleaf Plantain.
Gossypium Herbaceum—Cotton Root.
Guiaiac Wood—Lignum Vitæ.
Hamamelis Virginica—Witch Hazel, Striped Alder, Winter Bloom, Snapping Hazelnut, Spotted Alder.
Hedeoma Pulegioides—Pennyroyal, Squaw Mint, Tick Weed, Stinking Balm.
Helenium—Sneeze Weed, Sneezewort.
Helianthemum Canadense—Frostwort, Frost Weed, Scrofula, Weed.
Helonias Dioica—Starwort, False Unicorn, Unicorn's Horn, Drooping Starwort.
Helleborus Fœtidus—Bear's Foot, Setterswort.
Helleborus Niger—Black Hellebore, Christmas Rose.
Hepatica Americana—Liverwort, Liver Leaf.
Heracleum Lanatum—Masterwort, Cow Parsnip.
Heuchera Americana—Alum Root, Cliff Weed, Ground Maple, Split Rock.
Hieracium—Hawk Weed, Rattlesnake Weed.
Hydrangea Arborescens—Hydrangea, Wild Hydrangea, Seven-Barks.
Hydrastis Canadensis—Golden Seal, Yellow Root, Yellow Puccoon, Orange Root, Ground Raspberry, Eye Balm.
Hyoscyamus Niger—Black Henbane, Fœtid Nightshade, Poison Tobacco.
Hypericum Perforatum—St. Johnswort, Johnswort.
Impatiens Balsamina, Impatiens fulva and Pallida—Wild Celaudine, Balsam Weed, Jewel Weed, Touch-me-not.
Imperatoria—Masterwort.
Inula Helenium—Elecampane, Scabwort.
Iris Versicolor—Blue Flag, Flag Lily, Fleur-de-lis, Liver Lily, Poison Flag, Snake Lily, Water Flag.
Kalmia Angustifolia—Sheep Laurel, Narrow-leaved Laurel, Sheep Poison.
Kalmia Glauca—Swamp Laurel.
Kalmia Latifolia—Laurel, Mountain Laurel, Lambkill, Spoonwood, Calico Bush, Calfkill.
Krameria Triandra—Rhatany.
Lactuca Elongata—Wild Lettuce, Snake Bite.
Lappa Minor—Burdock Leaves, Clot Burr.
Laurus Benzoin—Fever Wood, Spice Bush, Spice Wood, Wild Allspice, Allspice Bush.
Ledum—Marsh Tea, Wild Rosemary.
Leontice Thalictroides—Blueberry.
Leonurus Cardiaca—Motherwort, Cardiaca, Wolfstrap.
Leptandra Virginica—Culvers Root, Culvers Physic, Black Root, Brinton Root, Tall Veronica.
Levisticum—Lovage, Lavose, Smellage.
Liatris Spicata—Button Snake Root, Gayfeather, Backache Root.
Linaria—Toad Flax, Snap Dragon.
Liriodendron Tulipifera—Tulip Tree Bark, Whitewood, White Poplar, Yellow Poplar, Len-nik-bi, Cucumber Tree.
Lobelia Cardinalis—Red Cardinal Flower, Red Cardinal Plant, Red Lobelia, Indian Pink.
Lobelia Inflata—Lobelia, Indian Tobacco, Wild Tobacco, Asthma Root, Emetic Herb, Emetic Weed, Puke Root.
Lycopodium Clavatum—Club Moss, Vegetable Sulphur.
Lycopus Europæus—Green Archangel, Water Hoarhound, Water Bugle, Bugle, Gipseywort.
Lycopus Virginicus—American Archangel, Red Archangel, Gipsey Weed, Virginia Hoarhound, Paul's Betony, Sweet Bugle, Bugle Weed, Bitter Bugle.
Lythrum Salicaria—Loose Strife, Spiked Strife, Purple Willow Herb.
Magnolia Glauca—Sweet Magnolia, Beaver Tree, Sweet Bay, White Bay, Swamp Sassafras.
Malva Rotundifolia—Low Mallows, Cheese Plant.
Malva Sylvestris—High Mallows.
Marrubium Vulgare—Prassium, White Hoarhound.
Medeola Virginica—Indian Cucumber, Cucumber Root.
Melilotus Officinalis—Kings's Clover, Sweet Clover, Yellow Melilot.
Melissa Officinalis—Lemon Balm, Dropsy Plant, Sweet Balm.
Menispermum Canadense—Texas Sarsaparilla, Yellow Parilla, Canada Wormwood, Canadian Moonseed, Vine Maple.
Mentha Piperita—Peppermint.
Mentha Viridis—Spearmint, Julep Grass, Garden Mint, Flavoring Herb.
Menyanthes Trifoliata—Buck Bean, Bog Bean, Marsh Trefoil, Water Shamrock, Bitter-worm.
Mimulus Moschatus—Musk Plant, Monkey Flower.
Mitchella Repens—Squaw Vine, Winter Clover, Partridge-berry, Hive Vine.
Momordica Balsamina—Balsam Apple, Balsamine.
Monarda Didyma—Mountain Balm, Oswego Tea, Red Balm, Square Stalk.
Monarda Punctata—Horse Mint.
Monotropa Uniflora—Fit Root, Fit Plant, Pie Plant, Pine Sap, Corpse Plant, Ice Plant, Indian Pipe, Ova-ova.
Mucuna—Cowhage.
Myrica Cerifera—Bayberry, Candleberry, Waxberry, Wax Myrtle
Myrica Gale—Sweet Gale, Sweet Willow, Dutch Myrtle, Bog Myrtle.
Nabula Albus—Lion's foot White Lettuce.
Nasturtium Amphibium—Water Radish, Water Cress, Amphibious Cress.
Nasturtium Palustre—Marsh Water Cress.
Nepeta Calaria—Catnip, Catmint, Catwort.
Nuphar Advena—Yellow Pond Lily, Toad Lily, Frog Lily, Cow Lily, Water Lily, Water Nymph, Cow Cabbage, White Lily, White Pond Lily, Sweet Water Lily, Water Cabbage, Spatter Dock, Beaver Root.
Nux Vomica—Dog Button.
Nymphæa Odorata—(See *Nuphar Advena.*)
Ocymum Basilicum—Sweet Basil, Royal Ocimum, Basilicum.
Œnothera Biennis—Evening Primrose, Tree Primrose.
Origanum Majorana—Sweet Marjoram, Amaracus.
Origanum Vulgare—Mountain Mint, Wild Marjoram.
Orobanche Virginiana, Orobanche Uniflora—Cancer Root, Beech Drop, Broom Rape, Squaw Root.
Osmorrhiza Brevistylis—Sweet Cicily, Short-styled Cicily, Hairy Sweet Cicily.
Oxalis Acetosella—Wood Sorrel, Acetosella, Cuckoo's Bread.
Panax Quinquefolia—Ginseng, Ninsin, Garantogen, Sang.
Papaver Somniferum—Poppy, Opium Poppy.
Pareira Brava—Ice Vine, Violet Leaf.
Parthenium Integrifolium—Prairie Dock. Nephritic Plant, Cutting Almond.
Pedicularis Canadensis—Wood Betony, Betony Weed, Lousewort.
Petroselinum Sativum—Parsley Root, Rock Parsley.
Phytolacca Decandra—Poke, Garget, Cocum, Pigeon Berry, American Nightshade, Jalap, Cancer Root, Pecatacalleloe, Scoke Root.
Pinckneya Pubens—Pinckneya, Carolina Cinchona, Georgia Bark, Fever Tree, Florida Bark.
Pinus Canadensis—Hemlock Spruce.
Pinus Balsamea—Balsam Fir.
Piper Angustifolium—Matico, Narrow-leafed Piper.
Plantago Major—Plantain, Way Bread, Rib Grass.
Podophyllum Peltatum—May Apple, Mandrake, Wild Lemon, Indian Apple, Raccoon Berry, Duck's Foot, Ipecacuanha.
Polemonium Reptans—Abscess Root, Blue Bell, Sweat Root, Greek Valerian.
Polygala Rubella—Bitter Polygala, Ground Flower.
Polygala Senega—Seneka Snake Root, Seneka, Senega, Mountain Flax, Milkwort.
Polygonum Hydropiper Smart Weed, Arsmart.

Polygonum Punctatum—Water Pepper, Dead Arsmart, Knot Weed, Biting Persicaria, Biting Knot Weed.
Polypodium Vulgare—Common Polypody, Brake Root, Rock Polypody.
Polytrichum Juniperinum—Hair-cap Moss, Robin's Rye, Bear's Bed, Ground Moss.
Populus Balsamifera—Balsam Poplar, Tacamahac, Balm of Gilead.
Populus Tremuloides—Trembling Poplar, Aspen, American Aspen, Quaking Aspen, Quiver Leaf.
Potentilla Canadensis—Cinque Foil, Five Finger.
Prenanthes—Rattlesnake Root, Lion's-foot, Cancer Weed, White Lettuce.
Prinos Verticillatus—Black Alder, False Alder, Striped Alder, Winter-berry, Fever Bush.
Prunella Pennsylvanica—Self Heal.
Prunus Virginiana—Wild Cherry Bark, Black Cherry.
Ptelea Trifoliata—Wafer Ash, Shrubby Trefoil, Hop Tree, Ague Bark, Wing Seed.
Pteris Atropurpurea—Rock Brake, Winter Fern, Indian Dream.
Pulmonaria Officinalis—Lungwort, Cowslips of Jerusalem, Gum Plant, Sage of Jerusalem, Spotted Comfrey, Spotted Lungwort, Maple Lungwort.
Pyrethrum Parthenium—Feverfew, Featherfew, Chrysanthemum.
Pyrola Rotundifolia—Wild Lettuce, Round-leafed Pyrola.
Pyrola Umbellata—Round-leafed Consumption Weed, Shin Leaf.
Quassia Bitter Wood, Bitter Ash, Bitter Weed, Simaruba, Mountain Zarusum.
Ranunculus Acris—Buttercup, Meadow Crowfoot, Yellow Weed, Meadow Bloom, Blister Weed.
Ranunculus Bulbosus—Bulbous Crowfoot.
Rhamnus Catharticus—Buck Thorn, Purging Berries.
Rhus Glabra—Smooth Sumach, Upland Sumach.
Rhus Toxicodendron—Poison Oak, Poison Ivy, Poison Ash, Poison Vine
Rubus Occidentalis—Blackberry, Thimbleberry, Black Raspberry.
Rudbeckia Laciniata Thimble Weed, Cone-disk, Sun Flower, Tall Cone Flower.
Rumex Aquaticus—Water Dock, Zanthoriza.
Rumex Crispus—Yellow Dock, Curled Dock, Narrow Dock, Sour Dock, Garden Patience.
Sabbatia Angularis—Red Century, Sabbatia, Bitter Bloom, Bitter Clover, Rose Pink, Wild Succory.
Salvia Lyrata—Wild Sage, Meadow Sage, Lyre-leaved Sage, Cancer Weed.
Salvia Sclary—Clary, Clammy Sage.
Sambucus Canadensis—Elder Blooms, Common Elder, Sweet Elder.
Sanguinaria Canadensis--Blood Root, Red Root, Puccoon, Indian Paint
Sanicula Marilandica—Black Sanicle.
Saponaria Officinalis Soapwort, Bouncing Bet, Old Maid's Pink, London Pride.
Sarracenia Purpurea, Sarracenia Officinalis—Side-saddle Plant, Fly-trap, Water Cup, Pitcher Plant, Eve's Cup, Huntsman's Cup, Small Pox Plant.
Scoparius Cytisus—Broom.
Scrophularia Nodosa—Figwort, Scrofula Plant, Carpenter's Square, Heal-all.
Scutellaria Lateriflora—Scullcap, Hooded Willow Herb, Hoodwort, Mad Weed, Mad Dog Scullcap, Blue Scullcap, Blue Pimpernel.
Sedum—Stone Crop, Mossy Stone Crop
Senecio Aureus--Life Root, Golden Ragwort, Uncum, Golden Senecio.
Senecio Hieracifolius—Fire Weed.
Senecio Obovatus—Squaw Weed.
Senecio Vulgaris Common Grounsel.
Serpentaria—Virginia Snake Root, White Snake Root, Snargel, Birthwort, White Sanicle.
Silene Virginica—Wild Pink, Virginia Catch-fly.
Sisymbrium Officinale—Hedge Mustard.
Sium Nodiflorum—Water Parsnip.
Smilax Herbacea—Carrion Flower.
Smilax Peduncularis—Jacob's Ladder.
Solidago Odora—Golden Rod, Sweet-scented Golden Rod.
Sorbus—Mountain Ash.
Spigelia Marilandica—Carolina Pink Root, Wormgrass, Indian Pink Root, Unsteetle, Star Bloom.
Spiræa Tomentosa—Hardhack, Steeplebush, Whitecap, Meadow Sweet, White Leaf.
Statice Caroliniana—Marsh Rosemary, Seathrift, Meadow Root, Ink Root, Sea Lavender.
Styllingia Sylvatica—Queen's Root, Queen's Delight, Cock-up-hat, Yaw Root, Silver Leaf.
Stramonium—Thorn Apple, Jimson Weed.
Sumbul—Musk Root
Symphytum Officinale—Comfrey, Healing Herb.
Taraxicum—Dandelion.
Taxus—Yew.
Tephrosia Virginiana—Goat's Rue, Hoary Pea, Devil's Shoestring, Catgut.
Thuja Occidentalis—Arbor Vitæ.
Toxicodendron—Poison Oak, Poison Ivy, Poison Ash, Poison Vine.
Trifolium Pratense—Red Clover.
Trifolium Repens—White Clover.
Trillium Pendulum Beth Root, Birth Root, Cough Root, Ground Lily, Indian Balm, Jewsharp, Lamb's Quarter, Pariswort, True Love.
Triosteum Perfoliatum—Fever Root, Feverwort, Wild Ipecac, Bastard Ipecac, Dr. Tinker's Weed, False Ipecac, Cinque, Horse Ginseng, White Gentian, Wild Coffee, Sweet Bitter.
Triticum Repens—Couch Grass, Quich Grass, Quitch Grass, Dog Grass, Knot Grass, Witch Grass, Quickens.
Tropæolum Majus—Nasturtium, Indian Cress.
Tussilago Farfara—Coltsfoot, Bull's Foot, Flower Velure.
Ulmus Fulva—Slippery Elm, Indian Elm, Sweet Elm.
Urtica Dioica—Nettle Root, Stinging Nettle.
Uva Ursi—Bearberry, Wild Cranberry, Bear's Whortleberry, Mountain Box, Mountain and Upland Cranberry.
Veratrum Viride—American Hellebore, Itch Weed, Indian Poke.
Verbascum Thapsus—Mullein, Yellow Moth, Blattaria.
Verbena Hastata—Blue Vervain, Purvain, Simpler's Joy.
Veronica Officinalis—Speedwell, Fluellin, Virginia Speedwell.
Viburnum Opulus—Cramp Bark, High Cranberry, Snowball, Cranberry Tree, Nanny Bush Bark, Guelder's Rose, Sheep's Berry.
Viburnum Prunifolium—Black Haw, Sloe.
Viscum—Mistletoe.
Xantheum Strumarium—Cockle Bur.
Xanthoria Apifolia—Yellow Root, Shrub Yellow Root.
Xanthoxylum Fraxineum—Yellow Wood, Prickly Ash, Suterberry, Toothache Tree, Parsley.

POISONING.

In the case of animals, the subject has been treated of in the body of this work. In cases of poisoning of any member of the family, send for a physician at once. But the following general treatment will be indicated, when the poison is not known: Vomit the patient freely with warm water and mustard, ipecac or salt water, then give white of eggs freely, or of lard, olive, or other bland oil, except in phosphorus poisoning. If an acid has been taken give freely of calcined magnesia, chalk, or other alkali. If the poison has been an alkali, give oil freely, and after the vomiting neutralize with acid drinks, followed by more oil and second vomiting, if acids will not make poisonous compounds with the alkali. If the source of the poisoning is known, the following special treatment will be indicated.

For Arsenical Poisoning. Vomit with ipecac. Solution of alum and salt water. Give white of egg freely, and follow with weakened solution of perchloride of iron or dialised iron. If the patient is very weak use hot applications, and very cautiously of alcoholic stimulants.

For Aconite, Belladonna, and Digitalis. Vomiting, stimulants, strong coffee, opium, and hot applications. Opium only under the care of a physician or experienced person.

Chloral Hydrate or Chloroform. Vomiting, stimulants, strong coffee, hot baths, and dropping the head lower than the rest of the body, to cause a flow of blood to the brain.

Lead Poisoning. Epsom salts in large doses, with ipecac until vomiting and purging sets in. Use white of egg if poison is a lead salt taken into the stomach, and give plenty of fresh milk. Strychnia is often found valuable when there is paralysis. Fresh milk used regularly in diet is said to prevent lead colic with those who work in paint or lead.

Lye Poisoning. Give freely of oil, or warm lard and white of egg, and if possible cause vomiting after giving the oil.

Opium or Morphia. Vomiting and white of egg. If the poison has been just taken give a solution of tannin to prevent ready absorption of the poison. If already diffused in the system, use tinct. belladonna in full doses until the pulse quickens, and the pupils of the eye begin to dilate, observing great caution after these signs appear. Strong coffee is beneficial, also electric currents, and frequent application of cold water so as to shock the system. Keep the patient in motion constantly if practicable.

Silver, Nitrate. Use moderately strong solution of common salt, and after the vomiting give freely of fresh milk.

Strychnia and its Salts. Vomiting, and if the poison has been recently taken use solution of tannin, and very freely of white of egg. If convulsions appear use chloroform, chloral hydrate, or opium.

Antidotes for Strychnia. Prof. Bellini, after a long series of experiments on poisoning by strychnia and its salts, arrives at the following conclusions: That the best antidotes are tannic acid, chlorine, and the tinctures of iodine and bromine. Chlorine attacks the strychnia even after it is diffused through the system. He believes the arrest in the symptoms by tannin to be due, not to chemical action, but to its astringent effects on the mucous membrane of the stomach, whereby the absorption of the poison is rendered difficult.

Chloroform. Death from chloroform need never occur, according to the doctrine of Syme, Lister and Hughes, if this simple rule be observed: "Never mind the pulse, never mind the heart, leave the pupil to itself. Keep your eye on the breathing, and if it becomes embarrassed to a grave extent, take an artery forceps and pull the tongue well out." Syme never lost a case from chloroform, although he gave it 5,000 times. This simple rule enabled him (so he thought) to make this excellent record. Another remedy is to lay the patient so that his head will hang lower than the rest of the body, and cause a flow of blood to the brain.—To avoid mistakes with poisons when not intending to use them: Keep all active poisons as arsenic, corrosive sublimate, Hall's and Fowler's solutions, etc., in bottles painted with rings of black, or a large black square under the label, in the center of which a death's head label might be pasted. This not only prevents using such medicines by mistake in place of comparatively harmless remedies, but also calls attention to their dangerous character when using properly and incites closer notice of quantities prescribed. For eruptions of poison oak or poison ivy, the following prescription is most valuable. Get the prescription filled by a druggist:

Acid Carbolic	Half drachm.
Ol. Sassafras	
Ol. Juniperi	Each one drachm.
Ung. Zinci Oxide (Benz.)	One ounce.

Apply from two to four times daily, and before going to bed wash the inflamed part thoroughly with warm water and soap.

POULTICES.

Bread Poultice. Dry bread crumbs, a sufficient quantity, boiling water to make a stiff mush of the crumbs, stirring well to remove all hard lumps, then stir in a half teaspoonful of glycerine to the teacupful of poultice, and it is ready for use.

Slippery Elm Poultice. Powdered elm, hot water or milk, enough of each to make a good paste, and then add glycerine half teaspoonful to a cupful of poultice.

When either of these two poultices are to be applied to very painful surfaces, a little laudanum can be added to advantage.

Mild Mustard Poultice. Good ground mustard, ground flax seed, each one ounce, water to make a thick paste and spread on muslin.

Strong Mustard Poultice. Best ground mustard, vinegar enough to make a paste, spread on muslin. This poultice will often blister nicely.

Linseed Poultice. Powdered flaxseed four ounces, hot water half pint. Add the seed gradually, stirring well till a soft paste is formed.

SINGING AND CAGE BIRDS.

The birds now kept in cages either for the beauty of their plumage or their song, now embrace a great variety, running all the way through the finches, linnets, sparrows, thrushes, up to the parrots, and the more magnificent plumaged araras and cockatoos. The musical canary is however, the universal pet, found in almost every household, and is generally admired for its sprightly action, delicate coloring, and its pleasing and varied song. Their original home is in the Canary Islands, but over 300 years of domestication has so changed their color and instincts that the domesticated bird would no longer be recognized, except by the naturalist, either in his songs or plumage. In confinement more birds are ruined by too much coddling, and mistaken kindness than by all other causes put together. They are semi-tropical birds and can not stand extremes of heat and cold, drafts, or a confined atmosphere. All the feathered tribes require plenty of air and light, and when at liberty take a large amount of exercise. This in confinement must be liberally supplied as to the first two; and the third their natural instincts will tempt them to so far as their cages will allow. Canary birds are classified, as German Harz, which resemble the wild birds more than others, and as Dutch Belgian, or Parisian, which have longer legs, a more arched back, and a somewhat ruffled breast. The first class are bright yellow, straw color, or nearly white, yellowish white, green or gray, cream colored filberts, and spotted or mottled. These latter may be smooth-headed single-colored birds, the head alone shaded, or they may be green, gray, brown, or black-headed with brilliant plumage as to their body; this with the depth of color on the head constituting value. There is another strain of birds called swallows; their value consists in the regularity of their markings. The most prized are the capped, filbert-colored birds, but swallows are not necessarily capped, since if the wings only are marked they are called wing swallows. The Belgian (Holland) canary is pure yellow in color. They are divided into Parisian, large birds, with ruffled shoulders and breast; the Holland smaller, and the ruffles less developed; and the Brussels, a slender, deep colored bird with a flat head. The German canaries, however, are generally considered to be the best singers. The shape of the cage is im material, but the larger the better. They must always be hung above the reach of cats; they should always have the morning sun, and in summer the cages should be hung out of doors, in the shade as much as possible. If painted cages are used, the paint should be kept well covered with varnish. The utensils should be of china or glass, the perches of soft wood of a size large enough so the claws of the bird may grasp half way round. And the utmost cleanliness should be used. Give them a water bath every day. The principal food should be clean, sweet canary seed, with a little rape added. A cuttle-fish bone should always be kept in the cage, and also a little clean, sharp, fine gravel should be allowed once a week. Chick weed and lettuce should also be given them, and occasionally, during the moulting season, the yolk of a hard-boiled egg rubbed up in Indian meal. Sweet apple is also good, and occasionally a piece of stale bread, but no cake of any kind. Until the bird is six months old, it should have the yolk of hard-boiled eggs as a part of the diet. If the birds are lean, give a little flax seed every other day, and occasionally to all birds, a little poppy seed, and coarse oatmeal grits. In relation to breeding and raising young birds, a writer describes the manner of breeding in the Harz mountains, Germany, as follows: According to the size of the space at your disposal, place from three to six males in your room, and three times as many females. Place a large number of jumping-bars at different heights and distances. Arrange, also, two nests for each hen. In the center of the breeding room a little table must be placed, for feeding and drinking purposes. Water vessels must be so arranged that the birds can not bathe in them. On the floor place building material, such as short-cut hemp, Manila, animal hair, feathers, etc.; the birds will take care of the rest. Supply fresh food and drink each day; the birds must be disturbed as little as possible. The principal food for them while breeding is German rape-seed mixed with a little canary seed. After the young have been hatched give them, twice or three times daily, eggs boiled hard, grated, equally mixed with soaked or grated crackers; instead of crackers, stale bread, moistened with water, may be served. One egg will be sufficient for fifteen or twenty birds each day. Lettuce should also be supplied in abundance; also, cuttle-fish, egg-shells, and gravel. Soaked rape-seed can not be sufficiently recommended; with it the old birds feed the young, and the young soon learn to feed themselves. To save time the egg may be cut in halves, and thus served. The egg-shells are eaten with great relish by the old birds, on account of the limy substance contained in them. If the egg be not grated, but served as before described, it will be well to add soaked (wheat) bread. Food and drinking vessels of china are preferable to all others. Greens, such as lettuce, chickweed, etc., can be supplied daily during hot weather; but on cold, damp days green food should be administered with great care, as it tends to induce diarrhœa, which, in many cases, proves fatal to the little songsters. During the first few days there will generally be well-contested fights among the males; unfortunately, this can not be avoided. After the birds have been mated, and each cock has obtained his hens, there will be peace and harmony in the breeding-room. The hens will then select their nests and labor diligently in their construction, the cock affording all the assistance in his power. The bird-raiser must now pay strict attention to his breeding-room or cage. It will be expedient to number the nests; observe carefully when the first, as well as the last, egg has been laid, in order to ascertain when the twelve days have passed, and when the young birds must come from the shell. Examine the nests daily, and remove the dead young. Watch closely lest there be among the flock a growler, who can do considerable mischief, destroying nests and eggs, as well as killing the young birds. Such ill-mannered growlers must be immediately removed. After the first brood have left their nests, and are no longer dependent for food on the parent birds, they must be separated from them and placed in a large cage, that the next brood may not be disturbed by them. They must then be well cared for, so that they may not catch cold. They must be carefully kept from every draft. As soon as the young cock can be distinguished by his singing, he must be separated from the others, and placed in a cage by himself near good singers, who will serve as his instructors. A breeding-room must have an abundance of light, and should have the morning sun. One or more evergreen trees, planted in boxes and placed in the bird-room will give it a pleasant appearance, and afford great pleasure to the birds. If no live trees can be had a few fir-trees, cut in the month of February, will answer instead, and remain green for some time. Nest-boxes of tin or wire are most desirable, as those of wood or pasteboard are suited for the generation of insects. After the young birds have left the nest, it is desirable to remove it and cleanse it thoroughly, in order that all the vermin may be destroyed. It will be well to keep constantly on hand some insect powder, and to strew, from time to time, a little in the nests. The genuine Parisian insect powder, although it completely destroys lice, is harmless to birds. Lice are dangerous enemies to the young brood. Want of cleanliness is the cause of the increase of insects, which annoy the breeding-hen, especially at night. Through this the little sufferer is compelled to scratch with her feet, in order to remove her enemy. Again, particles of excrement are thus collected on the claws, which becoming hard, increases the pressure on the delicate egg-shell and ultimately ruptures it. Under these circumstances, the nest may be purified by dipping it in boiling water, or by strewing in it Parisian insect powder. Should the bird have soiled claws it must be caught and have its claws purified by immersion in lukewarm water. The building material having been placed in the cage, becomes saturated with excrements and rendered unfit for use. Building material must, therefore, never be supplied in large quantities, but from time to time, as may be necessary. It may also be placed outside the cage, and accessible to the birds only through the wires. Nests placed inside the cages have not generally the necessary protection. The young bird of the preceding brood, and even the cock in the breeding cage, will often busy themselves about the nest, thereby causing the breeding-hen to leave the nest, while they inspect the eggs and in many cases break them. Sometimes they will peck at the materials of the nest, and, in so doing, break the eggs. A nest which is open at the top is not useful; nay, it is even unfit for use, because the excrements of birds whose nests are above will fall into them; soiled eggs will not be hatched out; the excrements will, moreover, harden, and with their sharp, pointed edges will often injure the coming brood. It will, therefore, be advisable to give the nest a covering of strong paper, or pasteboard, leaving only one part open in front; such protected nests are preferred by the birds. In such cases the birds do not rob each other of the building material, and the breeding birds are not disturbed by the approach of others. In cages the same general rule should be used. The nests too should be placed in corners opposite so the hen may take her choice, and covered so they may be retired. The material may be of short cotton wool as to the bottom with a little fine down for the surface, Sometimes the male bird is cruel. Unless very quiet he should be removed once the hen bird begins to sit; but if the male conducts himself properly and feeds his mate let him remain. While sitting the hen must be supplied with extra food about the tenth day or at least before the twelfth day. The food of the young birds should be hard-boiled yolk of egg rubbed up with stale bread crumbs. After the young birds leave the nest on or about the twenty-first day the old birds will continue to feed them, but it is better that there be a separation in the cage when the young birds are of this age, since the old birds often begin to lay for a second brood before the young birds are able to take care of themselves. Hence the advantage of a double cage for breeding purposes. During the whole time the old birds are feeding the young in addition to hard boiled yolk of eggs and bread crumbs, there should be soaked rape seed, canary seed, greens, and the usual food of the birds, and this should be continued for the young birds. When the young males begin to sing they should be separated from the females and hung where they may hear a first-class singer, and also the notes of out-door birds, if possible. Since thus they may learn to adapt their song to that of other birds. To learn a bird to whistle a tune: Select a strong, loud-voiced bird and place in a room where it can hear no other sound. Procure a good toned bird organ and play the tune selected for an hour at a time two or three times a day. It may take three months or more for the bird to catch the notes fully, and thereafter they will sing nothing else. The foregoing instructions will apply to all the sparrow and finch tribes or hard billed birds. In relation to the diseases of birds and their treatment, Our Pets or the Book of Birds says: It is much easier to prevent disease, by taking proper care of birds, than to cure them. It would, however, be ridiculous to state that birds, whose treatment is in every respect proper, never get sick. Even at liberty the bird is subject to diseases of various kinds. Whosoever watches his birds carefully will soon observe that the sick bird is exactly opposite to the same when well. The healthy bird is fond of exercise; and views his surroundings with bright eyes, while the sick bird will remain sitting on one spot, his plumage puffed and ruffled, his eyelids drawn down, and his head for the most part hidden behind his wing. The sick bird does not refuse to eat, but attacks his food with a greediness which immediately arouses the suspicions of the fancier. According to the nature of the disease other symptoms will soon appear. The sick bird opens his bill as widely as the healthy bird, during oppressively warm days, but the eyes of the healthy bird are wide open while so doing, whereas the sick bird will keep them closed. The breathing of the bird is accompanied by strange unnatural sounds, while the motion of the feathers on the bosom is irregular. The throat looks pale; he is feverish and cold, as shown by his shaking his body, which motion he repeats oftener and oftener. Fits generally follow, and the bird drops from his perch and lies a corpse in the bottom of the cage. Many diseases show symptoms of this kind, and even the doctor's power is of no avail; but a few hours elapse from the beginning of the disease till death.

Consumption. Many birds perish from irregular and improper nourishment. Such, as a matter of course, will induce extremely poor blood (*Anæmia*), leanness, weakness, and pains in the bowels; a diseae which is very commonly called (*Darre*) consumption. The bird may have this disease and appear lively. He eats the food given him; it may be, however, that he does not eat with his usual appetite; he takes but little, flies away, and again returns to his food. He stops singing. In a few days diarrhœa and consumption ensue, when he ruffles his feathers and dies. The consumption is more chronic if it derives its origin from the bowels. Birds frequently labor under this disease as the result of improper food and of colds. The symptoms are various. Sometimes they will continue to eat, though affected with costiveness or diarrhœa. The excrements will tell when birds are sick. Should costiveness or diarrhœa continue for any length of time, inflammation of the intestines will ensue, and defecation will become painful, as is manifested by the bird shaking his rump and tail. These alone will produce a fatal result. If, however, the food be changed during the early stages of the disease, the bird may be saved. In insect-eaters, meal-worms in many cases are very effectual, and should be given with a few drops of castor oil. Besides healthy food in this, as in all other diseases, the first and most necessary remedy is a good supply of fresh air, plenty of room for the cage, on which as much sunlight as possible, without burning rays, may fall. Plenty of gravel should be placed in the bottom of the cage; drafts should be avoided. Stacklen says in his report on singing birds: "In many cases diarrhœa and costiveness will be cured if, for example, you feed birds of prey with raw meat without removing the hair or feathers; fruit, or grain-eaters with nightingale food and greens; soft-eaters with meal-worms, drowned in olive or sweet oil, spiders, and ground hempseeds as much as they desire, and distilled water for drink. Their bathing-cup should, from time to time, be removed. As a rule, such diet will have a better effect than all quash prescriptions, such as liniments, (butter, oil, or lard), syringing, and other humbugs, such as we see recommended in many books. Many bird-fanciers believe that the consumption (*Darre*) results from induration of the excretory glands, from which birds take the oil necessary to grease their wings, or that it is merely a disease of this organ. They believe it advantageous to squeeze them open with the thumb-nail, or to prick them with a pin. Dr. Richter has designated this method as nonsensical. For such mal-treatment there is not the slightest excuse. Should a bird thus treated become well, the wound will heal, the same disease will recur, and the bird doomed to die only a little later. The only thing that can be done without injury is to oil this gland carefully with a feather. When we have a surplus of fat, it will be well to simplify the food, and to sprinkle the bird with lukewarm water about noon-time. This will compel the bird to clean itself, and thus, by regreasing his plumage, remove the surplus fat.

Fatness. This disease results from irregular food, and is the opposite of the *Darre.* It attacks grain-eaters most frequently; soft-eaters are rarely affected by it. Want of sufficient exercise is also a potent cause of it. Birds sometimes, when supplied with mixed food, consume only the most nutritious, and thus induce a surplus of fat. Some canary birds, when fed on German rape and canary seed, will eat only the latter, and never touch the former. If nothing be done to mend this habit, and compel the bird to eat rape seed and greens, he will soon become too fat and too lazy to sing. In the case of too much fat, grain-eaters should be supplied with plenty of greens; soft-eaters with berries, sweet turnips, or their juice, and well salted water to drink. The birds should, moreover, be excited to exercise more freely. Whoever lets a bird in this condition fly around a room for a few weeks generally cures him. When the disease is too far advanced, it will be useless to withhold his food, as the organs no longer perform their proper functions. In such cases they are sure to die, and the less we disturb them the better.

Apoplexy. Food which is too rich and nutritive, often produces this disease, many times resulting fatally to birds in a state of captivity as well as free. It often occurs that while they sing, eat or sleep, they suddenly drop and expire in a few minutes. Grain eaters are more subject to this disease than others, as their generally lazy mode of living makes them more fitting subjects of fat disease. These birds are sometimes saved by cutting the nail of the back toe until it bleeds, and then immerse them several times in cold water. A shower or plunge bath is, under these circumstances, advantageous; but it is of the utmost importance to protect the wet bird from draft, and afford him an opportunity of drying his feathers.

Epileptic Fits. Improper food may be considered as the cause of this disease, although brain disease and worms may also induce it. This terrible disease, very common among seed eating birds, and observed among other birds also, is incurable. The remedies which have been applied, may, for a time, alleviate the pain of the sufferer, but are wholly inadequate to eradicate the disease. The best thing to be done is to remove them at once, as no pleasure can be derived from a bird suffering from this disease.

Catarrh, Cold, (Pips). The care of captive birds is as important as their food. A great many diseases are brought on by colds induced by drafts, change of temperature, or unseasonable baths. The first of the diseases incurred from the above mentioned causes is pips, which is most frequently found among seed eating birds. The sick bird opens his bill because his nostrils are clotted with phlegm. He sneezes, coughs from time to time, with a view to clear his breathing organs; he gasps, ruffles the feathers on his head, and sinks exhausted on the floor of his cage. After the disease has continued for some time, the skin of the tongue and throat hardens, inflammation sets in, and all the symptoms of a severe catarrh fever may be observed. This disease kills many birds, yet a cure may be effected if they are taken in time. The first and best method is to place the bird in a sunny room with an even temperature; rinse his bill with lukewarm and moderately salt water; grease his nostrils with sweet oil; remove his bathing vessels, and supply him with the proper food. The experiment often resorted to by bird fanciers, of placing a greased feather in his nostrils, and of permitting it to remain there for several days, is not only useless, but detrimental, as it induces inflammation of the nasal organs—an effect worse than the original disease. It is equally dangerous, though sometimes recommended, to remove the diseased skin with a knife or needle. Many who know nothing of birds act as surgeons in these cases. No one understands what possible good it can do. I can only warn you against such maltreatment. It will not be dangerous to mix some well known cough medicines with sugar and their drink. These remedies are at least harmless. The proper treatment is: let the air be warm, moist, and of an even temperature. Should catarrh suddenly supervene, a vapor bath may be given in the following manner: wrap the bird in a damp woolen cloth, and place it in close proximity to the stove. During the operation the air must be kept damp by keeping a waterpot on the stove.

Diarrhœa and Costiveness. The same treatment may be observed as in the above diseases. Should they result from colds, a warm and damp air will be better than medicines, though the last should not be neglected in connection with the sweating process. As soon as one of our favorites looks sick, his nurse should examine his excrements. From these any one skilled in birds can tell what ails the sufferer. Again, the excretory organs should be examined. In the case of a liquid excrement, the feathers will be fastened together so that excretion becomes impossible. This alone will endanger the life of the bird. The male can resist an obstruction of this kind from twenty-four to thirty hours; the female from forty to fifty hours. Both may be saved at the last moment. The bird must be taken in the hand, the adhering feathers carefully cut away with scissors, and the parts anointed with sweet oil. Internal remedies may also be supplied. For canary birds a little fat pork suspended in the cage, carrot juice, a little of the tincture of rhubarb added to the water, say six to eight drops, rotsum bi-carbonicum salt, and a little rochelle salts should be given. In cases of diarrhœa, give them in their drink about two drops of laudanum. The food must be changed, as previously directed.

Gout. This disease, to which only cage-birds are subject, has been proved to arise from colds. Some say that the gout is contagious between man and the bird. This, however, is nonsense. Suitable food, exercise in a large cage or room having plenty of the sun's rays, a good clear air, and plenty of water for bathing, are the chief and only remedies.

Reeling Disease. Among the diseases resulting from wrongly-constructed and ill-furnished cages this is the most prevalent. By this disease the regular giddiness is not meant, as the latter is caused by worms, disease of the brain, and is incurable, while the former is induced by habit. The symptoms of the disease are as follows: The bird keeps his head bent backwards, is almost constantly turning his body, as if he were endeavoring to perform a somersault; he rocks to and fro and appears as if wholly incapable of supporting his body on his legs. Ultimately this disease becomes annoying; the bird at times falls as if in fits from his perch, and remains for some minutes senseless on the floor of his cage. This disease is generally observed in birds kept in small round cages, especially when the upper perch is fixed too high in the cage. Birds afflicted with this disease can not be cured with medicines. The only remedy is their timely removal to a larger cage.

Foot Disease—(Foot Gout). Foot disease generally results from unclean cages. This disease may be prevented by carefully cleaning the floor of the cage and the perches, as well as the birds which do not bathe themselves; washing their feet, and afterwards rubbing them with glycerine, which keeps their skin soft and tender. Every bird's feet should be bathed in lukewarm water from time to time, although this may at first glance appear a useless luxury. Leave their feet at least one minute in the bath, so that all matter adhering to them may be softened; remove the dirt, and dry well with a soft cloth before the sand again touches it. In this manner the birds will enjoy the full benefit of the bath. Old and hard corns may be removed at this time. When birds have sore feet they should be well washed and then touched with caustic, nitrous acid silver. Keep the bird in the hand until the caustic is dry, then put him back in his cage. If possible, place him on a perch, on which he will remain for some time owing to the pain caused by the caustic. Many valuable birds are saved in this way.

Moulting Moulting, strictly considered, is not a disease, but a regular and necessary change. Should, however, the bird be not properly treated during the moulting season, skin and feather diseases are easily contracted. Most birds moult from July to September, many foreign birds moult twice in the year, in spring and autumn. Nothing definite can be stated with regard to the beginning and duration of the moulting season, they being irregular even for the same bird. A bird may moult one year in July, while in the following year he may not moult before August or September. An observant bird-fancier will be able to mark the moulting season of his birds, not only from the loss, but also from the growth, of their feathers. The moulting bird is not actually sick, but the change of his plumage makes him feel ill and irritable, and will disturb his regular mode of life to such a degree that he will always be sullen, nor will he sing. He always sits on the same spot, ruffles his feathers and pecks at them, with the idea of helping the growth of the young, sprouting feathers, to remove those that are no longer useful, and to grease those that have attained a sufficient size. These actions are so remarkable that the inexperienced will easily take them for the symptoms of disease. Moulting does undoubtedly require peculiar treatment, but no nonsensical quackery should be resorted to. Those who keep their birds properly need do nothing but increase the quantity and quality of their food, while those who have paid but little attention to them, and would now during the moulting season place them in a more sunny locality, or expose them to the drafts, or give them richer food, would act injudiciously. Do not, during the moulting season, change the food of your birds. Increase your attention, supply fresh food frequently, give the seed-eaters, beside their usual food, such seeds as poppy, hemp, also some eggs. To soft-eaters supply as many different sorts of insects as possible; plenty of meal-worms; give them a frequent change of bathing-water, and an abundance of clean, dry gravel in the cage; protect them from intrusion from drafts, and from too much sunshine. It is an evil custom to carry a moulting bird to and fro, or to otherwise disturb or frighten him. When birds moult too heavily, we should suspend a cloth around their cage to protect them from draft. This I can recommend as an excellent plan. A light colored cloth must be used, as one of another color would render the cage too dark. Should these rules be observed, moulting will pass off quietly and quickly. It sometimes happens that birds in moulting lose their feathers altogether. This arises from their having caught cold, or from being kept in an overheated apartment.

Scrofulous. Such eruptions on the root of the bill and around the eyes, closing up the nostrils and injuring the eyelids, and sometimes causing blindness, are the result of uncleanliness and entire want of proper bathing arrangements. The only and best remedy for this is to wash the diseased parts several times each day with a solution of caustic; one to two grains to one ounce of water.

Bird Lice. If the bird seems to suffer from vermin, it is best to give the cage a thorough cleaning. Restlessness and moving around the cage after sunset are a sure sign that these parasites, which keep quiet during the day, are at work, and are depriving our little favorites of sleep. In a clean cage vermin seldom harbor; should they, however, be found there, it will be well to remove the cage at once. Should this not suffice they must be got rid of by other means. In winter time they can be exterminated by hanging the cage (without the bird) out of doors during a few cold nights. At other times I would advise to give the cage a thorough cleansing, washing the same with hot water; to examine the extremities of the perches carefully, and rub them with oil, as this will kill the lice. Brass cages should be sent to the factory to have them renewed and revarnished. After the cage has been well cleaned, and the bird placed in some other cage, strew its bottom with genuine Parisian insect powder. The best time for doing this is the evening. Then cover the cage well with a clean cloth. The lice will leave the bird and take refuge on the cloth. This must be removed in the morning and washed in boiling water. The process must be continued for eight days.

Worms in the Wind-pipe. The wind-pipe worm (*Syngamus Trachealis*, or *Sclerostomum Syngamus*) is one of the most terrible animals that annoy our favorite. The signs of his existence are a restless shaking of the head, opening of the bill, gasping and coughing; in short, all the symptoms of a severe catarrh. In the early stages of disease it sometimes happens that the worm is coughed out; but later, when it has settled and increased in numbers, this is impossible. These parasites increase with wonderful rapidity. Whether the disease is contagious has not been fully ascertained; it will be well, however, to keep the birds thus affected separate from the others. Unfortunately, we are acquainted with no means by which these parasites may be destroyed to a certainty. Cronon recommends to feed these birds with meal-worms soaked in olive-oil, or to directly put this oil on the wind-pipe with a quill. He says that by this means some birds have been cured.

Melancholy. The wonderful intelligence of birds affords a sufficient proof that they can suffer from depression of spirits, and even die of melancholy. The numerous instances of these facts on record leave no further doubt on the subject. Birds which have lost their mate, or have been robbed of their young, have grieved unto death; others, taken from their playmate, have fallen into a fit of dejection; others pined from missing their usual attendants. Their removal causes sadness. While so suffering, it is advantageous to dress the cage with green branches. Fresh air, sunlight, variety of food, a more roomy place for exercise, are advisable.

Mocking Birds—Are the very finest of singing birds, when we take into consideration the great variety and wonderful modulation of their notes. They will easily catch the song of any singing bird and repeat it with fidelity. Thus if the famous nightingale be placed within hearing, the mocking bird will repeat the notes with the utmost fidelity, and as a night singing bird they excel the nightingale itself. The food of the mocking bird is insects of various kinds, especially grasshoppers, fruits, ripe berries. Berries especially should be liberally supplied all during the season, and the carefully dried fruit may be softened in water and fed sparingly in winter. During the season when grasshoppers are about half grown, they may be caught in large numbers in a bag net, dried in the oven, and fed during winter, first being softened with water. A good mocking bird food, is to take sound, mealy potatoes, boiled, two-thirds, and yolk of hard-boiled eggs, one-third; mash the potatoes and then thoroughly mix with the egg. This is an excellent general food, and birds if fed also liberally on berries and insects, thrive wonderfully. Mocking birds should be supplied daily with pure water for bathing; must not be exposed to drafts of cold air, but should be kept where the air is pure and fresh. The cage should be at least thirty inches long by twenty inches wide, and if much larger it is better, since if allowed the bird will be in continual motion while singing.

STAINS.

Silver Stains, to remove. Put half a pound of glauber salts, a quarter of a pound of the chloride of lime, and eight ounces of water, into a wide-mouthed bottle, and when required for use pour some of the thick sediment into a saucer, and rub it well over the hands with pumice stone or a nail brush, and it will clean the fingers quite equal to cyanide, but without any danger. This will do to use over again until exhausted, and should be kept corked up. The disagreeable smell may be entirely avoided by the liberal use of lemon juice, which not only entirely removes the smell, but whitens the hands.

Stains, Iodine. By adding a few drops of liquid carbolic acid to the iodine tincture, the latter will not stain. According to Dr. Bogs, carbolic acid also renders the efficacy of tincture of iodine more certain.

STOPPERS, to Loosen.

Hold the hand around the neck of the bottle ten or fifteen seconds, until its warmth expands the glass of the bottle, when the stopper will move easily. If it does not, try a higher heat by means of a rag dipped in hot water and wrapped around the neck of the bottle for a minute or so. Another way is to hold the neck of the bottle, cautiously turning it so as not to expose any part too much,, or to too sudden a heat, near or over a gas jet or heat from a lamp. Or rub a little salad oil, with a feather, round the stopper close to the mouth of the decanter, then place it a short distance from the fire, that the heat may cause the oil to run between the stopper and decanter. When warm, strike the stopper gently with any light wooden instrument, first on one side, then on the other; if not movable, repeat the process till you can draw the stopper out.

TEETH.

Toothache Cure. Compound tinct. benzoin is said to be one of the most certain and speedy cures for toothache; pour a few drops on cotton, and press at once into the diseased cavity, when the pain will almost instantly cease.

Toothache Tincture. Mix tannin, 1 scruple; mastic, 3 grains; ether, 2 drachms. Apply on cotton wool, to the tooth previously dried.

Austrian Tooth Powder. Powdered soap, 100 parts; chalk, 40 parts; carmine, 1 part; oil peppermint, 2½ parts; alcohol, 15 parts. Mix and dry.

Charcoal Tooth Paste. Chlorate of potash, ½ drachm; mint water, 1 ounce. Dissolve and add powdered charcoal, 2 ounces; honey, 1 ounce.

Excellent Mouth Wash. Powdered White Castile Soap, 2 drachms; alcohol, 3 ounces; honey, 1 ounce; essence or extract jasmine, 2 drachms. Dissolve the soap in alcohol and add honey and extract.

WASHING FLUID.

Alcohol, 1 pint; spirits turpentine, 1 pint; aqua ammonia, 4f. 2 ounces. Mix. Put three or four tablespoonsful to one pint of soft soap or one pound of hard soap. The clothes should be in soak over night, if possible, before using this mixture, but if soaked an hour or two it will aid much.

Washing Fluid for Fine Linen, Laces, Etc. Borax, 4 ounces; water, 5 gallons. For crinoline or any stiff fabric increase the quantity of borax to six ounces.

WATER, Tests of.

Water Containing Iron. Dissolve a crystal of prussiate of potash in it. If it turns blue there is iron in it.

Water Containing Copper. A few drops of liquid ammonia will turn it blue if copper be present.

Water, Hard or Soft, Tests for. Dissolve a small quantity of soap in alcohol, and let fall a few drops of it into a glass of the water. If the water becomes milky it is hard, but if little or no milkiness appears the water may be said to be soft.

Water. Test for Lead. Add to the water a little sulphuret of ammonia or potash. If lead be present it will be known by the color of the water, which will have a dark brown or blackish tinge.

Gilt Articles, Test for. To ascertain whether an article is gilt or made of a gold-colored alloy, Weber uses a solution of bichloride of copper, which gives a brown spot on an alloy, but produces no effect on a surface of gold.

WEIGHTS AND MEASURES.

The following tables of weights and measures will be found valuable for reference in the household:

Apothecaries Weight, U. S.

20 grains	1 scruple.
3 scruples	1 drachm.
8 drachms	1 ounce.
12 ounces	1 pound.

Troy Weight, as used in the Pharmacopœia.

480 grains	1 ounce.
12 ounces	1 pound.

Apothecaries, or Wine Measure, U. S.

60 minims	1 fluid drachm.
8 fluid drachms	1 fluid ounce.
16 fluid ounces	1 pint.
8 pints	1 gallon.

Imperial Measure.

60 minims	1 fluid drachm.
8 fluid drachms	1 fluid ounce.
20 fluid ounces	1 pint.
8 pints	1 gallon.

Avoirdupois Weight.

Used in weighing drugs, etc., in the wholesale and retail trade, excepting prescriptions, formulæ, etc.

16 drachms	1 ounce = 437½ grains.
16 ounces	1 pound = 7,000 "

Relative Value of Apothecaries and Imperial Measure.

Apothecaries.	Imperial.			
1 gallon equals	6 pints,	13 ounces,	2 drachms,	23 minims.
1 pint "		16 "	5 "	18 "
1 fluid ounce equals		1 "	0 "	20 "
1 fluid drachm "			1 "	2½ "

Metric Weights.

10 Milligrams	1 Centigram.
10 Centigrams	1 Decigram.
10 Decigrams	1 Gram.
10 Grams	1 Dekagram.
10 Dekagrams	1 Hektogram.
10 Hektograms	1 Kilogram.

Metric Measures.

One Milliliter or Cubic Centimeter.

10 Milliliters	1 Centiliter.
10 Centiliters	1 Deciliter.
10 Deciliters	1 Liter.
10 Liters	1 Dekaliter.
10 Dekaliters	1 Hektoliter.
10 Hektoliters	1 Kiloliter.

Metric Lengths.

10 Millimeters	1 Centimeter.
10 Centimeters	1 Decimeter.
10 Decimeters	1 Meter.
10 Meters	1 Dekameter.
10 Dekameters	1 Hektometer.
10 Hektometers	1 Kilometer.

Metric Weights and Measures Equivalents.

1 Gram	1 Cubic Centimeter.
1 Gram, 15 grs	15 Minims.
4 Grams, 1 drachm	1 fluid drachm.
1 Milligram	1-65 gr. or Minim.
1 Centigram	2-13 gr. or Minim.
1 Decigram	1½ grs. or Minims.
1 Gram	15.4 grs. or Minims.
1 Dekagram	154 grs. or Minims.
1 Hektogram	1543 grs. or Minims.
1 Kilogram	2 1-5 lbs. Avoirdupois.
1 Cubic Centimeter	15 Minims.
4 Cubic Centimeters	1 f. drachm.
16 Cubic Centimeters	half an ounce.
32 Cubic Centimeters	one ounce.

Metric Length Equivalents.

1 Millimeter	.039 inch.
1 Centimeter	.39 inch.
1 Decimeter	3.9 inches.
1 Meter	39.37 inches.
1 Dekameter	32⅔ feet.
1 Hectometer	326⅔ feet.
1 Kilometer	1089 yards.

Domestic and Drop Measures Approximated.

A teaspoonful, one fluid drachm	4 grams.
A dessertspoonful, two fluid drachms	3 grams.
A tablespoonful, half fluid ounce	16 grams.
A wineglassful, two fluid ounces	64 grams.
A tumblerful, half pint	256 grams.

Weights of Oils to Gallon of Measure.

Sperm Oil	6¾ lbs. Avoirdupois.
Paraffine	6⅞ lbs. Avoirdupois.
Olive Oil	7 lbs. Avoirdupois.
Cod Liver Oil	7¼ lbs. Avoirdupois.
Whale W. B.	7¼ lbs. Avoirdupois.
Lard Oil	7½ lbs. Avoirdupois.
Castor Oil	7½ lbs. Avoirdupois.
Linseed Oil	7½ lbs. Avoirdupois.